MINIMISING THE PSYCHOLOGICAL EFFECTS OF ROAD TRAFFIC CRASHES IN THE UK

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by

Anne-Louise Humphreys

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ABSTRACT

Minimising the Psychological Effects of Road Traffic Crashes (RTC) in the UK
Anne-Louise Humphreys

Each year 50 million are injured on the world's roads and 1.2 million are killed. The public health consequences of these deaths and injuries are recognised at a global and national level, but the psychological impact of RTCs attracts less attention. Following road crashes, a range of psychological consequences have been reported, including Posttraumatic stress disorder (PTSD), Acute stress disorder (ASD) and Depression. Crash frequency together with the risk of psychological problems suggests that they also have community implications. Learning from the success of post-impact care for physical trauma, it was proposed that strategic approaches were required to minimise the psychological impact of RTCs within the UK.

The proposed healthcare model **(PlaTO)** has a three tier structure. 1) A service **Pla**tform, concerned with establishing an accurate understanding of the population demographics as a basis for the development of the service infra-structure. 2) A **T**argeting tier, with a "stepped-care" approach with low-intensity social support interventions. 3) The **O**rdnance tier, concerned with the delivery of brief and effective interventions to address established clinical level disorders.

The research undertaken informed the three tier design of the model. The first study tested the accuracy of extant UK crash data and informed the demographic profile of crash casualties, by comparison of Police and hospital data. This study found that 2.3 times the number of casualties attended Accident &Emergency compared to an analogous Police region.

The second study investigated the prevalence of ASD, PTSD and depression, associated risk factors and consequences of a crash, through a prospective survey of 200 A&E RTC attendees. After a week, 50% had ASD. After a month, 31% had PTSD and 41% had low mood with comorbidity being commonplace. 50% of the participants had sizeable functional problems after a month and participants on average attended at least one healthcare appointment in the month after their discharge, but none had contact with any psychological services. Investigation of risk factors found peri and post-crash factors particularly, support satisfaction, were better predictors of PTSD and low mood than pre-crash factors. This opened the possibility for minimising such disorders, through low intensity stepped-care interventions.

The third study investigated an exemplar case-study to extend understanding of an individual's crash consequences and their response to a preliminary single-case experiment that explicitly integrating social support within brief trauma-focused cognitive-behavioural therapy.

The results of these studies have been utilised to inform the emergent design of the **PlaTO** model, which must now be tested in situ for its efficacy and cost-effectiveness in minimising the psychological consequences of road traffic crashes, primarily in the UK and potentially on a wider basis to address this global health problem.

Key words: PTSD, ASD, Mood, Depression, Road Crashes, Motor vehicle, Trauma

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APPENDICES

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To Mum, thanks for everything.

At the 1896 inquest of the first victim killed in a road crash, 44 year old mother of two, Bridget Driscoll, the Coroner is reported to have announced;

'I trust that this sort of nonsense will never happen again'.

(Trauma.Org, 2009)

CHAPTER 1

Introduction

This chapter will provide an introduction to the thesis, in which the individual and cumulative psychological impact of road traffic crashes will be considered and the barriers presented by current health service recommendations, will be raised. It will be argued that a strategic model is required to develop an equitable and accessible psychological healthcare service for RTC casualties.

Following exposure to traumatic events, people can develop a range of stress symptoms, many of which abate rapidly once exposure ceases. For some, the trauma may be a stimulus for personal growth (Tedeschi and Calhoun, 1995), whilst in others, the symptoms may persist, resulting in the emergence of posttraumatic stress (PTS) disorders such as Acute Stress Disorder (ASD) in the initial month, or later Posttraumatic Stress Disorder (PTSD), depression and other anxiety disorders (Beck and Coffey, 2007). These may follow a chronic time course and result in considerable functional impairment for the individual (Green, McFarlane, Hunter and Griggs, 1993) and have wider consequences for society (Kessler, 2000), through the emergence of secondary problems with comorbidity being the rule rather than an exception (Brady, Killeen, Brewerton and Lucerini, 2000).

Whilst the original diagnostic category of PTSD aimed to offer a unifying disorder with identical symptoms emerging after all types of traumatic events, this notion has been challenged by the different symptom profiles and levels of risk that have subsequently been identified (Kelley, Weathers, McDevitt-Murphy, Eakin and Flood, 2009). Although inter-personal traumas, particularly those involving crimes such as rape and violent assault (Resnick, Kilpatrick, Dansky, Saunders and Best, 1993), may be highly likely to cause PTSD, by comparison the risk of PTSD after a RTC is reportedly lower (O'Donnell, Creamer and Ludwig, 2008). However, the relative frequency of crashes, means they are the largest cause of PTSD (Norris, 1992) resulting in a sizeable public health problem.

Crashes may result in comorbid physical and psychological consequences that are mutually maintaining (Jenewein, Wittmann, Moergeli, Creutzig and Schnyder, 2009).

Psychological services to meet the needs of this population must understand this interaction, particularly in relation to PTSD and pain (Kulich, Mencher, Bertrand and Maciewicz, 2000). This relationship is particularly apparent in disorders associated with whiplash (WAD), which are common amongst RTC casualties (Jaspers, 1998; Stirling, Jull, Vicenzino, Kenardy and Darnell, 2005). Social support is hypothesised to buffer people against stressful circumstances (Cohen and McKay, 1984) and has been reported to influence the development of PTSD (Brewin, Andrews and Valentine, 2000) and recovery from physical injuries (Danner and Radnitz , 2000 ; Unchino, 2004). However, a crash can affect access to support from family and friends, as they may also have been injured or be suffering psychological distress. The commonplace nature of crashes in the UK can also lead to compassion fatigue, which dulls the response of society (Moeller, 1999) and healthcare professionals (Clark and Gioro, 1998) to the traumatic impact that even a minor crash can exert upon an individual. This can result in personal disasters such as RTCs not attracting anything like the same level of support afforded to people involved in major disasters.

In order to reduce the burden upon the individual and society attributed to the psychological impact of crashes, the most obvious starting point is the prevention of RTCs. Improvements in vehicle and road design, together with extensive legislation, have had some limited impact (Richter, Barach, Ben-Michael and Berman, 2001), and yet, every year in the UK, huge numbers of people are placed at risk of developing psychological problems following a crash. An alternative strategy would be to intervene to prevent such psychological problems occurring in the first place, but interventions such as debriefing (Mitchell and Everly, 2000) and educational approaches (Ehlers, Clark, Hackmann, McManus, Fennell *et al.*, 2003; Turpin, Downs and Mason, 2005) have not lived up to their earlier promise and indeed harmful effects have been reported following debriefing (Wessely, Rose and Bisson, 2000; Roberts, Kitchiner, Kenardy and Bisson, 2009), making its routine use untenable.

Along with the changing thrust of psychological therapies, the next option would be to monitor people at risk of trauma, to offer early detection and in turn, early intervention to alleviate symptoms and minimise the risk of chronicity. Whilst access to high intensity psychological interventions remains routed within a secondary care model (Lovell and Richards, 2000), timely access to therapy is difficult after a trauma.

NICE guidelines for the management and treatment of PTSD (NICE, 2005) recommended a strategic approach to assess, monitor and treat people after a major disaster, which overcomes these delays. No equivalent strategic approach, to address the structural barriers within existing healthcare services, was offered for individual casualties of everyday traumas. There is increasing awareness of the need to adopt healthcare system models to facilitate intervention for RTC casualties, although these primarily focused upon those with severe injuries (Zatzick and Galea, 2007; O'Donnell, Bryant, Creamer and Carty, 2008). There is a need to develop an inclusive healthcare strategy that encompasses all RTC casualties regardless of their injury severity.

This chapter has argued that the scale of the RTC population and the associated risk of PTS disorders warrant the adoption of public healthcare approaches. These are necessary to address existing barriers to accessing appropriate therapeutic services and hence minimise the psychological consequences of RTCs for the individual and for society.

CHAPTER 2

Posttraumatic Stress Reactions (PTS)

This chapter argues that whilst humans demonstrate considerable resilience to adversity and disaster, external events can have both an acute and chronic impact on individuals, resulting in the emergence of posttraumatic stress disorders. Their prevalence following some events means that they not only have personal consequences but impact on wider society with public health implications.

Introduction

Most people will be exposed to at least one severely threatening situation during their life-time (Ozer, Best, Lipsey and Weiss, 2003) and respond resiliently to maintain their equilibrium and healthy functioning (Bonanno, 2004). History is permeated by accounts of such human resilience and an ability to transcend adversity, suffering and horror.

Posttraumatic Stress (PTS) Responses

However, recovery is not an inevitable outcome of a trauma and many people may find they become overwhelmed and the psychological impact can be limitless. Traumatic events can have wide-reaching physical, psychological and social effects (Kimerling and Calhoun 1994, ; Bromet, 1996) and unfortunately, wars have contributed greatly to our understanding of the consequences of trauma. Over the centuries the paradigm of "psychological trauma" has undergone tremendous change. Jones and Wessely (2003), comment that the symptoms which emerged after each major war were not always consistent. Throughout the history of trauma the prevailing cultural and social context has exerted an influence on the manifestation of trauma responses. Shell-shock that emerged in the First World War and War Neurosis in the second were considered to arise in feeble, defective individuals, whilst the complex trauma evident amongst Holocaust survivors started to challenge the notion that personality deficiency was central to trauma-genesis (Wessely, 2005). Therefore, the expression of symptoms must be conceived as a dynamic construct, influenced by the prevailing social, political, philosophical and scientific context.

Complexity of trauma reactions

What remains central to the paradigm of psychological trauma is that an external event has the capacity to acutely and chronically distress people, irrespective of whether this is through a direct or complex causal pathway.

Today, the same forces and arguments exert their influence on the contemporary paradigm that is termed “Posttraumatic Stress Disorder” (PTSD), which initially marked a turning point, by acknowledging that different traumatic events could elicit comparable responses in people (Kelley, Weathers *et al.*, 2009). Whereas the term itself inferred this is a single disorder with a specific causation with a single solution, it is argued (Wessely, 2005) that trauma reactions are more complex with individual factors being as influential as common factors to the psychological outcome. A range of psychological responses can be observed to a single event and it must be borne in mind that PTSD is one amongst many possible psychological consequences to a trauma (Mezey and Robbins, 2001). Currently non-PTSD type, PTS disorders receive less attention within the trauma literature (O'Donnell, Bryant *et al.*, 2008). Before the current diagnostic and theoretical concepts of PTSD are explored more fully, consideration will be given to some of the non-PTSD disorders that can emerge following a trauma (Resick, 2001).

Posttraumatic Stress Reactions

Following a disturbing event, a range of psychological responses may occur over both acute and chronic time-periods. Within this thesis, an umbrella term of posttraumatic stress (PTS) disorders has been used to indicate the broad constellation of psychological conditions that can emerge after a traumatic event.

Mood Disorders

Depression has been implicated as a pre-trauma vulnerability factor (Brewin, Andrews *et al.*, 2000), a trauma sequelae in its own right and comorbidly associated with PTSD (O'Donnell, Creamer and Pattison, 2004). Major depressive disorder (depression) is defined within the DSM IV (American Psychiatric Association, 1994) by the presence of at least five out of nine symptoms for a period of more than two weeks. The symptoms must include depressed mood, significant loss of interest or pleasure in activities and also includes behavioral, cognitive and physiological changes, sleep disturbance, distress and difficulty functioning.

Studies investigating post-traumatic depression report that its occurrence as a response, independently and comorbidly with PTSD (O'Donnell, Creamer *et al.*, 2004). Although PTSD is strongly linked with combat exposure, a study of British ex-servicemen found that 43.8% had a psychiatric diagnosis and the most common disorders were mood disorders (53.4%) and anxiety (18.2%) compared to only 16.3% with PTSD (Iversen, Dyson, Smith, Greenberg, Walwyn *et al.*, 2005). An analysis of data from RTC victims in Albany, USA (Blanchard, Buckley, Hickling and Taylor, 1998), found that over half of those with PTSD also had major depression 1-4 months post-crash, and this was associated with greater distress and functional impairment than patients with PTSD alone. Blanchard, Hickling, Taylor *et al.* (1995) found that 50% who developed PTSD had a prior history of depression, suggesting this was a risk factor for the development of PTSD.

After a major physical trauma, Holbrook, Hoyt and Anderson (2001) found depression in over half the participants at discharge which persisted at 18 months in 19% of men and 34% of women. These gender differences remained, even when adjusted for age, injury cause and severity. Functional outcomes and quality of life were also found to be significantly lower for women at follow-up. The National Comorbidity Study (USA) also found that depression and dysthymia occurred comorbidly with PTSD (Kessler, Sonnega, Bromet, Hughes and Nelson, 1995), but reported little difference between the frequency of comorbid depression for men (47.9%) or women (48.5%) and similarly for dysthymia (21.4% men, 23.3% women). These studies highlight the need to explore gender differences in both physical and psychological responses.

The high prevalence of the two disorders following trauma may in part arise from overlapping features, but true comorbidity also appears to occur. It is more usual for someone with PTSD to have at least one other psychiatric disorder, than to have PTSD alone (Brady, Killeen *et al.*, 2000; Ehring, Ehlers and Glucksman, 2006). In a UK study of 101 survivors examined within a year of a road crash, Ehring, Ehlers and Glucksman (2006) found that although only one individual developed depression alone, 10.9% had depression and PTSD. O'Donnell, Creamer and Pattison (2004) in their review of PTSD and depression found that reported rates varied considerably between 6-42% but was usually found to co-occur with PTSD.

It is important to acknowledge comorbidity of these disorders, as they can both independently affect function and their co-presence appears to exacerbate function and impair the overall recovery process. This was illustrated by a study of patients admitted to a level 1 trauma center after accidental injury. The 12 month prognosis for those with symptoms of PTSD and depression was considerably worse than for those with depression alone (O'Donnell, Creamer and Pattison, 2004). The emergent picture of post-trauma depression suggested that assessment for depression, on its own and with PTSD, was essential after trauma exposure, to ensure the most appropriate interventions were made available.

Anxiety Disorders

Fear and ensuing anxiety symptoms, like depression, seem to be a fundamental aspect of our evolutionary survival mechanisms (Marks, 1997; Gilbert, 2006). Unfortunately, these automatic mechanisms can also be the cause of distress and anxiety disorders (Kim and Gorman, 2005).

Phobias

Following a road crash the emergence of phobic anxiety has been reported with a sizeable group (30.7%) fulfilling the criteria for travel phobia (Ehring, Ehlers *et al.*, 2006), whereas Mayou Bryant and Ehlers (2001) found that only 6-10% of RTC casualties experienced travel anxiety in the year after the crash. Women were also significantly more likely to develop travel anxiety (Mayou, Bryant *et al.*, 2001). Hamanaka, Asukai, Kamijo *et al.* (2006) in a study of 100 consecutively hospitalised, severely injured RTC casualties in Japan, found that 13.4% had travel anxiety and generally their phobia was comorbid with PTSD.

Posttraumatic Stress Disorders

The trauma literature has focused the greatest attention on the posttraumatic stress disorders causally linked to traumatic events. These include posttraumatic stress disorder (PTSD) and the related Acute Stress Disorder (ASD).

The aetiology was core to the initial concept of PTSD with objectively more severe and prolonged stressors being more likely to lead to psychological distress, although this simplistic relationship has been challenged (Kaysen, Rosen, Bowman and Resick, 2009). PTSD was first included in the DSM III in 1980 (American Psychiatric Association, 1980).

PTSD is classified as an anxiety disorder, although its features overlap with many symptoms common to other psychiatric disorders, particularly depression (Franklin and Zimmerman, 2001). Uniquely to anxiety disorders the focus of the anxiety is on a past not a future threat. This conundrum arises since the recall of the event is particularly vivid and appears as if it is occurring in the present (Ehlers, Hackmann, Steil, Clohessy, Wenninger *et al.*, 2002; McNally, 2006). In the DSM IV (American Psychiatric Association, 1994) there is a distinction made between acute stress disorder (ASD) with duration of less than one month and posttraumatic stress disorder (PTSD), which is utilised when symptoms persist beyond the first month. The distinctive features of PTSD within both diagnostic systems are the presence of re-experiencing phenomena such as intrusive recollections of the event, daydreams or flashbacks and dreams together with a physiological reaction to such experiences.

The DSM IV diagnosis for PTSD is more rigorous than the ICD 10 criteria (World Health Organisation, 1992; American Psychiatric Association, 1994) requiring a more extensive profile of numbing, avoidance, occupational and social impairment, to meet the diagnostic criteria. Although Peters Slade & Andrews (1999) comparing the impact of using the DSM or the ICD, found 95% agreement between the two systems with the major discrepancy arising from the DSM requirement for clinically significant distress or impairment. It is recognised that trauma survivors may still experience considerable distress and impairment without meeting the full PTSD criteria (NICE, 2005). Although avoidance and increased autonomic arousal symptoms are specified in both systems a minimum of three avoidant and two arousal features are necessary to meet the DSM IV criteria. It is these criteria, which restrict the full diagnosis of PTSD to only those severely impaired following a traumatic event and which people with sub-threshold disorder often fail to achieve. Within the literature, sub-syndromal and sub-threshold PTSD are used to describe responses that do not meet the full diagnostic criteria, but can nevertheless result in considerable distress (Blanchard, Hickling, Forneris, Taylor, Buckley *et al.*, 1997; Blanchard, Hickling, Malta, Jaccard, Devineni *et al.*, 2003).

Since the original inclusion of PTSD in the DSM III in 1980 the original stressor has been revised twice. The criterion now permits a more subjective appraisal of an event.

The person's response of fear, helplessness or horror feature in the diagnosis, in addition to the objective severity of the event. The stressor criterion remains the source of ongoing discourse (McNally, 2003). Summerfield questions the scientific and clinical validity of a belief in the centrality of aetiology, claiming that pre-exposure variables contribute to the symptom variance more than the event itself, (Summerfield, 2001) whereas Brewin, Andrews and Valentine (2000) found that post-trauma variables had greater influence than trauma ones.

In DSM-IV (American Psychiatric Association, 1994) criterion A now allows for peri-trauma appraisal of the event, thus broadening the formulation to more common traumatic experiences, such as road traffic crashes and industrial accidents. However, McNally is concerned that "conceptual bracket creep" (McNally, 2003) is possible through placing the emphasis on the sufferer's reaction.

Despite the concerns and limitations, the PTSD label has added an idiom to the lexicon of severe distress, providing a common language for the public, clinicians and researchers to describe traumatic reactions and stimulated the advancement of theoretical models and treatment approaches. Furthermore effective interventions may be most efficiently promoted through a sound theoretical base and models which enable simplification and organisation of knowledge into meaningful patterns for clinicians, researchers and survivors, (Dalgleish, 1999).

Theoretical concepts of PTSD

Current knowledge would make it imprudent to suggest that PTSD always results from a single factor and requires a single treatment modality to restore the individual to previous functional levels. Knowledge from physiological, neurological, psychological and sociological sciences has led to different models emerging. Whilst each theory may provide insights into the possible nature and context of the disorder, no single theory fully accounts for all the features of the PTSD (Dalgleish, 1999).

Following exposure to a stressor, biological reactions are triggered to marshal an appropriate response and terminate the stress reaction when it is no longer required. Dysfunction in this modulation is evident in PTSD sufferers since their stress reaction persists after termination of the trauma. The Hypothalamic-Pituitary-Adrenal Axis (HPA) consists of a group of endocrine centres which modulate the stress response.

Cortisol inhibits many of the biological processes that are activated as part of the stress response, (Yehuda, 2000) limiting the energy consuming process and is considered an "antistress" hormone (Munck, Guyre and Holbrook, 1984). Stress theory holds that excessive demands on an individual are buffered by a series of homeostatic processes that enable efficient self-conservation and allocation of resources, (Shalev, 1996). Changes in HPA axis functioning in PTSD were anticipated to mirror those identified for depression and anxiety but it appears that a different profile occurs in PTSD (Yehuda, 2000). Other neurological changes have been reported (Kolb, 1987; Smith, Davidson and Ritchie, 1989) although whether reported changes are the precursor or consequence of PTSD is unclear. Some studies amongst PTSD subjects have also reported a reduction in hippocampal volume (right-hemisphere) together with functional deficits in verbal memory, (Bremner, Randall, Scott, Bronen, Seibyl *et al.*, 1995; Gurvits, Shenton, Hokama, Ohta, Lasko *et al.*, 1996). Whilst the mechanisms underlying these findings are uncertain, they indicate an association between the verbal memory difficulties reported in PTSD and hippocampal function. This in turn suggests an area to target in intervention, although whether this is most realisable through pharmacological or psychological strategies requires further elucidation.

There are a range of psycho-social theories of PTSD, linked the concept that, individuals possess a series of beliefs and mental representations developed from their earlier life experiences. The traumatic event is conceptualised as carrying new information that has to be interpreted and integrated into the person's mental constructs. Unsuccessful integration and processing will result in distress and disruption to normal processing of information. Different theories differ in their conceptualisation of where the difficulties occur, (Dalgleish, 1999) and the resultant models are influenced by different therapeutic modalities.

Psychodynamic theory proposes that a trauma can create conflict between the individual's view of self and others and the traumatic event, resulting in a strong emotional response. Activation of defence mechanisms and emergence of primitive coping mechanisms occurs to reduce the affect. Marmar, Weiss and Pynoos, (1995) proposed that the traumatised individual may replay early maladaptive relationship patterns. Intervention involves the resolution of conflict through re-enactment of the trauma, within the therapeutic relationship, (Lindy, 1989; Lindy, 1996).

Horowitz's Stress-Response Syndrome drew on psychodynamic concepts focussing on how cognitive processing enabled integration of an inconsistent event into an existing belief system (Horowitz, 1986). The model proposed that a traumatic event results in an initial period of horror and "outcry" when an individual may be faced with a wealth of new information to be processed. To prevent becoming overwhelmed and exhausted, inhibitory regulatory efforts are initiated, to remove information from conscious thought defending the person from emotional pain (Horowitz, 1986). This process manifests itself as numbing and denial reactions such as dissociative experiences and restricting of affect. A "completion tendency" drives processing of new information until the reality of the experience and internal schemas are brought into alignment. Assimilation of the memory occurs through a biphasic process with oscillating periods of denial and intrusion that permit the processing of tolerable doses of information, until the trauma is "worked through" and the information can be successfully integrated and "completion" is achieved (Horowitz, 1993). Whilst the model does address the PTSD symptoms of intrusion, hyperarousal and numbing it does not allow for the influence of post-trauma variables on the development of pathology.

Janoff-Bulman's cognitive appraisal theory (Janoff-Bulman, 1985; Janoff-Bulman and Morgan, 1994) built upon Horowitz's model, focusing upon the importance of the pre-existing fundamental assumptions that people hold about themselves and the world. Many psychologists have described similar notions of such internal representations of the self and the world. Many different terms have been used to describe these cognitive concepts, such as "assumptive world" (Parkes, 1975), a "working model" (Bowlby, 1969; Bowlby, 1973), or a "personal theory of reality" (Epstein, 1980). These inner conceptual systems involve a set of assumptions that reflect and guide our experiences with the external world and promote effective functioning by providing a means of recognising, planning & responding to the demands of the environment, (Parkes, 1975). Janoff-Bulman (1992) proposed that three fundamental assumptions were widely held, the world is benevolent, the world is meaningful and the self is worthy. These beliefs only become evident when impacted by experiences that challenge their "reality". The distress and confusion following a traumatic event arises from the "shattering of assumptions" through incongruence between the event and pre-existing beliefs resulting in loss of cognitive equilibrium (Janoff-Bulman, 1992).

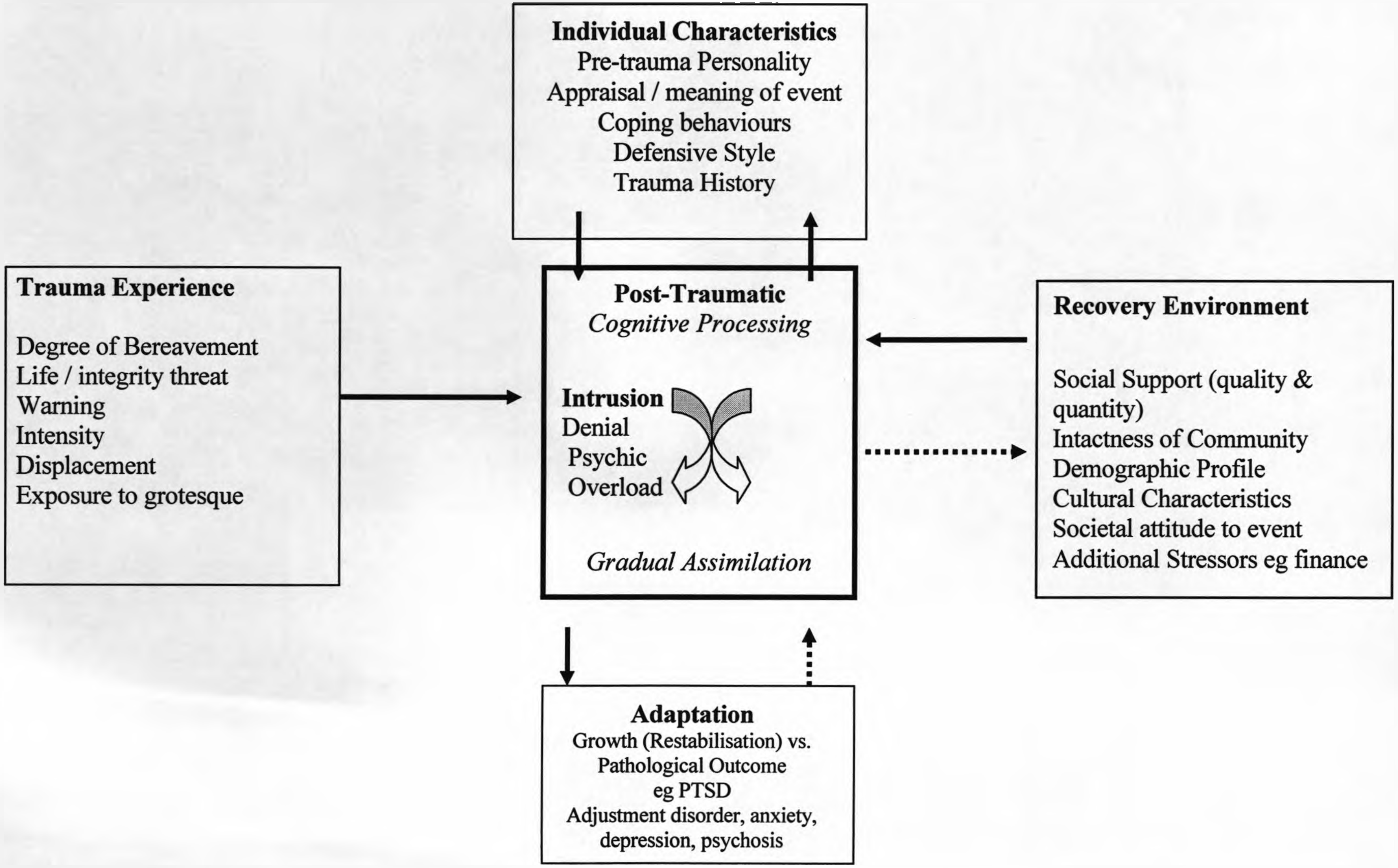
Congruent with Horowitz's "completion tendency" (Horowitz, 1993) the model suggests a need to align the event with pre-existing information or for the individual to reconstruction their core beliefs, thereby restoring their cognitive equilibrium.

Whilst this model may have considerable face validity (Joseph, Williams and Yule, 1997) it failed to account for distress amongst people with negative beliefs prior to a trauma. Additionally Dalgleish (1999) raised concerns over the lack of understanding of what neurological mechanisms bring about the "shattering" process and questioned whether the core assumptions were universally applicable. Joseph, Williams et al (Joseph, Williams *et al.*, 1997) questioned the implicit difficulty in studying what is theorised to be inaccessible to consciousness in non-traumatised individuals.

Green, Wilson and Lindy (1985) also extended Horowitz's model through the integration of idiosyncratic pre-trauma characteristics, the trauma and the recovery environment (Figure 1). It was intended to guide intervention and although largely speculative subsequent studies have identified pre, peri and post trauma variables that influence the outcome of trauma exposure (Green, Wilson *et al.*, 1985; Weisaeth, 1996; Brewin, Andrews *et al.*, 2000) and unlike the Stress-response model (Horowitz, 1993) it includes the social context of the trauma (Green, Wilson *et al.*, 1985). Campbell (1995) criticised this model suggesting that cognitive processing and adaptation are not uni-directional.

Whilst Mower's two-factor theory (1947) contributed to the understanding of how fear and avoidance develop and are maintained in PTSD it did not satisfactorily address the intrusive symptoms. Lang (1977) developed the notion of "fear structures", conceptualised as networks of stored memories containing verbal and non-verbal information, visceral and somatic responses, propositions regarding the meaning of cues and external stimuli propositions. Foa Steketee and Rothbaum (1989) integrated Lang's work together with the concept of "emotional processing" and proposed a theory of "Fear Networks" which develop as conditioned responses to traumatic events. Fear networks consisted of information about the event and information about the cognitive, behavioural and physiological reactions to the event. Interoceptive information links the stimuli and the response creating a network.

Figure 1: A Working Model of PTSD: A psychosocial framework - adapted from Green, Wilson and Lindy (1985)



Peri-traumatic dissociation and attentional alteration during the trauma may result in disorganised and fragmented networks. Resolution of distress required the assimilation of the network into existing memory structures through activation of the fear network by event-related stimuli, causing intrusive re-experiencing symptoms. Attempts from the individual to suppress activation of the network would result in avoidance and emotional numbing. Successful resolution required repetitive and prolonged activation of the fear network, allowing exposure to and modification of the memory within an environment that promoted fear incompatible information. Processing may be hindered by the perception of the event, with uncontrollable and unpredictable events being more difficult to integrate into existing beliefs of controllability and predictability, (Foa, Steketee *et al.*, 1989).

Unfortunately this model only addresses fear, whilst trauma often triggers other reactions such as guilt or anger. Although several aspects of the model have been empirically studied (Foa, Feske, Murdock, Kozak and McCarthy, 1991; Foa, Zinbarg and Rothbaum, 1992; McNally, English and Lipke, 1993) the laws and pathways that govern these networks have not been fully identified (Tryon, 1999). However the model does provide a framework for conceptualising how social support may affect the development or resolution of PTSD, through the presentation of fear incompatible information, it does not offer sufficient explanation of why fear networks develop to a greater extent in some people (Dalgleish, 1999).

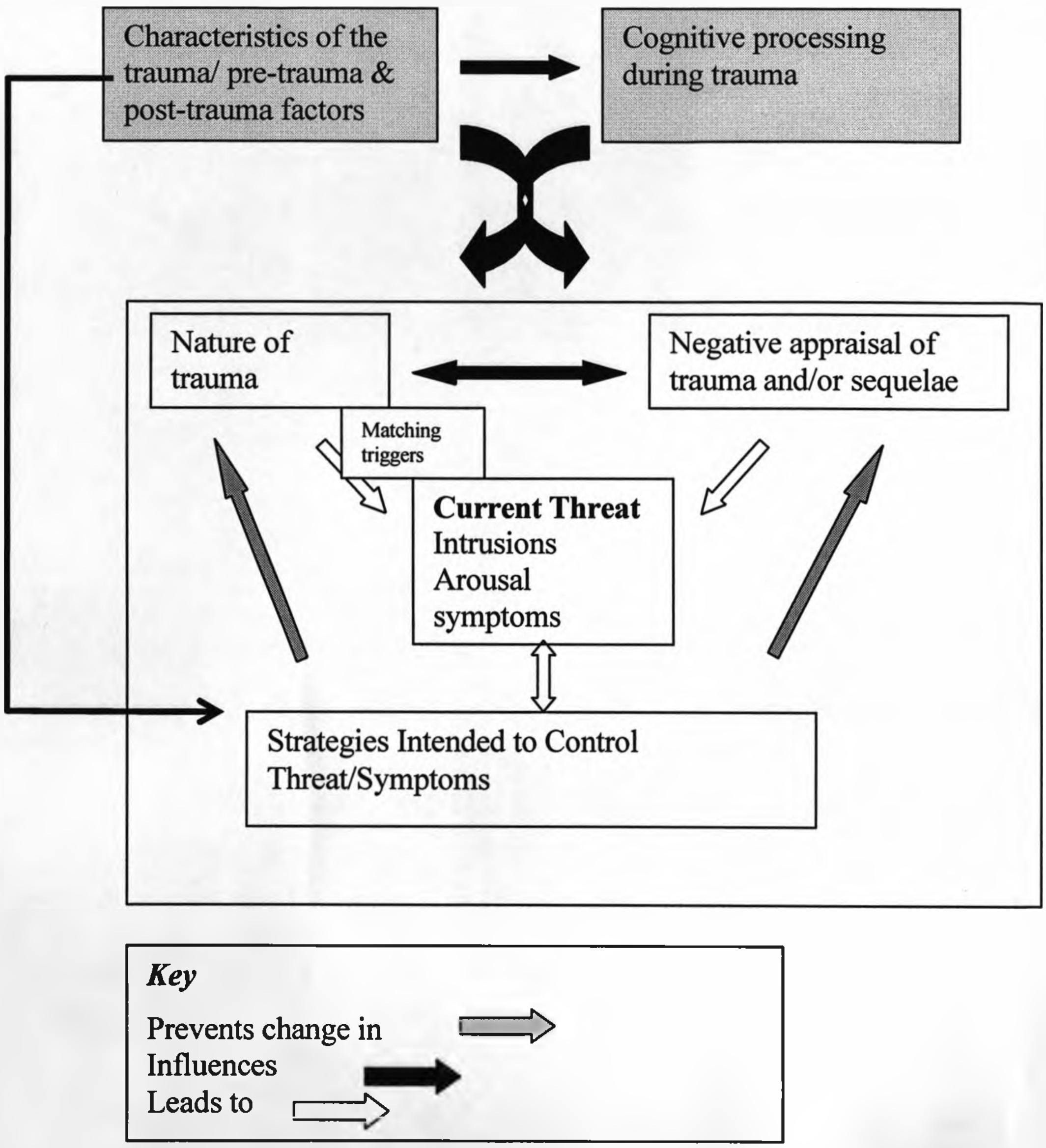
Brewin (2001) argued PTSD could not be accounted for by a single level of information processing and proposed a dual representation theory that involved two modalities that operate consciously and non-consciously. He proposed that during a trauma, information may be encoded as verbally accessible memories (VAMs) and situationally accessible memories (SAMs). VAMs are autobiographical, declarative memories containing information sufficiently processed to permit storage in long-term memory (Brewin, 2001). High levels of arousal impair the encoding of VAMs and accounting for the poor temporal quality and detail of trauma memories (Bremner, Krystal, Southwick and Charney, 1995). VAMs may be selective due to a narrow attentional focus but are amenable to alteration and deliberate retrieval from memory. They can be edited progressively as a person attempts to reconcile disparities between beliefs and the event.

Such memories were proposed to be processed at a cortical and hippocampal level within the brain. The processing of VAM equates with the assimilation or accommodation of the event with pre-existing beliefs proposed by Janoff-Bulman (1992) and Horowitz (1986) and the deliberate recounting of the event encouraged in therapy (Brewin, 2001). The conscious search for a reconciled meaning to the event is proposed to continue until a sense of safety, control and reduction in distress is achieved (Brewin, 2001).

SAMs are conditioned at the time of the event and consist of sensory, physiological and motor information. The encoding of SAMs is promoted by increased arousal and occurs primarily non-consciously. SAMs are difficult to deliberately access, emerging automatically into awareness in response to situational triggers, reminiscent of the trauma. SAMs are reportedly extensive and resistant to alteration or editing and although primarily processed through the amygdala they can be inhibited by higher cortical and hippocampal input (Brewin, 2001). SAMs are experienced as automatic intrusive sensory experiences, physiological arousal, intrusive images and flashbacks. Brewin, suggested that the intrusive phenomena aided cognitive readjustment to the trauma by providing the necessary sensory & physiological information about the event in response to VAM processing. Successful processing involves the transfer of increasing amounts of sensory information (SAM) into declarative memories of the event (VAM), facilitating the inhibitory effect of VAM onto the amygdala. When in consciousness, SAMs may be altered by the integration of non-threatening information resulting in a reduction in their frequency and intensity (Brewin, 2001). Failure to fully integrate VAM and SAM for an event may result in chronic processing (Brewin, Dalgleish and Joseph, 1996), leading to psychological disorder. Whilst some aspects of dual representation theory have been empirically tested others remain speculative. Dalgleish (1999) also questions how assumptions about self and world that are not in immediate awareness (Janoff-Bulman, 1992) can be considered entirely verbally accessible. Neither does the model fully explore the effects that the pre and post-trauma environment may have on the processing of the trauma.

The Ehlers & Clark Cognitive Model (Figure 2) acknowledged the influence of other theories and aimed to explain the persistence of PTSD and provide a framework for cognitive-behavioural therapy (Ehlers and Clark, 2000).

Figure 2: A diagrammatic overview of Ehlers & Clark Cognitive Model



It also endeavoured to explain why many people recover following a traumatic event and some do not. The different recovery patterns are seen as the consequence of idiosyncratic appraisals of the event, its sequelae and the nature of the memory and previous autobiographical memories. The model pays particular attention to providing explanations of how the individual appraisals of both the event and its sequelae can contribute to the perception of current threat with the event remaining partitioned from the person's autobiographical memories. This erroneous perception of current danger for an event in the past, together with maladaptive behavioural and cognitive strategies was proposed as central to PTSD.

Whilst the model included factors that may influence the processing of the event eg event characteristics, previous life experience, state factors and intellectual ability (Ehlers and Clark, 2000) there was no direct consideration of how social environment may influence the development or recovery of PTSD.

These models have greatly contributed to the present day understanding of trauma responses and informed the development of interventions. However none of them fully account for the complexity of chronic and acute stress disorders. Furthermore they generally lack empirical validation and fail to explicitly consider the significance of the social environment on the development and maintenance of PTSD. If interventions to alleviate distress are to be effective, then they need to consider the potential interaction between the psychological, neurological, physiological and social, aspects of distress portrayed in these theoretical models of PTSD.

Acute trauma Responses

Whilst these models primarily focus upon PTSD, two acute reactions are also recognised. In the ICD-10 classification there is no ASD equivalent, although Acute Stress Reaction (ASR) is included to designate the difference between an acute and extreme stress reaction that falls outside usual limits. ASR applies only to the first two to three days after a trauma, thereafter PTSD is the diagnostic category used.

This classification has rarely been the focus of research studies (Isserlin and Zerach, 2008). In the acute aftermath of a traumatic event, high levels of anxiety symptoms and distress are often encountered in survivors and these may persist (Bryant, 2003). A reliable process of differentiating those at long-term risk is necessary, if early intervention to prevent PTSD is to be achieved.

The diagnostic category of Acute Stress Disorder (American Psychiatric Association, 1994) aims to identify people with high levels of distress between 2 days and one month after a trauma (American Psychiatric Association, 1994) and offer a prognostic indicator of PTSD (Spiegel, Koopman, Cardena and Classen, 1996). However, the validity of this purpose has been contested (Creamer, O'Donnell and Pattison, 2004).

Criteria were selected for ASD that, theoretically, identified people with PTSD at one month (Marshall, Spitzer and Liebowitz, 1999). Although the symptom profile is largely similar to PTSD, its diagnosis relies more heavily on the presence of dissociation, requiring three out of five defined symptoms (Bryant, 2003). The emphasis on dissociative symptoms arose more from a theoretical rather than an empirical stance, although some studies had shown that peri-trauma dissociation predicted the development of PTSD (Marshall, Spitzer *et al.*, 1999).

As empirical studies have been carried out, the evidence of dissociative symptoms predicting future pathology has also been ambivalent, with no clear picture emerging to justify this as the main route to PTSD (McNally, 2003). There is also the possibility that dissociation and subsequent PTSD do not follow a cause and effect pattern, but are linked by common vulnerability factors such as sexual abuse (Dancu, Riggs, Hearst-Ikeda, Shoyer and Foa, 1996). In a study of ninety road crash survivors attending an emergency department, the diagnosis of ASD was only able to predict 50% of those with PTSD at 6-8 months (Fuglsang, Moergeli and Schnyder, 2004). Creamer, O'Donnell and Pattison (2004), in a study of severely injured trauma patients, found that relying on the requirement of dissociative symptoms for ASD reduced the ability to predict PTSD. Since the purpose of the diagnosis was largely to screen for high-risk individuals, permitting them to receive early intervention, the low sensitivity of the ASD diagnosis renders it a poor indicator in isolation (Creamer, O'Donnell *et al.*, 2004). Marshall Spitzer and Liebowitz (1999) in their review of peri-traumatic dissociation as a predictor of PTSD, conclude that many people who develop PTSD would not have had ASD and that acute dissociative symptoms were not the only route to PTSD. Whilst assessment of ASD symptoms carries a danger of pathologising transient distress, it may also permit the identification of people experiencing high levels of initial distress. The merit of this evaluation may lie more in determining whether there is a need for additional support or palliative intervention, rather than in predicting PTSD.

Risk Factors

The underlying value of identifying PTS risk factors is to understand causal mechanisms and develop strategies to prevent the emergence of disorders. The value of ASD as a predictor of PTSD has already been considered.

A review of five ASD studies (Isserlin and Zerach, 2008) found that the disorder was able to correctly predict PTSD in 42% - 78% of the road crash participants. However, only 29-73% of participants with PTSD had previously been diagnosed with ASD. They conclude that the predictive value could be improved by excluding dissociation from the necessary criteria. In a study of healthy military participants, 96% reported dissociative symptoms after exposure to acute stress, whilst trauma-hardy personnel showed less increase after exposure (Morgan, Hazlett, Wang, Richardson, Schnurr *et al.*, 2001). Murray, Ehlers and Mayou (2002) found that peri-trauma dissociation following a RTC was linked to chronic PTSD, but persistent dissociation was better at predicting persistent trauma responses.

These studies suggest that dissociation around the time of the trauma was associated with subsequent PTSD and ASD. Furthermore, there is the suggestion that pathological dissociative responses may be operated by individuals with a predisposition or previous trauma exposure (Butler, Duran, Jasiukaitis, Koopman and Spiegel, 1996; Morgan, Hazlett *et al.*, 2001). As such it may be indirectly associated with PTSD and merely act as a marker for other factors.

The link between ASD and depression has rarely been investigated, but a study of September 11th rescue workers found that those with ASD were 3.9 times more likely to be depressed seven months later. However, the unique nature of this event and the sizeable loss of life prevent unquestioned transfer to other traumas. This is an area that requires further investigation through prospective studies involving more universal trauma exposure.

Two meta-analyses of risk factors have been reported (Brewin, Andrews *et al.*, 2000; Ozer, Best *et al.*, 2003). Ozer, Best, Lipsey *et al* (2003) reviewed 2,647 PTSD studies and through application of inclusion criteria explored seven factors. These were family history of mental health problems, threat at the time of the trauma, previous psychological problems, previous trauma exposure, post trauma social support and peri-traumatic dissociation and emotional response. All of these factors were found to be associated with PTSD, but the pre-trauma factors had the smallest effect and dissociation the greatest. Brewin, Andrews and Valentine (2000) found that some predictive factors were event dependent including age, gender and race.

Other factors were consistently associated with PTSD characteristics, such as sexual abuse, personal and family psychiatric history. Another category of factors showed less consistency, including education and previous trauma. Consistent with Ozer, Best, Lipsey *et al* (2003) pre-trauma factors were less predictive than peri-trauma or post-trauma factors such as trauma severity and poor social support.

Studies have attempted to identify physiological predictors. Heart-rate (HR) has been widely explored, since it could reasonably be speculated to increase after a trauma due to autonomic arousal mechanisms and activation of fear conditioning (Yehuda, McFarlane and Shalev, 1998). Whilst many studies have found such an increase to be associated with PTSD (Shalev, Sahar, Freedman, Peri, Glick *et al.*, 1998; Bryant, Harvey, Guthrie and Moulds, 2000), others have failed to find such a link (Blanchard, Hickling, Galovski and Veazey, 2002). Bryant examined ten prospective studies in which HR within a week of a RTC was compared with subsequent PTSD and concluded that PTSD development was not necessarily linked to elevated HR (Bryant, 2006). Kuhn (2006) suggested that a relationship between heart rate and ASD and PTSD at 6 months was mediated via peri-traumatic dissociation rather than distress. The apparent variability in these studies prevents its use as a reliable screening factor.

Gender differences

Gender differences in the lifetime prevalence of PTSD were reported amongst young adults (Breslau, Davis, Andreski and Peterson, 1991), with women having a lifetime prevalence of 11.3% compared to 6% for men, despite their greater risk of trauma exposure (Norris, Foster and Weisshaar, 2002). Higher PTSD rates for women are consistently reported (Kessler, Sonnega *et al.*, 1995), (Breslau, Kessler, Chilcoat, Schultz, Davis *et al.*, 1998). Norris has also recognised significant differences between males and females in terms of the frequency and types of traumatic events they were exposed to (Norris, 1992). Even when men and women are exposed to the same trauma type, such as motor collisions, gender differences have been demonstrated. In a study of 171 crash casualties only 8% of men compared to 23% of women were diagnosed with ASD (Bryant and Harvey, 2003). After six months both genders had higher rates of PTSD with 15% of men and 38% of women diagnosed. They attributed the differences to greater dissociative symptoms within women.

Throughout adulthood, women are twice as likely to develop PTSD compared to men, even after exposure to similar events and the disorder tends to be more persistent amongst women (Norris, Foster *et al.*, 2002). These findings emphasize the need to consider gender differences when delivering trauma services.

Social Support

Social support is a heterogeneous term, describing the resources provided by other people (Cohen and Symes, 1985) and conceptually consists of a number of factors. House (1981) defined four broad classes of behaviours; emotional, instrumental, informational and appraisal which constitute the social support construct. Affective support, when coupled with either informational or instrumental support (Cwikel and Israel, 1987) and having a close confiding reciprocal relationship (Benbenishty) are associated with more positive outcomes. However, not all social support is beneficial and some people may be more vulnerable to its negative effects (Lefrancois, Leclerc, Hamel and Gaulin, 2000; Swickert, Rosentreter, Hittner and Mushrush, 2002).

Numerous studies have identified a negative relationship between social support and PTSD development (Brewin, Andrews *et al.*, 2000; Ozer, Best *et al.*, 2003). There is also evidence to support gender differences in the relationship between PTSD and social support (King, King, Foy, Keane and Fairbank, 1999), which are unsurprising given the recognised gender differences in social support patterns (Fuhrer and Stansfeld, 2002) and different risk for PTSD already discussed. The reported deleterious influence of depression and PTSD, on interpersonal relationships (Beck, Grant, Clapp and Palyo, 2009), suggests that the link between support and pathology may be bi-directional. In a large longitudinal study of male Gulf War veterans, their findings suggested that interpersonal problems associated with PTSD had a detrimental impact on their support resources in terms of both quality and quantity (Daniel, Casey, Lynda, Charity and Erika, 2006). From a clinical perspective, this emphasises a need to assess and if necessary augment support particularly during early trauma intervention. Traumatised people may need support to maintain their relationships and protect them from further erosion (Tarrier and Humphreys, 2003; Daniel, Casey *et al.*, 2006). Social support investigation and intervention amongst trauma populations has rarely considered.

However a few studies addressing social support have yielded promising outcomes (Bordow and Porritt, 1979; Zatzick, Roy-Byrne, Russo, Rivara, Droesch *et al.*, 2004).

Injury Severity

An inconsistent relationship has been observed between PTS disorders and injuries sustained. The injury severity scale scores single and multiple injuries (Greenspan, McLellan and Greig, 1985) and aims to provide an objective measure of injury that can be correlated with morbidity, mortality and hospital stay length. However, O'Donnell, Creamer and Pattison (2004), in a study of severely injured patients, did not find the scores satisfactory predictors of PTSD. In another study of hospitalised patients, increasing injury severity did not correlate with PTSD severity (Zatzick, Kang, Muller, Russo, Rivara *et al.*, 2002).

Injury severity also has a subjective perspective which may drive psychological reactions making it unsurprising that objective measures did not show a linear relationship with PTSD. It may therefore be more relevant to assess people's appraisal of injury severity, to assess psychological risk rather than use objective measures as indicators. Pain and PTSD frequently co-occur (Blanchard, Hickling, Freidenberg, Malta, Kuhn *et al.*, 2004), a relationship which is proposed to be mutually maintaining (Asmundson, Coons, Taylor and Katz, 2002), although Jenewin, Wittmann, Moergeli *et al* (2009), suggests that in the chronic forms of these disorders, PTSD drives the persistence of pain. It has also been reported that the relationship between pain and PTSD is fully mediated through the presence of depression (Poundja, Fikretoglu and Brunet, 2006).

Impact on Individuals and Society

Emphasis has also been placed on a range of psychological problems that have been identified in trauma populations, since there is a danger that PTSD is portrayed as the sole difficulty experienced. Studies have demonstrated a range of mood and anxiety disorders are frequently encountered and where they occurred comorbidly with PTSD, often gave rise to greater dysfunction and distress than PTSD alone. Hence a traumatic event can be life-changing and for some individuals the toll it takes on the personal, social and occupation life can be considerable and in the absence of appropriate intervention and support, can persist with serious secondary effects.

Most of the epidemiological studies have been carried out in the USA and have relied on the earlier (DSM III) diagnostic criteria for PTSD (Klein and Alexander, 2009). In a study of 5877 adults, lifetime prevalence rates of PTSD were estimated overall at 7.8% (5% males, 10.4% females) and in the population exposed to trauma, prevalence was higher (8% males, 20% females) (Kessler, Sonnega *et al.*, 1995). A replication of this study found similar lifetime prevalence estimates of 8.7% (Kessler, Chiu, Demler and Walters, 2005). Breslau, Kessler, Chilcoat *et al* (1998), estimated an average lifetime prevalence of 9.2% after exposure to trauma. The relatively high prevalence of PTSD in these studies must be cautiously extrapolated to the UK population. Since a similar study carried out in Germany found lifetime prevalence was only 1% for males and 2.2% for females, although these estimates were based on a younger population than the previous studies (Perkonigg, Kessler, Storz and Wittchen, 2000).

It is potentially more useful to examine prevalence in "at risk" groups following exposure as such events are not distributed evenly across the community (Breslau, Kessler *et al.*, 1998). Interpersonal related events seem to proffer higher rates of PTSD than natural disasters (Breslau, Kessler *et al.*, 1998), so it is prudent to examine the prevalence of the disorder after exposure to a specific type of event, rather than considering prevalence generally, particularly as different events may lead to different symptom patterns (Kelley, Weathers *et al.*, 2009). Rape and sexual assault seem to be associated with some of the highest rates, with 45% of women and 65% of men having PTSD (Kessler, Sonnega *et al.*, 1995).

When the risk is coupled with the prevalence of some events their differential impact on wider society becomes evident. Yule suggests that PTSD is as common in the general population as schizophrenia (Yule, Williams and Joseph), whereas the extent of the problem is generally less acknowledged and few specialist services are available to help manage and treat the disorder. For example after a road crash, PTSD prevalence has been estimated as 10-30% after a year (Ehlers, Mayou and Bryant, 1998; Holeva, Tarrier and Wells, 2001; Bryant, Duckworth, Lezzi and O'Donohue, 2008) with prevalence doubling if sub-threshold disorder is included (O'Donnell, Creamer *et al.*, 2004). Additionally the persistence of the disorder in a small subset of the population is concerning (Mayou, Tyndel and Bryant, 1997).

Although other traumas may create higher incidence of PTSD than road crashes, the cumulative impact of their frequency and risk of PTS disorders is concerning at an individual and public health level. Norris (1992) considers road crashes to be the most significant single source of trauma in the American population. It is possible that RTCs have a similar impact on UK society, implying a social and financial imperative to reduce the psychological impact of road crashes and their sequelae. In order to achieve this goal, greater understanding of crashes needs to be developed, together with interventions to prevent or minimise the emergent common psychological disorders discussed previously.

This chapter has argued that following a traumatic event for some people acute and chronic psychological problems may emerge. For individuals experiencing PTS reactions they can be associated with considerable distress and impaired functioning. Current understanding of risk factors cannot satisfactorily predict all who will develop such disorders. Vehicle crashes by virtue of the prevalence and risk of PTSD have personal and public health consequences.

CHAPTER 3

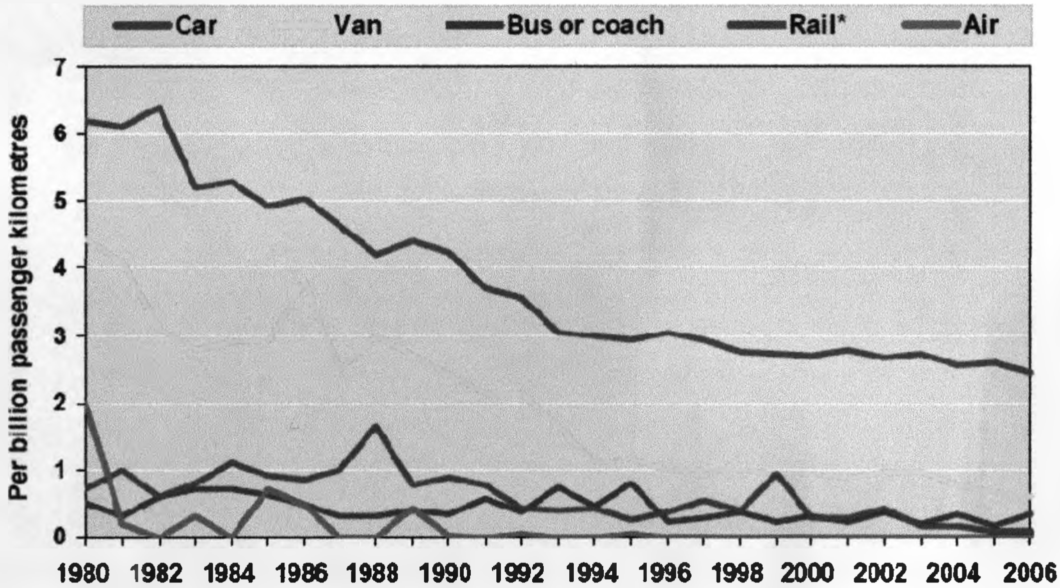
Road Crashes as Everyday Disasters

This chapter will argue that road-traffic crashes are a major public health concern worldwide and create a major population at risk of posttraumatic stress disorders. It will be posited that, an improved understanding of the full impact of crashes is necessary to design strategic services to minimise their impact.

Introduction

Crashes can result in physical and psychological consequences and rehabilitation needs to encompass the interaction between acute and chronic physical impairment, pain, and psychological distress, within the context of a casualty's social situation.

Figure 3: Transport Fatalities UK (Department for Transport, 2009)



Vision Zero

Figure 3 compares the incidence of different UK transport fatalities and provides a stark illustration of the extent of the road crash problem, compared to other forms of transport, which, conversely, receive more media and public attention. In the UK road crashes constitute the major group of transport crashes (98%), placing far more casualties at risk for PTS disorders from this group, than other travel incidents (Department for Transport, 2009).

The representation of fatalities by kilometres travelled conceals the limited reduction in actual numbers killed over the same time period. Records for Great Britain reported, 2,946 people killed in 2007 from RTCs compared to 3,578 killed during the 1994-1998baseline (Department for Transport, 2008). The scale of RTCs presents a major health issue for the UK population, considered within the context of post-crash PTS prevalence rates of 10-30% (O'Donnell, Creamer *et al.*, 2008), echoing the cumulative trauma burden, proclaimed by Norris (1992).

Crash Prevalence

Each year, there are estimated to be 1.2 million deaths and 50 million injured in road crashes (World Health Organisation, 2009). By 2020, RTCs are predicted to rank third in the world burden of disease (Roberts, Mohan and Abbasi, 2002) and to constitute the third highest cause of disability by 2010 (World Health Organisation, 2009). Within countries the rates vary with lower income nations shouldering a disproportionate burden (Danzon, 2004). Although Scurfield of the World Bank, asserted the key to road safety was reliable statistics to inform research and effective implementation strategies (Scurfield, 2002), inconsistent recording and reporting of data continues to hinder the accuracy of information in some countries. In spite of this a consistent picture emerges, with fatalities predominantly involving young adults (15-44 years), men and vulnerable road users (World Health Organisation, 2004). Rates vary across countries with the UK ranked 10th in fatalities across Europe (Department for Transport, 2007).

National (UK) Perspective

UK records are based on police information and used to develop a national understanding of the causes of crashes. The UK crash data was congruent with the global profile, with fatalities predominantly affecting young adults, males and vulnerable road users (Department for Transport, 2008).

Crash Patterns

Understanding the type of injuries and demographics of crash casualties is important in planning services for the needs of casualties. The severity and type of injuries typically sustained obviously vary with road type, age, speed and vehicles involved.

Motorcyclists consistently have the highest risk of death or serious injury as they most frequently sustain severe injuries to the head, thorax and limbs (Robertson, Branfoot, Barlow and Giannoudis, 2002), whereas car drivers have the lowest (Murray, Pitcher and Galasko, 1992; Department for Transport, 2005). Differences in risk of crash involvement, type of crash, severity of injuries and recovery vary according to age (Department for Transport, 2008). Age is associated with road crashes, directly and indirectly, for example through risk taking behaviours or length of driving experience (Meadows, Stradling and Lawson, 1998). Young adults are more likely to be involved in single-vehicle collisions at speed, sustaining severe injuries to the head and extremities. However, the elderly are more vulnerable to situations where they have to attend to several tasks eg manoeuvring or junctions (Lundberg, Hakamies-Blomqvist, Almkvist and Johansson, 1998) and consequently tend to be mostly injured in low impact collisions or as pedestrians. The consequences of a crash also vary with age, with the elderly being at greater risk of fatality or serious injury (Hakamies-Blomqvist and Peters, 2000) placing greater demands on health and social services. Understanding some of the underlying causes and injury patterns across the age range is valuable to inform prevention and rehabilitation strategies.

Gender differences are pronounced, with males being consistently over represented in fatalities and severe injuries but female casualty numbers are rising, with the increase being most marked in the 22-39 age-group (DETR, 1999; Department for Transport, 2008). Women have been reported to sustain more severe injuries after a RTC (Evans, 1991) and outnumber men for chronic conditions such as whiplash, back pain and post-concussional syndrome (Bring, Bjornstig and Westman, 1996; Dufton, Kopec, Wong, Cassidy, Quon *et al.*, 2006).

Norris (2000), in a prospective study of drivers, found that pre-crash personality features and approach to risk taking behaviours, explained the predominance of male casualties. The role of gender in crashes may be both direct and indirect, with a myriad of factors implicated. The relative contribution of gender on crash consequences needs further exploration since men and women may require different support and services post-crash because of different underlying factors for their crash involvement.

Regional Perspectives

There are notable differences in crash numbers between UK countries (Department for Transport, 2008) and variations also occur across regions. Greater London consistently had the worst rate in the country, but targeted measures achieved a sizeable reduction in crashes. The greatest improvements since 1998 have been observed in regions with higher rates, with little change in those initially with fewer crashes (Department for Transport, 2008).

Northwest Regional Perspective

In 1998, Cheshire and Merseyside had the third and fourth highest RTC casualty rates in the country, resulting in the Northwest region being ranked next to Greater London, with 14% of the total casualties (DETR, 1999) and by 2007 it ranked above Greater London with 13% of all UK crashes (Department for Transport, 2008). The Northwest region includes large rural areas, two metropolitan areas (Manchester and Merseyside) linked by an extensive motorway network. The two environments are associated with different crash and casualty patterns. Most of the serious casualties (70%) in the Northwest occur on built-up roads, in contrast to the East of England where 70% occur on non built-up roads (Department for Transport, 2005). The densely populated urban areas of Greater Manchester and Merseyside were associated with high casualty numbers and less severe injuries. Thus, even within one region there are patterns of crash and casualty consequences that affect the healthcare services required. The high crash rates in the Northwest indicate that this area must be prioritised for preventative services.

Road Traffic Crash Consequences

Commonly, physical injuries after a RTC include minor injuries such as back and neck sprains, with a minority sustaining serious injuries such as head injuries and fractures.

Fractures

In a study of orthopaedic clinic patients 51% met the criteria for PTSD, whilst 65% of pedestrians and 57% of vehicle users had PTSD but motorcyclists had the least (44%) (Starr, Smith, Frawley, Borer, Morgan *et al.*, 2004). Although PTSD patients had more severe injuries, it was uncertain how injury severity and PTSD were associated as psychological problems increased with time.

This had previously been observed in a study of patients with severe lower limb injuries (McCarthy, MacKenzie, Edwin, Bosse, Castillo *et al.*, 2003). This phenomenon may occur through a process of mutual influence (Sharp and Harvey, 2001), as neither study found injury severity was a direct predictor of distress.

Traumatic Brain Injury (TBI)

The majority of brain injuries occur from road crashes and despite the use of helmets, some motorcyclists still sustain brain injury (Richter 2001). A large European study of head injured patients, found that 51% occurred from road crashes (Murray, Teasdale, Braakman, Cohadon, Dearden *et al.*, 1999) with the average age on admission 42 years with the six-month prognosis for severe injury being poor, since 40% died. Although mild TBI had better long-term outcomes, 15% still had chronic problems. Their condition was also associated with chronic pain and psychological problems, affecting occupations, daily function and relationships. Although men were more at risk of sustaining a TBI, women were more likely to develop chronic problems as a result of an injury (Fenton, McClelland, Montgomery, MacFlynn and Rutherford, 1993) and 39% had psychiatric conditions after 6 weeks. Anxiety and depression are recognised as a common consequence of a TBI (Jorge, Robinson, Starkstein and Arndt, 1993). Therefore, TBI patients may also require psychological support and intervention during recovery.

Back Injuries

Psychological problems, such as depression and PTSD, have been estimated to occur in 20-40% of spinal cord injury (SCI) patients, with poor social support being a risk factor for PTSD (Nielsen, 2003). Relationships, occupational status and quality of life were found to be adversely affected by SCI (National Spinal Cord Injury Statistical Centre, 2009). Far more common than SCIs are back sprains. The Co-operative Crash Injury Study reported that 25% of casualties studied suffered back sprain and women were more at risk in all spinal regions (Co-operative Crash Injury Study, 2003)

Whiplash /Whiplash Associated Disorder (WAD)

Whiplash arises from acceleration-deceleration in the neck (Scholten-Peeters, Verhagen, Bekkering, van der Windt, Barnsley *et al.*, 2003). WAD refers to a collection of symptoms that can arise after a whiplash event (Dolinis, 1997).

Symptoms can include neck pain, headaches, stiffness, poor concentration, numbness and tingling and are the most common crash injury (Murray, Pitcher *et al.*, 1992; Quinlan, Annest, Myers, Ryan and Hill, 2004).

A study of 539 A&E attendees found that 91% of car users comprised those with WAD, making it a significant risk for this group. WAD was also associated with disability, placing a high demand on healthcare resources (Sterner, Toolanen, Gerdle and Hildingsson, 2003).The Insurance Institute estimate that 68-85% of disbursements for vehicle crashes are for chronic neck and back injuries (Quinlan, Annest *et al.*, 2004)). UK insurance companies estimate there are 250,000 claims for whiplash disorders annually and Norwich Union stated 80% of all car claims are for WAD (AVIVA, 2006).

Whilst most people will go on to make a full recovery, a proportion develops chronic complaints (Dolinis, 1997; AVIVA, 2006). What influences the path to recovery or symptom perseverance has been extensively investigated (Scholten-Peeters, Verhagen *et al.*, 2003). Chronic WAD has been linked to previous neck injury (Dolinis, 1997; Sterner, Toolanen *et al.*, 2003), female gender (Sterner, Toolanen *et al.*, 2003; European Transport Safety Council, 2007) and initial pain severity (Stirling, Jull *et al.*, 2005). Despite the number of studies undertaken to predict acute and chronic risk of WAD, the quality, sampling differences and limited outcome measurements (Solomon, 2005), a lack of clarity remains about the best predictive factors.

In an epidemiological study of whiplash, men and women had different crash patterns, which influenced their injuries (Bring, Bjornstig *et al.*, 1996). Male injuries primarily occurred as drivers in single vehicle, head-on collisions. Women were typically injured as pedestrians or passengers in side or rear-end collisions. This suggested that these differences may account for more whiplash amongst women.

Consistent with Solomon (2005), recovery from most crash injuries does not appear to be dictated by the injury type or severity. Factors such as psychological responses, pain intensity, social support and gender also appeared influential. Ongoing pain and dysfunction arising from an injury could trigger psychological problems (Scholten-Peeters, Verhagen *et al.*, 2003; Starr, Smith *et al.*, 2004; Stirling, Jull *et al.*, 2005).

Jenewin, Wittman, Moergeli *et al* (2009) suggested that, in the longer-term, PTSD exacerbated chronic pain. This highlights the importance of effective pain management in the early stages and the need to address PTS disorders, to minimise the development of chronic pain.

The Cost of Crashes

Costs arise directly from the physical and psychological problems for an individual after a RTC, but are increased by secondary issues such as treatment and loss of income. The World Bank estimated that 51% of fatality and 59% of disability adjusted life years lost globally were from road crashes since they disproportionally affect the most productive age groups (Nantulya and Reich, 2002). They estimated that road crashes cost US$518 billion globally each year (World Health Organization, 2004). Whilst the effects of RTCs are often measured by fatalities, crashes are rarely fatal and the full long-term impact on quality of life for survivors with physical and commonly psychological consequences must be considered. When an economic valuation for the lost quality of life is included, the cost of crashes was estimated to be on average around 2.5% of a nation's gross national product, (Elvik, 2000). Clearly the prevalence of crashes and their consequences can impact upon the wealth of a nation. Hence governments and policy makers are alert to the financial merit of RTC prevention and improving trauma services, but these focus primarily on the physical consequences.

In the UK a non-admission NHS episode of care costs around £172 or £582 per day for in-patients (Great Britain and Elizabeth II, 1999), with the cost of a serious collision estimated at £13,360 and £1,180 for a minor crash (Department for Transport, 2007). The burden crashes place on the NHS is estimated at around £470 million (Department for Transport, 2007) and total costs of RTCs were estimated as 2% of the UK's GNP, (Elvik, 2000). This profound financial burden alone should provide sufficient motivation to address this issue, irrespective of the personal suffering as a result of a RTC.

So far, crashes have been discussed in terms of their broad consequences and financial implications. When examining the macro-picture, it is easy to neglect the personal suffering underlying these statistics, making it equally important to understand the idiosyncratic features of a crash for individuals.

A crash has the potential to trigger acute or chronic disability, psychological distress or social and financial disruption that extends beyond the individuals involved (World Health Organisation, 2004).

The Trauma Recovery Project was a large prospective epidemiological study examining outcomes following major adult trauma 62% of which were from RTCs (Holbrook, Anderson, Sieber, Browner and Hoyt, 1999). After 18-months, more than 40% of patients had poor functional outcomes, associated with major extremity injury, hospital stay more than a week, a decline in support satisfaction and psychological morbidity. Depression at discharge and early onset of intrusive PTSD symptoms were also associated with poor functional recovery in this trauma population (Holbrook, Hoyt, Stein and Sieber, 2001). The study demonstrated that recovery from a major trauma, such as a RTC, is not linear, influenced by physical, social and psychological factors. Whilst the physical injury was indirectly linked to function, psychological problems also impeded recovery. In a study of quality of life, 5 years after major trauma (Sluys, Häggmark and Iselius, 2005) 68% reported physical disability, 41% psychological problems and 38% reported suffering both problems. Half of these participants considered the hospital could have supported them more with their problems. The authors concluded that inadequate pain management was a contributing factor to the chronic health problems of this population, which echoes the opinion of Stirling, Jull, Vicenzio *et al* (2005) for WAD.

The majority of research, treatment and policy directed at minimising crash consequences focus on reducing physical injury and fatalities. The systematic improvement in trauma care, together with the compulsory use of seat belts and crash helmets, has positively influenced RTC fatality and injury rates in the UK (Department for Transport, 2008). Although considerable healthcare resources are consumed by trauma care, the societal costs of longer-term support are less recognised (Murray, Pitcher *et al.*, 1992).

Public Health Concerns

Despite the obvious financial and social imperatives, Roberts (2002) believed that crashes have not been appropriately prioritised within the UK public health agenda. The WHO called for the preparation of national plans and "proven interventions to prevent crashes and minimise injuries and their consequences" (World Health Organisation, 2004).

Roberts (2002) compared the annual impact of road crashes to the World Wars and called for broad-based coalitions and research to counterbalance the propaganda and public complacency around road crashes.

However, these statements failed to specifically address the public health impact of PTS disorders after RTCs. Rather than focusing efforts exclusively on the physical consequences; this review has demonstrated the need to consider psychological problems and their influence on recovery and residual disability within the population. Whilst strategies have been considered to monitor and support survivors of major disasters (NICE, 2005), no equivalent guidance exists for casualties of everyday events such as RTCs. In view of the immense and complex problems reported to arise from crashes, multi-level strategic approaches equivalent to those available following major disasters, are essential to address personal and public health consequences of crashes.

Minimising Crashes and their Psychological Consequences

Reduction in the psychological burden of RTCs relies on two potential routes, preventing crashes from occurring or averting their psychological consequences. Barach suggested that reducing RTC trauma required three key approaches (Barach, 2001),

1 Active & Passive Methods

This involves design to prevent crashes or to reduce their impact. Examples of active methods would include seatbelts. Passive methods include measures such as side impact protection (Barach, 2001) and are assumed to be more efficient as they do not rely on behavioural change. However, Smeed's Law (1949) predicts that driving behaviour will alter to maintain the level of risk, consequently reducing any benefits of the change. Smeed's Law predicts homoeostasis of casualty rates (Wilde, Robertson and Pless, 2002), consistent with the plateau seen as UK regions improved their safety measures. Whilst physical damage may be alleviated by active and passive measures, the prevalence of psychological distress may be less affected, as it does not correlate with injury.

2 Education and Enforcement

Improved public understanding of the impact of crashes and their consequences is required (Roberts, 2002). Within the UK a raft of legislation covers road safety.

The White Paper, "Saving Lives: Our Healthier Nation" (Department of Health, 1999) identified RTCs as the principle cause of accidental death and injury. Although the paper did not address how to reduce the psychological consequences of accidents, it did recognise their existence. The paper recommended the development of locally informed, relevant health services. In order to develop locally responsive services for RTC casualties, the regional and local RTC patterns must be explored.

A 23% reduction in overall casualties has occurred in the last decade with 247,780 reported in 2007 (Department for Transport, 2008) but still RTCs remain a sizeable problem. Efforts now need to be employed to minimise RTC consequences not only through injury prevention, but also by addressing their psychological impact.

3 Hazard Control

Whilst crashes cannot be entirely prevented, steps to minimise injury should be adopted. For physical injuries, this may include barriers to protect pedestrians or speed bumps (Barach, 2001). PTS disorder after a RTC may have a direct impact on well-being with the potential to influence physical recovery (Holbrook, Anderson *et al.*, 1999). Strategies to control this hazard are necessary and equivalent physical and psychological post-impact care services (European Road Safety Observatory, 2007) must be considered.

This chapter has presented the extent of RTC from a worldwide to a UK perspective and highlighted the public health concerns they raise, although the concomitant psychological problems are often overlooked. Minimisation of crash consequences must focus on psychological responses, at an individual through the development of psychological-healthcare strategies.

CHAPTER 4

Strategic approach to minimising the psychological consequences of road crashes

The previous chapters have presented the public health implications arising from RTCs and the need to develop strategic measures to reduce the burden of crashes by minimising their psychological consequences. The accuracy of current RTC data sources and known PTS risk factors will be reviewed and psychological post-trauma care to engage and support all casualties will be considered.

Introduction

There is growing awareness of the need to establish a systematic approach to psychological post-impact care within the trauma literature. However, previous healthcare strategies have focused more strongly towards severe physical injuries, arising from a range of traumas (Zatzick and Galea, 2007; O'Donnell, Bryant *et al.*, 2008) rather than an RTC specific population or explicit incorporation of social support within such the service model, despite recognition within the literature of its link with PTSD development. Although Zatzick, Roy-Byrne, Russo *et al,* (2004) reported some early benefits of a collaborative stepped-care approach, they failed to fully elaborate on the supportive aspect of this role and its potential to influence recovery. It is also necessary to take a wider perspective on post-trauma healthcare strategies and learn from the good-practice in physical trauma management. Barach (2001) proposed a four-step process to minimise motor-vehicle related trauma.

Whilst his model originally aimed to address physical trauma, such an approach has merit to guide the development of services for psychological trauma after a RTC. Similarly, a strategic approach to service delivery has been recommended by Tarrier and Wykes (2004) for people with psychosis. They used a naval analogy to portray mental health service design, where the service "Platform" for treatment delivery, is as important as the effectiveness of the treatment, termed "Ordnance". Comparing their ideas to Barach's model, the service "Platform" related to step 1 where an accurate understanding of the problem and patterns are required.

“Ordnance” fits with stage 3, involving the development of interventions and countermeasures and stage 4 where interventions are tested in conjunction with the “Platform”. The RTC model needs to target interventions towards people at risk of chronic PTS disorders, which differs somewhat from a psychosis model, where disorder is established. Hence Tarrier & Wykes’ naval analogy did not include the equivalent of Barach’s stage 2, since RTC casualties must be screened to target interventions towards people at elevated risk of disorders. Adapting the naval analogy for RTC casualties, such a screening process could be considered as a “Targeting” stage to enable “Ordnance” to be aimed towards the individuals most likely to benefit.

Utilising this conceptual PlaTO model based upon Platform, Targeting and Ordnance tiers, to develop strategic psychological services for crash casualties required a review of the extant data, to identify areas where further research was necessary to inform the service design.

1. *Magnitude, patterns and accuracy of data (Platform issues)*

Barach’s process demanded accurate data about RTCs, their psychological consequences, demographic patterns and evaluation of the validity of such information (Barach, 2001).

Annual UK, RTC casualty data was published, based on police (STATS19) information. However, concerns have been raised about the data’s accuracy and this requires further investigation before being used to inform a service model. The reported distortions in RTC data (Lyons and Thoreau, 2006) hinder the development of an appropriate service “Platform”. Since flaws have appeared in the national data, closer examination of local information may yield a more accurate picture of the problem. Detailed scrutiny of crash data at a local level could enable greater understanding, evaluation of accuracy and investigation of patterns within police and NHS records.

The prevalence of PTSD after a crash has been estimated at between 10-30% (O'Donnell, Creamer *et al.*, 2008), based on studies of casualties attending emergency departments and treatment seeking. Using the UK police data, regardless of under-reporting suggests that 24,778 - 74,334 casualties may develop PTSD annually.

However, PTS disorder prevalence must be tested in the service localities due to the varied prevalence reported, the acknowledged influence of post-event factors and because studies have generally overlooked other trauma consequences.

2. Identifying Causes, Risks and Modifiers (Targeting issues)

People are largely resilient to even major traumas (Bonanno, 2004) and the majority of RTC casualties will not develop persistent PTS problems (Bryant, 2003). Consequently, Gray and Litz (2005) have cautioned against treating all trauma casualties on ethical grounds. Their view is pertinent, since single and multiple session preventative interventions may have adverse effects for some individuals (Rose and Bisson, 1998; Roberts, Kitchiner *et al.*, 2009).

As PTS disorders cannot be diagnosed immediately after a crash diagnosis cannot occur whilst casualties attend A&E, although predictive screening proximal to the crash may differentiate casualties who will recover spontaneously from those who won't. Development of such screening requires knowledge of factors associated with subsequent PTS disorders. An array of factors has been studied as prognostic indicators (Brewin, Andrews *et al.*, 2000; Ozer, Best *et al.*, 2003). However within A&E only pre-existing and peri-crash predictors were relevant. Peri-trauma biological markers have been studied but were not reliable enough for screening tools (McFarlane, Atchison and Yehuda, 1997; Shalev, Sahar *et al.*, 1998). In a meta-analysis of risk factors (Brewin, Andrews *et al.*, 2000) post-trauma factors such as social support were stronger predictors than pre and peri-factors, suggesting immediate screening may be the least reliable. Whereas peri-trauma reported factors were found to be reasonable predictors in another meta-analysis (Ozer, Best *et al.*, 2003). Alternatively casualties would have to be assessed for PTS disorders after discharge.

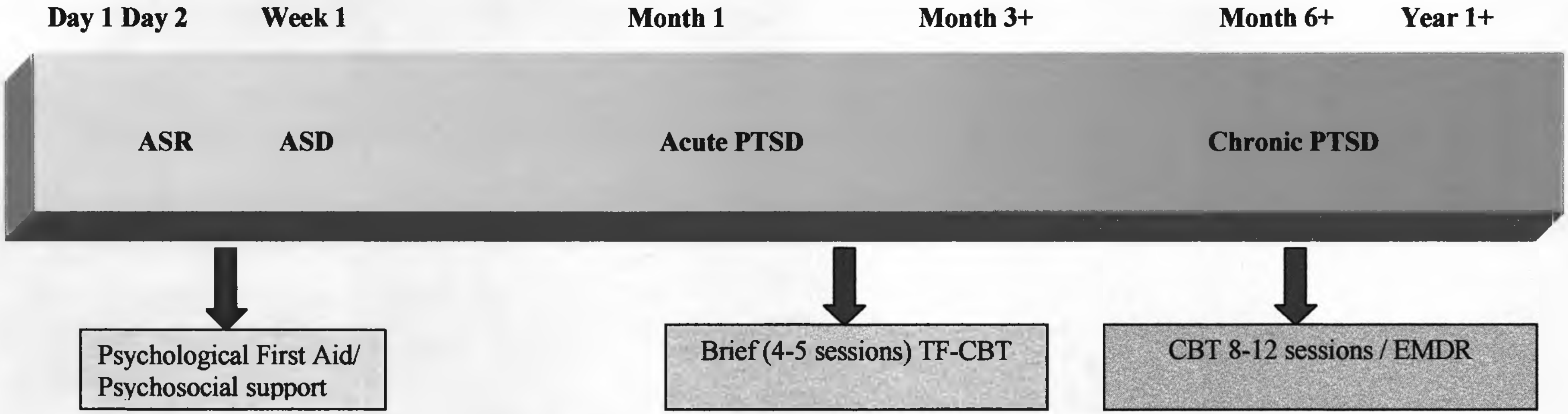
Since PTSD and trauma-related depression cannot be diagnosed until weeks after a trauma, many studies have investigated the predictive value of ASD, which is diagnosable after 2 days (Figure 4). Previous studies have indicated that ASD was strongly associated with subsequent PTSD development (O'Donnell, Bryant *et al.*, 2008), but, there appears to be more than one route to the disorder and many individuals not meeting ASD criteria may subsequently develop PTSD (Bryant, 2003).

Therefore, ASD cannot be used as a single prognostic indicator of PTSD and its merits as a predictor of other PTS disorders are largely unexplored, warranting investigation of additional risk factors. Typically risk factor analysis has included a range of trauma types (Brewin, Andrews *et al.*, 2000; Ozer, Best *et al.*, 2003). As crashes involve a unique interplay of stressors, these may influence the risk of psycho-pathology and exploration of risk in an exclusive RTC population may help to develop a more relevant screening tool.

Alongside risk factor screening, the RTC population size dictates the importance of exploring approaches, capable of modifying trauma consequences. No such approaches are known to operate in the UK for psychological trauma, although physical trauma management protocols have been successful. The WHO considered that 15-50% of the reduction in trauma mortality rates was attributable to the implementation of management strategies (Mock, Lormand, Goosen, Joshipura and Peden, 2004). Nathens, Jurkovich, Cummings *et al* (2000) also found that the introduction of organised trauma-care systems reduced mortality beyond road-safety achievements or demographic changes. Unfortunately, the successful integration and communication between physical trauma services has rarely incorporated mental health services (Zatzick, Roy-Byrne *et al.*, 2004) regardless of the association between physical and psychological trauma (Holbrook, Anderson *et al.*, 1999).

The low status placed on a casualty's psychological needs was highlighted in a study of A&E culture. Low status was attached to patient interaction compared to the performance of technical procedures (Crowley, 2000). Poor support for RTC casualties in A&E, could exacerbate the stress of a traumatic experience, risking the development of sanctuary trauma (Silver, 1985). Better integration and communication between physical and mental health care within A&E may enhance assessment of RTC consequences and reduce the risk of sanctuary trauma. However, in a busy department, which is geared towards the physical repair of high volumes of "walking-wounded", transformation of attitudes and services may be beneficial, but difficult to achieve without embedded protocols.

Figure 4: Timeline for the development and treatment of PTSD and NICE guidance (NICE, 2005)



The most frequent consequence of RTCs is whiplash (Spitzer, Skovron, Salmi, Cassidy, Duranceau *et al.*, 1995; Quinlan, Annest *et al.*, 2004), a condition linked to psychological factors (Mayou and Bryant, 2002; Stirling, Jull *et al.*, 2005). Strategies recommended for the management of WAD such as education, emphasising a return to normal daily activities and the self-limiting nature of the disorder were considered essential by the Quebec Task Force (Spitzer, Skovron *et al.*, 1995) and may be useful to inform services for psychological disorders.

A review of WAD management highlighted the importance of consistent written and oral information, presented to patients as soon as possible after an injury (McClune, Burton and Waddell, 2002). Similar to PTS disorders, it has proved difficult to predict who on initial presentation will develop chronic WAD and Tomlinson, Gargan and Bannister (2005) overcame this in their recommendations to screen patients through A&E follow-up 2-12 weeks later, permitting re-assessment and intervention before chronic physical and psychological patterns have become established. Stirling, Jull, Vicenzino *et al* (2005) recommended that such an assessment explores the interactions between pain, disability, physical and psychological problems and that social and cultural factors are all associated with chronic WAD. If the current difficulties in screening for PTS at the time of the crash cannot be overcome, recommended strategies for WAD management offer a useful guide for the development of a post-impact care strategy.

Social support has already been discussed as a risk factor for PTS disorders and its influence on physical health is well recognised (Unchino, 2004). Social support is a complex construct and an individual's perception of support appears more important than actual support (Solomon, Mikulincer and Hobfoll, 1987). Knowing support is available, even when not utilised, also seems to exert a stress buffering effect (Rohall and Martin, 2008). These studies suggest that availability of support for RTC casualties, eg. through telephone contact or follow-up could buffer against the stress of a crash and thereby, influence recovery. However social support is not a universal panacea. In a study of the elderly, received support was associated with increased mortality, but anticipating support reduced mortality (Krause, 1997), which highlighted that social support was not a benign intervention. Gender differences exist in support patterns (Fuhrer and Stansfeld, 2002) with men recognised to value practical support and obtain emotional support through a few close relationships.

Women appear to more strongly value emotional support and obtain it from extended networks. Therefore, social support provision may need to encompass a gendered perspective and its impact on health must be carefully analysed. Despite the literature linking social support and PTSD (Litz, Gray, Bryant and Adler, 2002) it is often overlooked within therapy (Tarrier and Humphreys, 2003). The potential to influence the psychological impact of a RTC through social support is encouraging, but thorough investigation is required to establish the timing and type of support which is most effective for crash casualties as Joseph (1999) recommended practical support is more important during the initial recovery and emotional support is valued later.

In the absence of a single causative route, targeting of services towards those most in need demands either waiting until disorders emerge, or being able to conduct a predictive assessment immediately after a RTC. Currently predictive screening is not sufficiently accurate for clinical purposes. Through further investigation of risk factors within a specific trauma group, it may be possible to improve screening procedures and increase the prediction of disorder. Accurate early prediction of psychological disorder could permit targeted implementation of early intervention to minimise RTC consequences.

Increased awareness and the provision of social support within A&E may also prove beneficial for RTC casualties. Social support provision and psychological screening of casualties must be tested within an A&E department, so that lessons can be learnt about both the effectiveness and practicalities of operating within such an environment.

3. Developing interventions and countermeasures (Ordnance Issues)

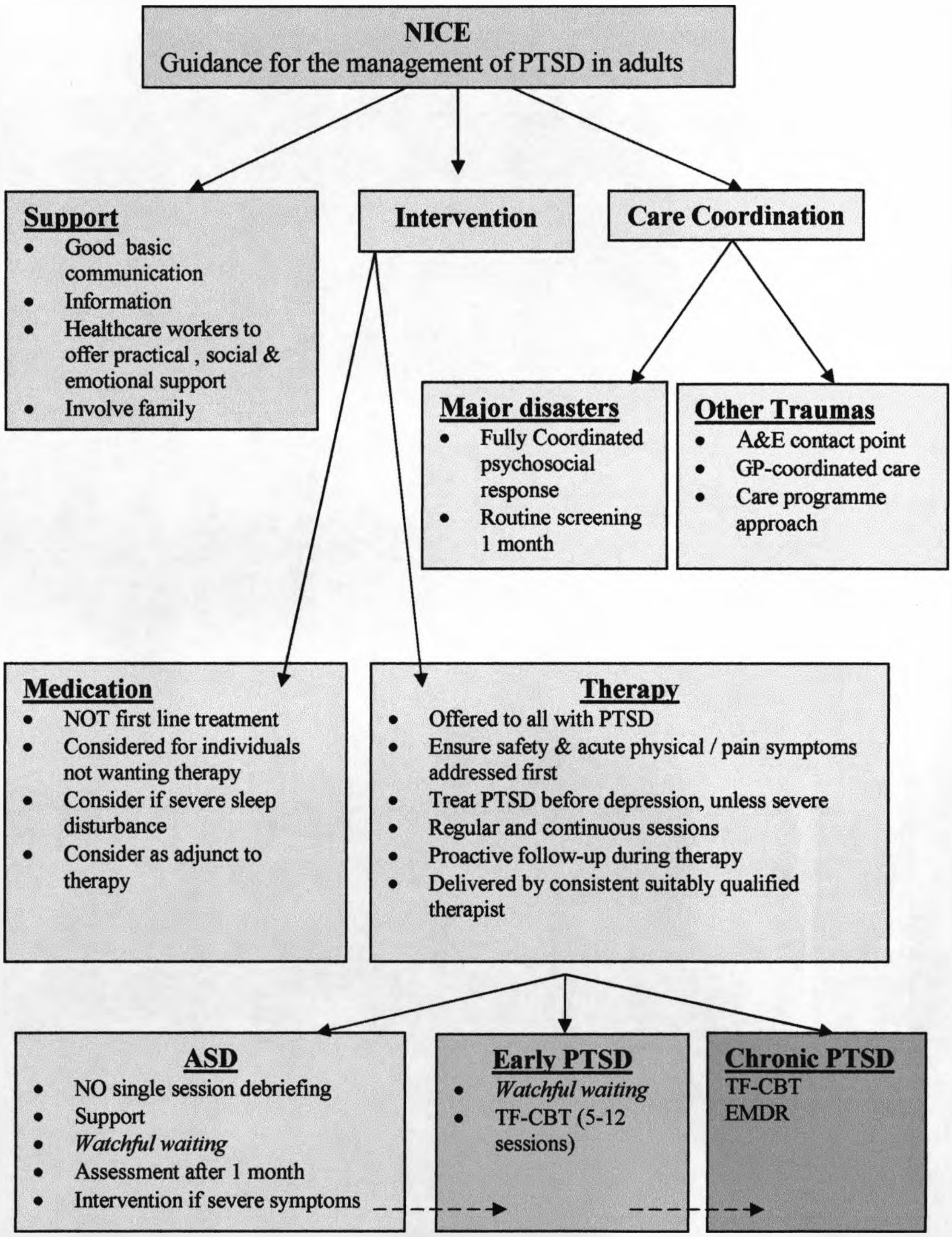
Within the UK, the National Institute for Health and Clinical Excellence (NICE) developed guidelines for patients, professionals and the public, whilst aiming to ensure the health service is patient-centred and that any variation in quality and provision is minimised (NICE, 2005).

The systematically developed clinical practice guidelines aim to:

Provide up to date evidence based information about the treatment of specific clinical conditions for healthcare professionals
Set standards to assess healthcare practice
Assist patients to make informed decisions about their treatment and care

(NICE, 2005)

Figure 5: Schematic outline of key guidance for PTSD management (NICE, 2005)



Clinical Practice Guideline 26 (NICE, 2005) addresses the management and treatment of PTSD and provides evaluation of both clinical and cost effectiveness. This guideline identified RTC casualties as a group with high risk of PTSD. The key guidance points are detailed in Table 1 and Figure 4 can be considered in terms of immediate, early and later interventions, corresponding with the diagnostic timeline (Figure 4).

Immediate Interventions

Immediately following a major disaster, NICE guidance stipulated that authorities should implement protocols for screening individuals and supporting their longer-term psychological management.

The guideline recommended that the plans should include "psychological first aid" for all, although its content and strategic provision is not defined. Roberts Kitchiner, Kenard *et al*, (2009) define it as basic comfort and information, together with emotional and practical support. During the first month a process of "watchful waiting" was recommended (Table 1), which involves active surveillance for emergent problems through repeated assessment. The merit of social support was recognised but guidance for its delivery was not included. In contrast to survivors of major disasters, no structured pathway was recommended for "everyday" traumas which may leave such casualties vulnerable to individual variations in healthcare responses and the ability to self-refer.

Early Interventions

This is a developing area of trauma research. Studies conducted in this area usually address the emergence of PTSD, or aim to treat acute PTSD, although a few studies have also addressed post-trauma depression (O'Donnell, Bryant *et al.*, 2008). The NICE guidelines investigated two aspects of early intervention; treatment for all and targeted therapy.

The treatment for all group included preventative interventions such as education, collaborative care, pharmacotherapy and debriefing. Educative interventions, whilst intuitively useful, did not have a clinically significant impact on PTSD amongst assault victims, when delivered face to face (Rose, Brewin, Andrews and Kirk, 1999) or on PTSD and depression, when offered as a self-help booklet to accident casualties (Turpin, Downs *et al.*, 2005).

Table 1: Selected key NICE recommendations for PTSD

A	The response to a major disaster should involve health and social services in the provision of immediate practical help, community support, access to specialist mental health evidence based assessment and treatment services	(11.10.1.1)
B	Following a major disaster, individuals at risk should be screened for PTSD after one month	(11.2.3.1)
C	Single session, individual debriefing should not be offered routinely	(11.9.1.3)
D	For other types of trauma, opportunities for recognition of the disorder should occur during routine healthcare interventions for physical treatments within a primary or general hospital setting	(11.3) (11.3.2)
E	Healthcare staff in primary care teams, emergency departments, plastics and orthopaedic clinics should be aware of PTSD associated with traumas	(11.3.1.2 &11.3.2.1
F	Within primary care GPs should take responsibility for the assessment and coordination of care for PTSD sufferers	(11.4.1.1)
G	Healthcare professionals should provide information, practical advice on accessing appropriate services and facilitate the provision of social support	(11.6.1.1)
H	Watchful waiting and follow-up contact should be used to manage mild problems within the first month	(11.9.1.1)
I	All PTSD sufferers should be offered a course of individual psychological treatment regardless of the time lapsed since the trauma	(11.9.2.1) (11.9.2.2)
J	People with severe PTSD symptoms in the first month should be offered trauma focused CBT	(11.9.1.4)
K	Trauma-focused CBT should be offered to people who present with PTSD within 3 months of the event	(11.9.1.5)
L	Trauma-focused CBT should be, delivered by the same person, on a weekly basis, for 8-12 sessions although 5 may be adequate if delivered within the first month	(11.9.1.6)
M	Treatment should be delivered by competent and appropriately trained individuals	(11.8.1.6)
O	In cases of comorbid depression and PTSD, professionals should consider treating the PTSD first	(11.8.2.1)

However, a study offering collaborative care through individual case-managers found beneficial effects in terms of depression and PTSD (Zatzick, Roy-Byrne, Russo, Rivara, Koike *et al.*, 2001), although this difference was lost by four months. Two different early drug treatments were investigated, but no conclusive evidence emerged. Critical Incident Debriefing (CID) was originally described by Mitchell and Everly (1995) as a single supportive group intervention delivered in the immediate aftermath of an event. Debriefing studies with varied approaches, taking place after a range of incidents, including RTCs were examined. The evidence suggested that CID was unlikely to be clinically effective at preventing PTSD and therefore was not recommended for routine practice (NICE, 2005).

None of the included studies fully adhered to Mitchell and Everly's (2000) CID programme. A subsequent Cochrane review of multiple session preventative interventions again found no difference between treatment and control groups (Roberts, Kitchiner *et al.*, 2009). Concerns have been raised following reviews of the effectiveness of CID (Wessely, Rose and Bisson, 1998; Van Emmerik, Kamphuis, Hulsbosch and Emmelkamp, 2002) with the suggestion that it may increase trauma symptoms in some individuals (Bisson, Jenkins, Alexander and Bannister, 1997; Wessely, Rose *et al.*, 1998; Roberts, Kitchiner, Kenardy and Bisson, 2009)

The notion of being able to prevent PTS disorders is compelling and the public have come to expect counselling or support after a traumatic event. However, at present, there is insufficient evidence to endorse CID for all casualties and evidence indicating deleterious effects for some. However the guidelines recommend practical and emotional support (Figure 5). Despite non-significant outcomes, education was also recommended for good clinical practice. Since the armoury to prevent PTS disorders was not viable, then targeted early intervention was the next option to minimise RTC related trauma. Such intervention must operate in tandem with a screening system to satisfy the ethical concerns about exposing all casualties to the risks of intervention, when some may recover unaided (Gray and Litz, 2005).

NICE evaluated nine studies including five different types of early interventions, which were either trauma-focused (TF) or generic and all had a TF-CBT trial arm (NICE, 2005). TF-CBT typically included psycho-education, imaginal reliving, reversal of avoidance and cognitive-restructuring (Ehlers and Clark, 2003).

NICE recommended that generic interventions eg relaxation should not be offered routinely, although evidence supported TF-CBT within 6 months of a trauma, for people at risk of chronic PTSD. Evidence supporting TF-CBT for casualties with severe symptoms within the first month and for everyone presenting with PTSD within three months, was identified (NICE, 2005). Whilst 8-12 sessions were recommended, they suggested 5 sessions may be sufficient, when offered early and were more cost-effective than waiting. A subsequent meta-analysis of multiple-session early intervention (Roberts, Kitchiner *et al.*, 2009), found TF-CBT to be the only therapy with credible evidence supporting its efficacy. Individuals with a PTS diagnosis were the most likely to benefit from TF-CBT, so its delivery should be limited to people with established ASD or PTSD. However, Ehlers and Clark (2003), in a review of early intervention, reported TF-CBT was effective for reducing anxiety and depression.

Overall these studies provided evidence that early provision of TF-CBT may reduce some PTS disorders. None of the TF-CBT interventions have specifically integrated aspects of social support within their sessions, despite the evidence linking it to PTSD development (Brewin, Andrews *et al.*, 2000; Ozer, Best *et al.*, 2003). Given the paucity of social support within existing CBT protocols (Tarrier and Humphreys, 2003) and within TF-CBT (Litz, Gray *et al.*, 2002; Roberts, Kitchiner *et al.*, 2009), its integration into trauma treatment could increase efficacy, engagement and compliance (Roberts, Kitchiner *et al.*, 2009). How to embed social support within emergency service responses and TF-CBT must be considered to reduce the psychological impact of crashes.

Later Interventions

Psychological interventions for chronic PTSD were reviewed by meta-analysis (NICE, 2005). The analysis supported offering all individuals with chronic PTSD 8-12 sessions of TF-CBT. Eye Movement Desensitisation and Reprocessing (EMDR) (Shapiro, 1999), was also recommended, but the evidence was weaker.

For RTC casualties with physical injury and chronic pain outcomes were poorer (Taylor, Fedoroff, Koch, Thordarson, Fecteau *et al.*, 2001; Gillespie, Duffy, Hackmann and Clark, 2002). Therefore, clients with complex pathology such as pain, disfigurement or permanent injury, such as RTC casualties, may require more intervention as part of a broader care plan (NICE, 2005). Brief early interventions may also need to be extended, particularly since pain and injury can still be acute in the first months after a crash.

After a traumatic experience, depression and anxiety can occur independently or comorbidly with PTSD, but unfortunately few intervention studies have addressed non-PTSD disorders. The NICE guidelines suggests treating PTSD first in cases of comorbid depression (NICE, 2005), whereas Ljubicic, Peitl, Peitl *et al* (2009) suggested the two disorders should be addressed simultaneously.

NICE Guideline 23 provided depression specific recommendations (NICE, 2007). A "stepped care" approach was recommended, in which the intensity of intervention was responsive to symptom severity and individual circumstances (Bower and Gilbody, 2005). The first step is "watchful waiting" involving assessment and reassessment within two weeks. Intervention for individuals, who don't respond to lower intensity input, is then stepped up to more intensive intervention, with guided self-help and 6-8 sessions of CBT. This stage is broadly consistent with recommended early PTSD intervention. The third step entails pharmacological management, together with 6-9 months of CBT (NICE, 2007), which is congruent with treatment for complex PTSD. A similar stepped approach to intervention is also recommended in Guideline 22 for disorders such as general anxiety disorder and panic disorder (McIntosh, Cohen, Turnbull, Esmonde, Dennis *et al.*, 2004). NICE guidelines for depression and anxiety, offer broadly similar recommendations to those for PTSD. Whilst not specified in Guideline 26, Roberts et al (Roberts, Kitchiner *et al.*, 2009) proposed that delivery of TF-CBT should also form part of a "stepped-care" system in which post-trauma screening could enable timely access to appropriate early intervention.

NICE recommendations for PTSD applied to all types of traumatic events, although protocols ensuring a coordinated response including advice, screening and early psychological intervention were only detailed for major events. Hence, access to support would be determined by the scale of the event rather than the subjective experience of survivors. Large-scale major disasters resulting in multiple death and injury, such as transport disasters or bombings are fortunately relatively rare in the UK and only account for a small percentage of accidental deaths and injury each year, whereas RTCs constitute a large group at risk of PTSD with such everyday traumas resulting in significant personal and societal costs (Chan, Air and McFarlane, 2003). Healthcare services are expected to incorporate trauma assessment and treatment within routine care (NICE, 2005).

However, the recognition of trauma symptoms amongst clinicians has been questioned (Green, McFarlane *et al.*, 1993; Liebschultz, Saltz, Brower, Keane, Lloyd-Travaglini *et al.*, 2007). The lack of clearly defined care-pathways for monitoring PTS disorders amongst RTC casualties could hinder access to timely intervention. If the psychological consequences of everyday traumas, such as RTCs, are to be minimised, then strategies to deliver a coordinated response must be investigated without which inequitable trauma pathways that discriminating between "Everyday Disasters" and "Major Disasters" may merge. However the cost effectiveness of early treatment for posttraumatic stress, was established irrespective of the event's scale (NICE, 2005).

The guidelines are intentionally informed by quantitative research outcomes that permit inferences about the trauma population and potential treatment responses. A drawback of this approach is that they limit the portrayal of the extent of an individual trauma, the attendant healthcare response and the process of therapy for individuals. Furthermore, everyday traumas are inherently less "newsworthy" and are therefore less evident within the media (Harrabin, 2002). The quantitative focus of research, together with limited media coverage, can reduce awareness amongst the public and researchers about this public health concern. Portrayal of an individual's crash and its aftermath may additionally inform development of service models and enable engagement of a wider audience into the public health issues associated with RTCs.

4. Implement change and test effectiveness

The clinical guidelines for PTSD, depression and anxiety provide an evidence-based guide to their management and treatment, but, they failed to recommend healthcare pathways to ensure timely assessment and intervention occurred following everyday traumas. Considering the RTC population size and potential risk of PTS disorders, it is essential that a robust service platform is *in situ* to guide healthcare responses. Further investigation must be undertaken to establish accurate knowledge of the RTC population and the prevalence of PTS following a crash, to inform the development and organisation of a therapeutic platform. It is then necessary to test the effectiveness of both platform and ordnance within a naturalistic setting, since they must operate synergistically to achieve optimal impact (Tarrier and Wykes, 2001).

The review has demonstrated that there is a need within a RTC trauma service to identify people that may develop PTS disorders, so that resources can be appropriately targeted.

Delivering early TF-CBT demands screening strategies to either predict risk or monitor psychological symptoms in the few months after a trauma. For everyday traumas, such as a RTC, providing timely access to social support and therapy requires further research to investigate readily measureable predictive factors associated with subsequent PTS disorders.

This chapter has proposed that the scale of posttraumatic stress disorders following RTCs necessitates a strategic approach to the problem. The PlaTO model has been proposed and existing evidence reviewed in the context of the three tiers of the model. To develop the PlaTO model further accurate RTC data is vita. Additionally an individual's crash experience must be explored, risk factors identified, and the feasibility of delivering intervention that integrates social support within the recommended TF-CBT tested.

CHAPTER 5

Methodology

This chapter will discuss several connected research studies needed to inform the three defined tiers of the model. The rationale for the chosen modes of enquiry and research study designs will be placed within the context of research methodology.

Research Purpose

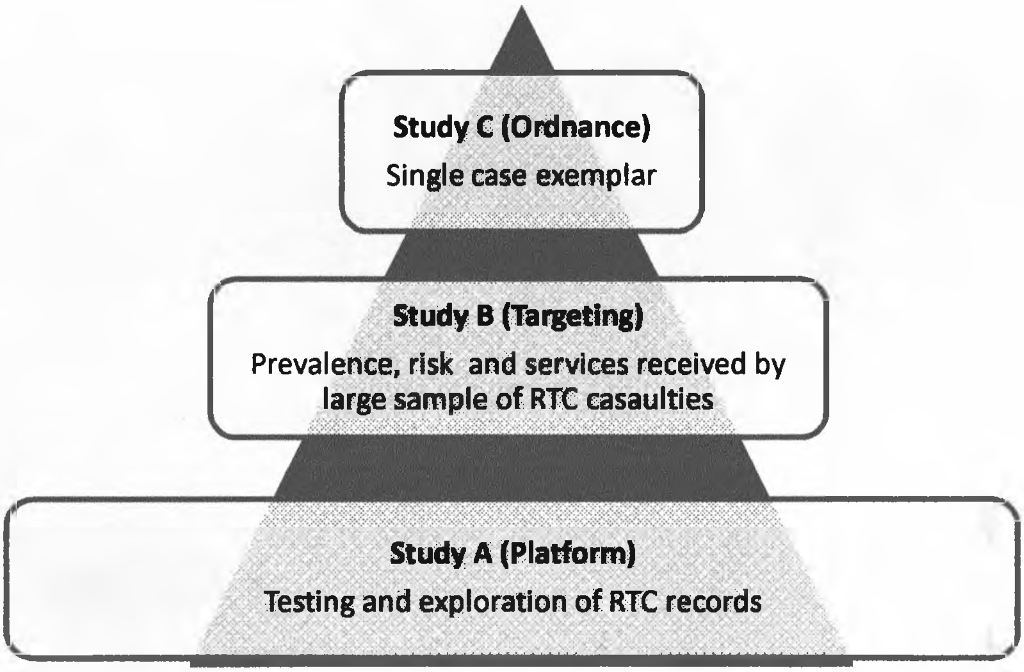
This research study was conducted to address the identified limitations of existing knowledge about the RTC population, the risk of PTS disorders and delivery of early psychological interventions following a crash. Without addressing the limitations of existing research, the development of PlaTO as a strategic model would have been ill-informed and not routed within the principles of evidence-based practice (Sackett, Gray, Haynes and Richardson, 1996).

The aim of the proposed PlaTO model is to minimise the psychological consequences for the road crash population. To achieve this, it was imperative that an understanding of RTCs and their consequences were established at multiple levels so that integration of the outcomes from the research studies led to the final model. Development of existing knowledge and understanding the psychological impact of RTCs from a national to an individual level required diverse avenues of enquiry. A multi-method study (Robson, 2002) was required to inform the PlaTO model at both a macro and micro-level, since focusing only on the cumulative impact of crashes would not provide sufficiently detailed understanding of the impact for individuals. Therefore, different research approaches, designs and methods were essential and led to the development of a series of interrelated, but distinct studies. This meant that the study capitalised on the ability to statistically analyse and generalise some results, , whilst gaining a deeper insight into the impact of crashes made possible through small-scale research (David and Sutton, 2004).

Three studies, represented by a pyramidal design (Figure 6), were conducted and linked to specific tiers of the model facilitating a macro to micro understanding of RTCs. Large data sets were necessary to address the broad concerns about the RTC population and their consequences (Study A), central to the platform studies. The second tier addressed psychological risk factors and crash consequences (Study B). Study B required a participant sample to obtain personal information.

The third aspect of the study (Study C) required exploration of an exemplar case and the delivery of a novel ordnance within a routine clinical setting.

Figure 6: Pyramid Research Design involving three linked research studies



Research Aims

Consistent with the study purpose to guide the development of a service model, aims were developed for each study congruent with the limitations within existing research.

Study A Rationale:

Accurate information about RTC incidence and demographics were essential to estimate the prevalence of PTS disorders each year in the UK (Barach, 2001). The UK Police record RTC details and although these are used to inform government policy, their accuracy has been questioned (Lyons and Thoreau, 2006). Therefore the validity of this data must be tested, as a basis to inform a service platform.

Purpose:

The purpose of Study A is to test the accuracy of existing police records and investigate the demographic patterns of RTC casualties, their physical and psychological injuries and healthcare received, to inform the development of the service platform.

Lines of Enquiry

From the stated purpose of Study A, the following specific lines of enquiry (A1-5) were established and used to guide the research method.

A1) Question: How were road crashes & their impact recorded by the Police and NHS in the UK?

A2) Hypothesis: Police RTC data (STATS19) correctly recorded the total number of people injured annually in a road traffic crash.

A3) Question: What were the demographic patterns of the RTC population?

A4) Question: What was the prevalence of psychological distress amongst RTC casualties?

A5) Question: What treatment and follow-up services did RTC casualties receive?

The outcomes of these studies provided data to guide the design of Study B.

Study B Rationale:

Studies from the UK and other developed countries consistently report that a proportion of individuals develop PTSD (Holeva, Tarrier *et al.*, 2001; Mayou, Ehlers and Bryant, 2002; Bryant, Duckworth *et al.*, 2008), but the emergence of other psychological disorders is less recognised (O'Donnell, Bryant *et al.*, 2008). Previous studies have indicated an association between initial levels of distress after a traumatic event and the subsequent development of PTSD (Shalev, Freedman, Peri, Brandes, Sahar *et al.*, 1998). However, the results of Study A suggested that RTC casualties may be more resilient to trauma than previously reported demanding investigation to directly determine the prevalence, of PTS disorders amongst RTC casualties.

Following exposure to major disasters, monitoring should occur to ensure early identification and treatment (NICE, 2005). Due to the scale of RTCs and the limited follow-up identified within Study A, it was necessary to evaluate the feasibility of screening casualties whilst they attended A&E, so that the PlaTO model could provide a similar healthcare process for RTC casualties.

Predictive screening within A&E had to rely on pre and peri-trauma risk factors, since most casualties only attended once, on the day of the crash. Gender differences in distress were noted in Study A and previously recognised within the literature (Berberich, 1998; Brewin, Andrews *et al.*, 2000; Freedman, Gluck, Tuval-Mashiach, Brandes, Peri *et al.*, 2002). Given the elevated physical vulnerability (Evans, 2004) and reported psychological vulnerability of women (Norris, Foster *et al.*, 2002), the impact of RTCs also required investigation from a gendered service-perspective (Berberich, 1998).

The PlaTO model was only essential if existing healthcare did not address the psychological needs of RTC casualties. Therefore, further research was necessary to determine whether timely psychological services were received by RTC casualties with PTS disorders, in order to decide if further development of the PlaTO model was justified.

Purpose:

The purpose of the study was to establish a more detailed understanding of the psychological and functional impact of a RTC and through investigation of the prevalence of PTS disorders, associated risk factors and consequences of a crash, evaluate whether a Targeting process within the proposed PlaTO model was necessary or feasible.

Lines of Enquiry

From the stated purpose of Study B the following specific lines of enquiry were established and used to guide the study design.

What was the prevalence of PTS disorders following a RTC?

What predictive factors were associated with PTS disorders following a RTC?

What were the consequences of a RTC?

Were there gender differences in the prevalence of PTS disorders, predictive factors and consequences of a RTC?

The implementation of these studies yielded data that was used to justify and inform the overall design of the PlaTO model.

Study C Rationale:

The previous studies aimed to investigate RTCs through large samples. Taking this "grand tour" approach offered insight into the scale of the RTC population and prevalence of psychological and functional consequences for casualties. The limitation of such a nomothetic approach lies in depersonalising the individual impact of a crash. It was imperative that the PlaTO model was informed by both the nomothetic and idiographic impact of a crash and particularly how a RTC impinged upon a casualty's daily life and social support.

The delivery of early psychological intervention was reliant upon recognition of PTS disorders amongst healthcare professionals, triggering "psychological first aid", monitoring and promptly referring to specialist services for intervention. The healthcare information available for examination in Study A and B necessitated a more detailed exploration of casualties' healthcare pathway, to determine whether PTS disorders were appropriately recognised and timely support and intervention initiated, since barriers to their recognition have been reported (Liebschultz, Saltz *et al.*, 2007).

Evidence-based practice (EBP) involves using the best quality research evidence, to assist clinicians make judicious intervention decisions for specific patients (Sackett, Gray *et al.*, 1996). NICE offers evidence-based advice to guide clinicians in such decision making. They recommended that individuals with PTSD should receive TF-CBT within three months of the trauma (NICE, 2005). CBT was also recommended for the treatment of established depression and anxiety through a stepped-care approach (McIntosh, Cohen *et al.*, 2004; NICE, 2007). However, their guidelines emerged from multiple clinical trials, grounded in a nomothetic approach (Bullock and Trombley, 2000), which inherently masked individual differences. Although large scale randomised controlled trials rank highly (Sackett, Gray *et al.*, 1996) and are considered the "gold standard" for testing the effectiveness of interventions, they have been criticised for their lack of ecological validity and application to real-world clinical practice (Horn and Gassaway, 2007). Furthermore, such trials aim to establish the average response to treatment, whereas casualties possess idiosyncratic features that influence therapy outcomes (Barlow, 2007).

Whilst the hierarchy of evidence affords case-studies a low rank (Sackett, Gray *et al.*, 1996), it is at this individual level that practitioners and clients judge the validity and success of therapy.

Clinicians are constantly called upon to bridge the gap between the nomothetic perspective of empirically grounded interventions and an idiographic perspective towards their client (Barlow, 2007). Beutler, Williams, Wakefield *et al* (1995) called for strategies to bridge the communication divide between clinical-scientists and practitioners. Case-study research offers such a strategy, which is particularly important within the diverse discipline of traumatology and "spans all levels of human functioning" (Linley, 2003 p601). In areas as broad as trauma and RTCs specialists from a range of disciplines and the public require an accessible route to address the pertinent issues from Study A and B. Case studies offer accessible communication tools to illustrate complex issues (Yin, 2003) to a broad audience, thereby enabling participation in the discourse around the public health concerns of PTS disorders after crashes.

Although NICE recommend CBT for the treatment of PTS disorders, such interventions have been criticised for the lack of explicit assessment and integration of social support within therapy (Tarrier and Humphreys, 2003). Others have also recommended the inclusion of social support within early trauma intervention (Litz, Gray *et al.*, 2002; Roberts, Kitchiner *et al.*, 2009), since social support appears to buffer against stress (Cohen and McKay, 1984) and poor support was associated with PTSD in a meta-analysis of risk factors (Brewin, Andrews *et al.*, 2000). Whilst Study B assessed a range of aspects of social support, it was essential to determine the feasibility of integrating it within the recommended brief TF-CBT intervention. The explicit integration of social support within TF-CBT constituted a novel intervention (TF-CBT^{SS}), so it was ethically imperative to test it initially using single instance research, which importantly enabled its evaluation within a realistic clinical setting (Aldridge, 2005). Turpin (2001) reminded researchers how well described case studies have been pivotal in the development of psychotherapy. They have significantly contributed to the understanding of trauma and the development of existing treatments within traumatology (Lovell, 1991; Basoglu, Marks and Sengun, 1992; Blore, 1997; Weaver, Nishith and Resick, 1998; Bisson, 2008).

Research case studies must explore the interplay between theoretical expectations and concerns within the clinical context of an individual through a process of rigorous systematic evaluation (Sim and Wright, 2000; Kazdin, 2007). Although in terms of EBP, case-studies cannot offer strong evidence or indicate future practice, they offer ready translation to clinical practice (Aldridge, 2005) and involve people like routine patients.

In contrast randomised controlled trials require homogeneous patient groups and trial participants that can be unrepresentative of typical patients (Wessely, 2002). Therefore, a research case-study provided an opportunity to understand the impact of a crash and the healthcare response for a "typical" patient, whilst examining the therapeutic process and merit of a novel intervention with the aim of enhancing the recommended therapy and informing the development of the proposed PlaTO model.

Purpose:

The purpose of Study C was to investigate the impact of a RTC for an individual with PTS disorder, the response of the healthcare service, risk factors for PTS disorders and evaluate the feasibility and effectiveness of incorporating social support into brief TF-CBT (TF-CBT^{SS}), through a process of disciplined enquiry.

The study was also conducted to inform a diverse audience about the impact of a RTC and evaluate the delivery of a novel intervention to inform the Ordnance aspect of the proposed PlaTO model.

Lines of Enquiry:

From the stated purpose of Study C the following specific lines of enquiry were established.

C1) Question: What was the impact of a RTC for a casualty who developed PTS disorder?

C2) Question: What healthcare did a casualty with a PTS disorder receive after discharge from A&E?

C3) Question: Were the predictive risk models from Study B consistent with those reported by a casualty with a PTS disorder?

C4) Null Hypothesis: A brief TF-CBT^{SS} intervention was not effective in reducing symptoms of PTS disorders

Modes of Enquiry

Aggregation of the outcomes from Study C with Studies A and B informed the development of the three tiers of the proposed PlaTO model (Figure 8).

Before conducting these studies detailed consideration was given to the requisite methodology and design of each study. Firstly consideration was given to the qualities of different philosophical approaches to research and their relevance to the purpose of this research. Sim and Wright claim that without understanding the epistemology of research, such investigation can

"...fall foul of a number of conceptual and logical shortcomings and inconsistencies, and will consequently fail to achieve its intended purposes." (Sim and Wright, 2000 p8)

There are two modes of enquiry commonly encountered in research; quantitative and qualitative. Whilst it is argued that at a data level there may be little difference, there are fundamental philosophical differences (Trochim, 2000). Quantitative research is grounded in the philosophical arena of positivism (Robson, 2002), with the epistemological assumption of a single objective reality that exists independently from an individual's values and perspectives (David and Sutton, 2004).

This stance is termed "value neutrality" (Sim and Wright, 2000). Within quantitative research the researcher is the discoverer of that objective reality, without personal interference, whereas within qualitative research, their role is to understand the entirety of the participants' perspective within their unique context (Sim and Wright, 2000). Another key assumption in quantitative research is that knowledge must be based on the collection of factual (quantitative) information to ensure "value neutrality". Consequently, a positivist empirical line of enquiry requires the collection of numerical or quantifiable data to test hypotheses and explore the causal relationships between variables.

Study A needed to test the accuracy of existing numerical data through empirical enquiry in a manner that required "value neutrality" and fitted within a quantitative approach. Study B aimed to assess prevalence through the collection of numerical data and investigate relationships between risk variables, consequence variables and prevalence. Hence Study B similarly fitted within a quantitative paradigm. The purpose of Study C was to undertake an exploration of the idiosyncratic impact of a crash, using an exemplar case study, and to test the feasibility of integrating a social support component into a brief psychological intervention. A case-study can involve qualitative or quantitative research. A qualitative phenomenological approach would permit exploration of crash phenomenon (Trochim, 2000), but was not appropriate for testing the effectiveness of an intervention.

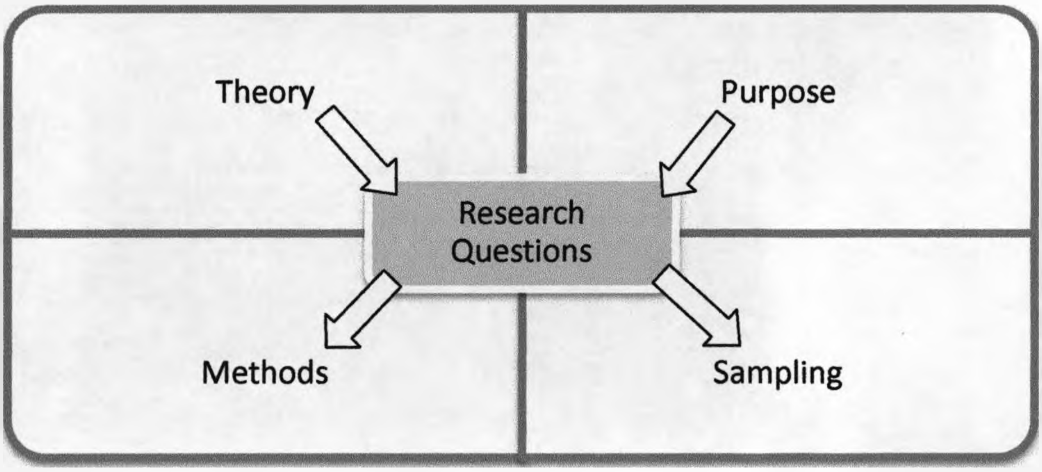
Quantitative methods offered objectivity in the evaluation of therapy outcomes (Turpin, 2001), congruent with Peterson's call for scientific rigour (Peterson, 1991). Although Study C aimed to portray the impact of a specific crash as an exemplar, comparison of the exemplar with participants in Study B was also important, requiring the comparison of quantifiable measurements between studies. Evaluating the impact of therapy similarly required psychometric assessment to determine pre-post intervention changes. Hence a quantitative mode of enquiry was selected to guide the study design.

Deductive approaches involving the testing of theories or exploration of "cause and effect" are often of concern within the social sciences. Popper was critical of the scientific rigor of some empirical methods, (Popper, 2002). Instead Popper advocated a "critical rationalistic" approach (Sim and Wright, 2000), wherein the scientific status of a theory was based upon its falsifiability, refutability or testability (Popper, 2002). Therefore, the research process should endeavour to test and refute the theory rather than seek to confirm it. Such a hypothetico-deductive research model enables the rejection, modification or acceptance of pre-conceived theories (David and Sutton, 2004) essential within social sciences to ensure the quality of quantitative research, avoiding the hazards of inductive processes (Popper, 2002).

Research Design

The framework of the research design for each study was informed by Robson's model (Robson, 2002), in which theory and study purpose inform the research questions and guide the selection of methods and sampling strategies (Figure 7).

Figure 7: Robson's Research Design Model



Research Ethics and Legal Considerations

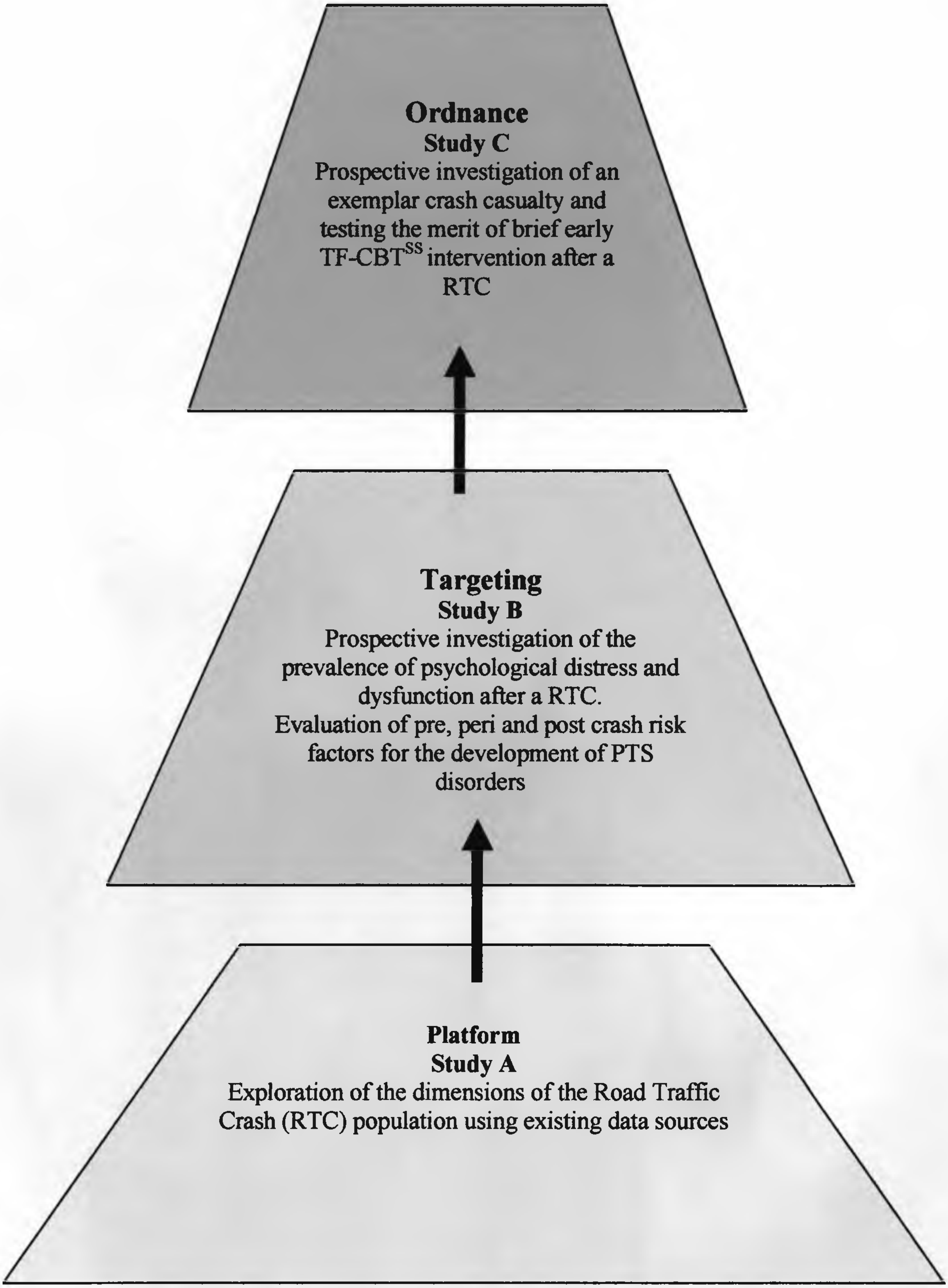
A limitation of Robson's model arises since ethical considerations are not explicit within the design framework. Researchers, especially clinical researchers, have a social and moral responsibility to conduct their work with meticulous attention to ethical concerns. That responsibility involves the execution of methodologically rigorous studies, with the potential to contribute to the advancement of society and protect participants from harm (American Psychiatric Association Task Force on Research Ethics 2006). Ensuring that research conforms to the ethical principles of respect, beneficence and justice (Smith, 2001) must be central to the design of all research. Within this research study, ethical concerns were fundamental to the design, since the research involved hospital records and human participants. Access to human information is usually regulated via the Data Protection Act (1998) or within the NHS falls under the jurisdiction of a Caldicott guardian (Caldicott Review 1997), whereas studies that require the involvement of NHS participants need authorisation from the local research ethics committee.

Study design summary

The overall research project was designed to balance the need to develop a broad and in depth understanding of the extent RTC casualties were affected by a crash. This resulted in a "pyramid-shaped design" (Figure 6), with three separate research studies each built upon the results of the preceding one to achieve the overall research purpose and assist in the design of the Platform, Targeting and Ordnance (Figure 8) aspects of the PlaTO model. The methodological approach adopted was shaped by due consideration of ethical principles, in view of the nature of the data required and an endeavour to maximise the research quality, whilst minimising the demands placed on participants. This resulted, wherever possible, in the use of extant information, minimising the intrusion for participants through self-report questionnaires and a double consent process, to ensure valid consent was obtained for Study C, whilst promoting maximal participation in Study B. An overview of the resultant process is given in Figure 8, whilst the rationale for the resultant design for each study is specified within the individual studies.

This chapter has presented a research study to inform the proposed PlaTO model. The rationale for undertaking three individual linked studies to achieve the overall research purpose has been discussed. Research theory and ethical considerations strongly influenced the finalised design of the sequential studies.

Figure 8: Flow Diagram of whole research project to inform the PlaTO model



CHAPTER 6

Study A: Methods and Results

This chapter describes the methods and reports the results from Study A, undertaken to increase understanding of the existing sources of RTC information, patterns of road crashes and their consequences to guide the development of the Platform within a proposed strategic model. Study A consisted of a sequential series of studies. The methods and results will be presented in sequence, to direct the reader chronologically through the research process.

Study A Purpose (Platform Issues)

The overall purpose of Study A was to test the accuracy of existing RTC datasets and investigate demographic patterns, injuries sustained and healthcare delivered to RTC casualties, in order to inform the development of a service platform.

Design Considerations

Following Robson's model (Robson, 2002) appropriate methods and samples to achieve the intended outcomes were identified and the design took into account legal and ethical requirements for NHS patient information .

To maximise understanding about RTCs and achieve the stated aims of Study A (A1-5), both breadth and depth of information about crashes and their consequences was essential. To collect such diverse data from different sources, a series of distinct, but related research studies were developed, with the outcomes informing the design of the subsequent study. Study A required investigation of multiple data sources, as there was no single extant source of information. A mosaic impression of the RTC population and their consequences had to be developed, informed by outcomes from five studies. The studies involved the collection and analysis of data obtained from a national to a local level from selected samples.

Method Considerations

RTC statistics are published annually by the UK Police (STATS19), as are the NHS's Health Episode Statistics (HES). Investigation of these extant data sources was necessary to establish a picture of RTCs and their consequences.

Evaluation of the consistency and accuracy of the recorded information was achieved through comparisons between data sources. As HES records did not include A&E data, the information had to be obtained directly from the departments.

As extant data was required, a non-experimental study was appropriate and a series of cross-sectional surveys involving A&E departments was adopted with the detail obtained increased sequentially as Study A progressed. Data from consecutive years was collected to avoid the typical distortions that can occur due a single time measurement (Fife-Shaw, 2000). However, when scoping the research, feasibility tests demonstrated that it was not viable to conduct a population census (Trochim, 2000) from every hospital. Therefore, sampling of the target population was necessary.

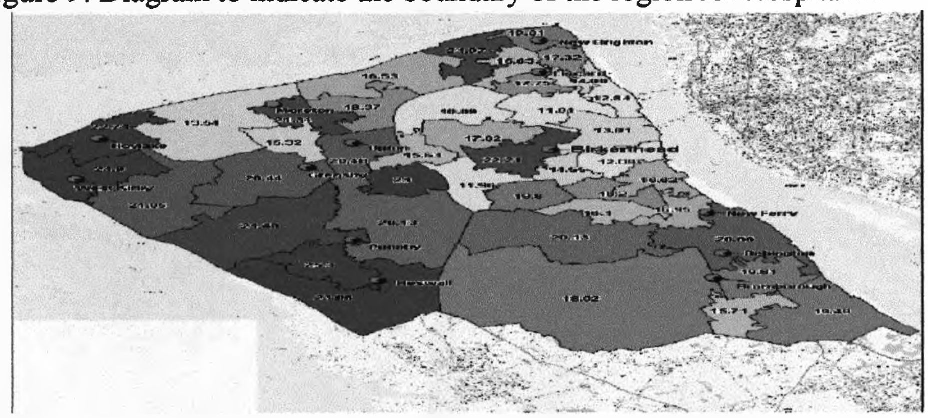
Sampling Considerations:
Since no single data source was able to inform all the aims of Study A, a mosaic impression of the population was determined through a series of related studies, the outcomes of each influencing the design of the subsequent study. Within surveys, the selection of the sample impacts upon the generalisability of the survey results (Fife-Shaw, 2000) and whilst probability samples may permit the sampling error to be calculated, non-probability samples have logistical advantages and are useful in preliminary, exploratory studies (Trochim, 2000) such as Study A. The police reported congruent regional datasets that could be compared with the NHS records. To achieve the study aims, sub-samples were used to obtain detailed data collection and analysis.

A non-probability judgement sample of A&E departments was chosen since a census study was not viable and the number of influential variables affecting RTCs hindered the feasibility of probability sampling. Judgement samples enable selection to involve selected population units deemed relevant to the study (Trochim, 2000). In Study A, the initial sampling judgement aimed to include a large representative sample of RTC attendees similar to the target population in terms of demographics, crash severity and balance of urban and rural crash locations. The Northwest of England was purposively selected because the high incidence of RTCs, suggested the need for intervention strategies. However, since a non-probability sample was selected, the sampling error in the Northwest sample compared to the target population could not be determined. To probe deeper into the demographic patterns of RTCs, access to more detailed clinical information was necessary requiring Caldicott approval from each hospital.

Therefore, a sub-sample of A&E departments from the Northwest, were chosen for examination of A&E patient records. Again, a purposive judgement sample was chosen based on selection criteria. The inclusion criteria were that RTC attendances fell within a standard deviation of the Northwest mean attendance and the departments used electronic patient-records. Three hospitals met the required inclusion criteria and formed the sub-sample. From these, a single A&E department was selected for more detailed investigation, based on its unique location.

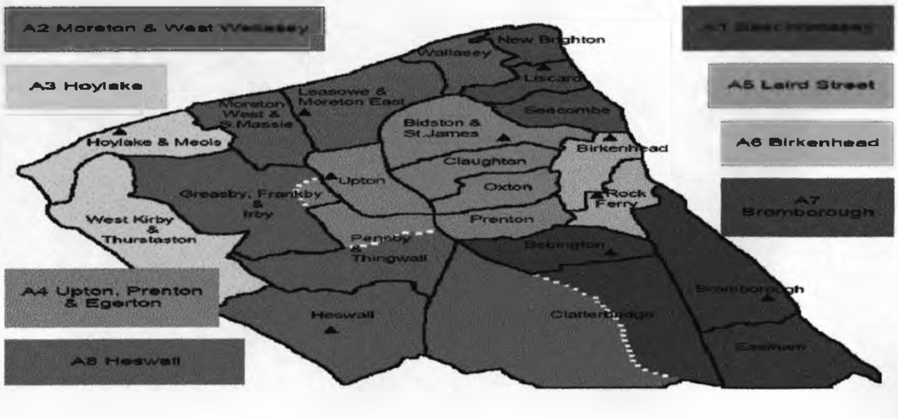
The hospital (Hospital A) served a peninsular region covered by a single police force, with varied road types and potentially varied injury severity.

Figure 9: Diagram to indicate the boundary of the region for Hospital A



Most importantly the health and police service shared co-terminus boundaries (Figure 9& Figure 10), with a low likelihood that patients experiencing a crash would attended a hospital outside of the locality, enabling comparisons to be made between the datasets.

Figure 10: Diagram to illustrate Police Service region covering Hospital A



Identified limitations in the hospital's electronic records required further investigation through comparison with the original clinical records. A cross-sectional survey was chosen using quota sampling. This strategy can be preferable to other types of non-probability samples, since it can force the inclusion of different sub-populations, with those selected being similar to the whole population. However, this method can disguise significant bias (Trochim, 2000) and consequently strong inferences cannot be drawn.

A consecutive sample of 100 adult RTC casualty notes was the chosen quota, to conduct a comparison with the corresponding electronic data. Since access to clinical information required ethical approval, it was only feasible to investigate a single sample of casualty records from one hospital.

Ethical Considerations:

Access to anonymised data obtained from the region's A&E departments was obtained either through the hospital management or where they were available, the hospital's Caldicott guardian. Access to casualty notes required ethical approval, obtained in conjunction with Study B (Appendix 9), since the data was not anonymised before coding by the researcher.

A series of five separate studies (A1-A5) were undertaken to address specific research questions or hypotheses within the overall context of Study A. The process and outcome of each of these studies are reported separately and overviews of the information sources used within the study are given in Table 2 and Table 3 .

Study A1

Background

As the NHS and Police provide nationwide services for people involved in a RTC their crash records were of potential value to the development of the service platform.

Table 2: Study A Categories of data available from RTC data sources

Data sources available to inform Study A	**Notes**	**National Police (STATS19) data**	**Local Police (STATS19) data**	**NHS (HES) data**	**Northwest Hospital electronic records**	**Hospital C electronic records**	**Hospital B electronic records**	**Hospital A electronic records**	**Hospital A casualty records**
Numbers involved in RTC	Definition of RTC may vary by data source	√	√	√	√	√	√	√	√
Age	Secondary data sources permit only mean/ categories	√	√	√		√		√	√
Gender	Available as % or individual data	√%	√%	√%		√ n	√n	√n	√n
Road user type	Level of detail varies with source	√	√	√		√	√	√	√
Address	Not obtained for anonymised data	√	√			√	√	√	√
Postcode	Not obtained for anonymised data	√	√			√	√	√	√
Speed of impact	Estimated speeds only	√	√						√
Point of impact	Estimated or reported site	√	√						√
Breathalysed/ Alcohol levels	Only aggregated data available	√	√						
Drug levels	Only aggregated data available	√	√						
Time of crash		√	√					√	√
Date of crash		√	√			√		√	√
Previous medical conditions	Potential to record in notes								√
Type of Injury incurred						√	√	√	√
Severity of injury incurred		√	√						
Medical intervention						√		√	√
Length of stay in hospital	Mean or individual stay length			√ mean				√ indiv	
Follow-Up services	After discharge from A&E					√	√	√	√

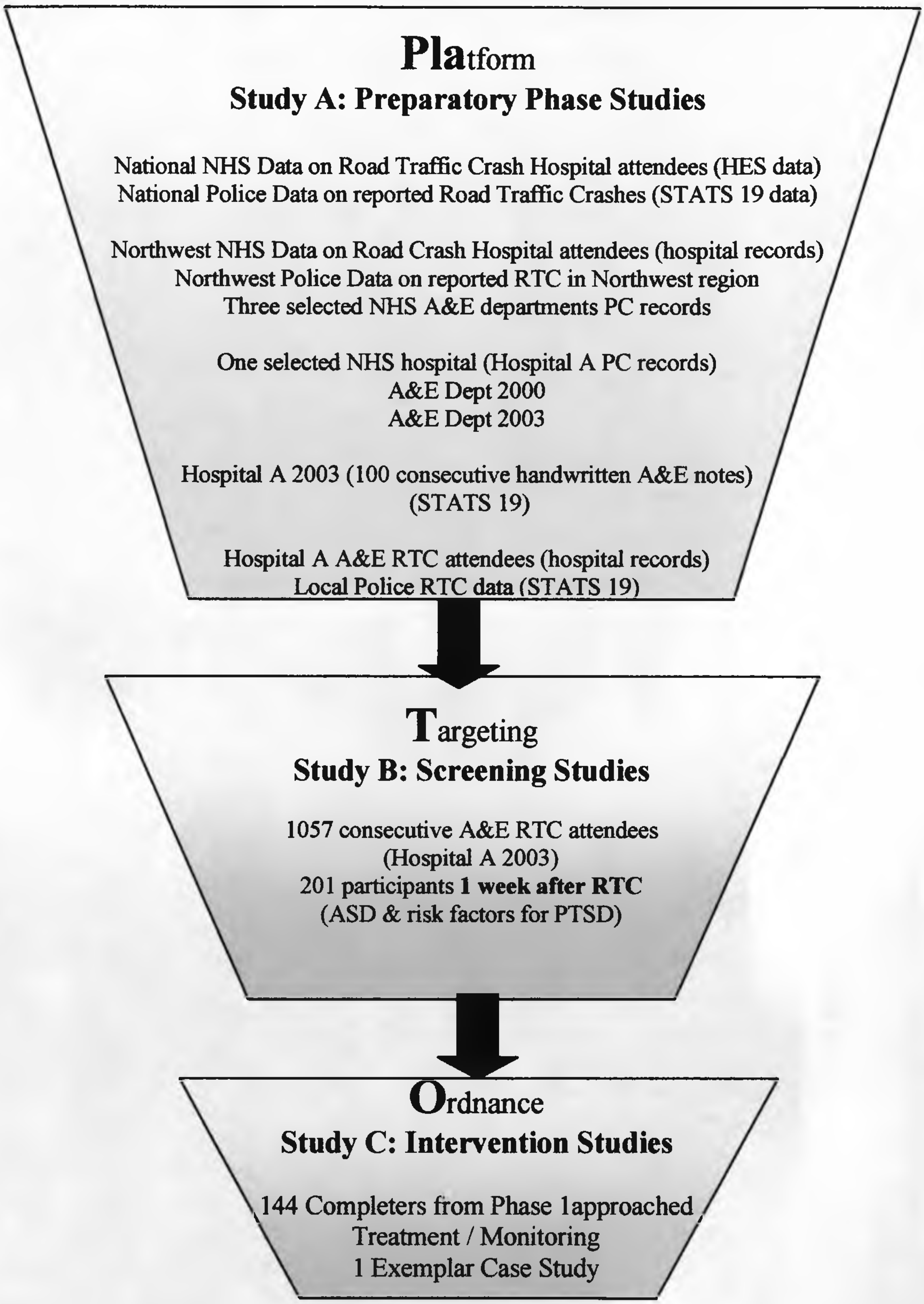
Key: Demographic details ○ Crash details ○ Injury and treatment details ○

Table 3: Data Sources used to inform aims of Study A

Study A Data sources	**A1**	**A2**	**A3 i**	**A3 ii**	**A 3 iii**	**A 3 iv**	**A3 v**	**A4 i**	**A4 ii**	**A4 iii**	**A5 i**	**A5 ii**	**A5 iii**	**A5 iv**	**A5 v**	**A5 vi**
Department of Transport (STATS 19)	√															
Hospital Episode Statistics (HES)	√															
National Police 2000 (calendar year)		√		√	√		√									
National Police 2003 (calendar year)		√			√		√									
Northwest region Police 2000 (calendar year)		√					√									
Local (Hospital A) Police 2003 (calendar year)		√	√				√									
NHS (HES) 2000 (financial year)																
NHS (HES) 2003 (financial year)																
NHS (HES) 2006 (financial year)																
Northwest region NHS 1999 (calendar year) 15/30 hospitals		√														
Northwest region NHS 2000 (calendar year) 15/30 hospitals		√														
Hospital C 2000 (calendar year)			√	√		√	√	√		√	√	√	√	√	√	√
Hospital B 2000 (calendar year)			√	√		√	√	√		√				√	√	√
Hospital A 2000 (calendar year)			√	√		√	√	√		√	√	√	√			
Hospital A 2003 (calendar year)		√	√	√	√	√		√		√	√	√	√			
Hospital A casualty records 2003 (calendar year)									√							

Key to study aims
A1 – How were road crashes & their impact recorded by the Police and NHS in the UK?
A2 – Police RTC data correctly recorded the total number of people injured annually in a RTC
A3 – What were the demographic patterns of the RTC population?
A4 - What was the prevalence of psychological distress amongst RTC casualties?
A5 - What treatment and follow-up services did RTC casualties receive?

Figure 11: Research Project Data Sources Overview



Study A1 Research Question: How were road crashes & their impact recorded by the Police and NHS in the UK?

Study A1Method

Research scoping was undertaken to determine how RTCs were recorded by these government departments and the access procedures for this information, by direct contact with such agencies.

Study A1Ethics and Data Access

All data accessed in this study was accessible through the public domain and already categorised. Therefore, there were no ethical concerns with the secondary use of data within this study.

Study A1 Results

The Police use a structured data collection form (STATS19) using pre-set guidance (STATS20) to record crashes consistently. Attending police officers complete a STATS19 and the Department of Transport collate the information. Since a legal duty operates in the UK, to report to the police any RTC involving personal injury (Great Britain, 1988), all such crashes should be included within this dataset, making it a valuable resource platform development.

The NHS collates information on hospital attendances, the reason for the attendance and treatment received. The aggregated data forms an electronic resource, termed the Hospital Episode Statistics (HES). The dataset uses the International Classification of Diseases, (ICD-10) to code conditions treated.

There was no unified ICD-10 code for a RTC and it had to be collated from a range of codes (V-0 to V-90). Within the HES system In-Patient and Out-Patient treatment was recorded separately and A&E information was not included (Northgate Information Solutions, 2008). Hence HES data only records significantly injured casualties and omits minor injuries.

Discussion

The police and NHS databases operate for different purposes and, therefore use different coding systems limiting comparisons between the databases.

The HES system was limited, as it did not include minor injuries whereas these are included in the STATS19 system. Reliability of the data was strengthened by coded recording systems. However, comparisons between the sources, was hindered by the different coding systems. The STATS19 system appeared to provide the more comprehensive picture of the total RTC population.

Conclusion

Further investigation of the Police data was required to test whether it accurately recorded road crashes and their impact on individuals, so that a better understanding of crash consequences could be established to inform PlaTO.

Study A2

Study A2 Background

Although both the Police and the NHS record information about RTCs and their consequences, Study A1 identified that A&E data was not included in the HES records, so this information primarily recorded severe injuries. The STATS19 potentially offered a more comprehensive picture of the RTC population. Further investigation of the Police and A&E data was undertaken to test the accuracy of the STATS19 data.

Study A2 Research Hypothesis: Police RTC data (STATS19) correctly recorded the total number of people injured annually in a road traffic crash.

Study A 2 Method

The hypothesis was tested by comparing the police records with the results of a survey of RTC casualties from A&E departments. It was not viable to conduct a census of all UK emergency departments, so a comparable Police and NHS geographical area was selected as a sample region. The Northwest region was judiciously selected because of the number of crash casualties per annum.

In order to undertake a survey of the RTC-related attendances in Northwest A&E departments, requests were made to the relevant A&E Directors. Local procedures were followed to obtain the information. The data requested was annual RTC attendances. Wherever possible, hospitals provided attendance details for two retrospective years and the current year's attendances. The corresponding northwest Police data was obtained from the Department for Transport and compared with the hospital attendances.

A further comparison between police and hospital records was undertaken using a specific sample from a region in the northwest obtained through a written request to the local Police and Caldicott approval for retrospective A&E records from Hospital A. The Police data had already been collated which limited the comparisons analysed between the two sources.

Study A 2 Results

Thirty A&E departments were identified within the northwest criteria. Half of these were unable to retrieve the required data (Appendix 1), for at least one of the years being investigated, despite a requirement, under the Road Traffic Act 1999 (NHS Charges) (Great Britain and Elizabeth II, 1999), to recover the costs of treatment. The A&E records often operated independently and were incompatible with those of the main hospital, echoing the division in HES data collection systems (Northgate Information Solutions, 2008).

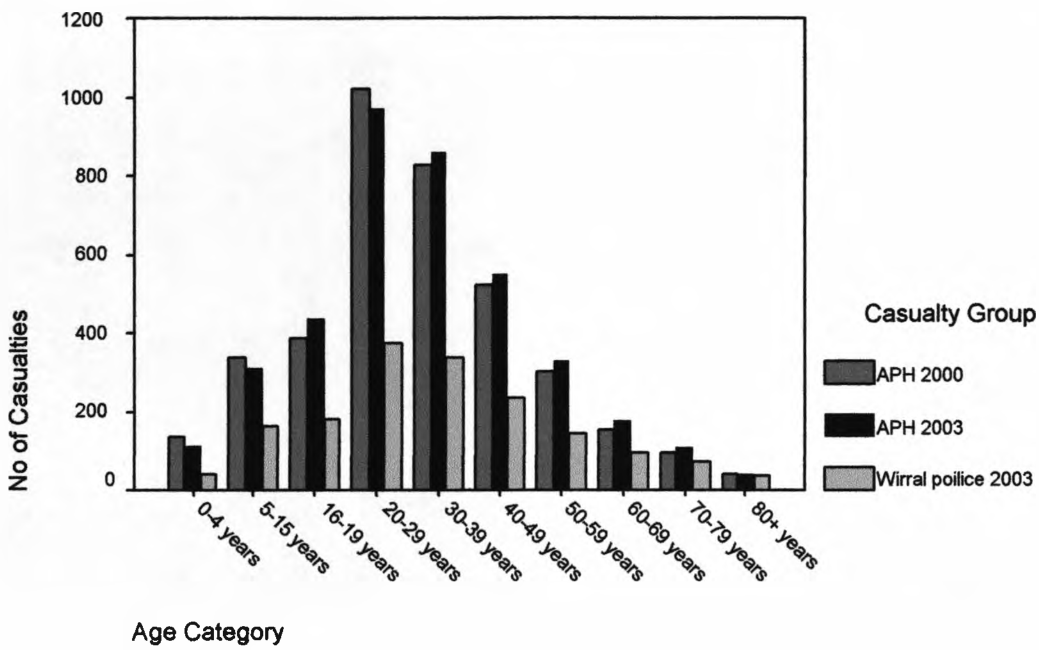
A maximum of sixteen out of thirty hospitals provided their RTC attendance figures. The total RTC attendances for the participating Northwest hospitals (n=15) was 49,533–46,976, per annum, even though data was missing from half the A&E departments in the region (Appendix 1).

Total annual attendances varied (1,524-5,378) between departments, with the averages being 3095-3131. There was a consistency in the annual attendances and a strong correlation between the casualty numbers for individual hospitals across the two years (Pearson Correlation 0.963, 2 tailed, $p < 0.01$). However, the variability in attendance figures between A&E departments, prevented estimation of the total number of RTC casualties for the Northwest, based upon extrapolation from the participating departments.

The northwest Police in comparison reported between 44,815–44,750 casualties per annum, lower than attendances reported by only half the region's A&E departments, questioning the reliability of the STATS19 data. The local Police reported only 43% (1,680) of the casualties compared to Hospital A (3,890), again demonstrating higher A&E attendances than the police records. Men constituted 55.5% of the casualties in the police records compared to only 53.7% in the hospital records, whereas the population of the region was 47% male in the 2001 census (Office of National Statistics, 2001).

No significant difference in gender was found between the police and A&E record and the preponderance of men was consistent with both the national STATS19 and HES records.

Figure 12: Comparison of RTC by age for police and A&E

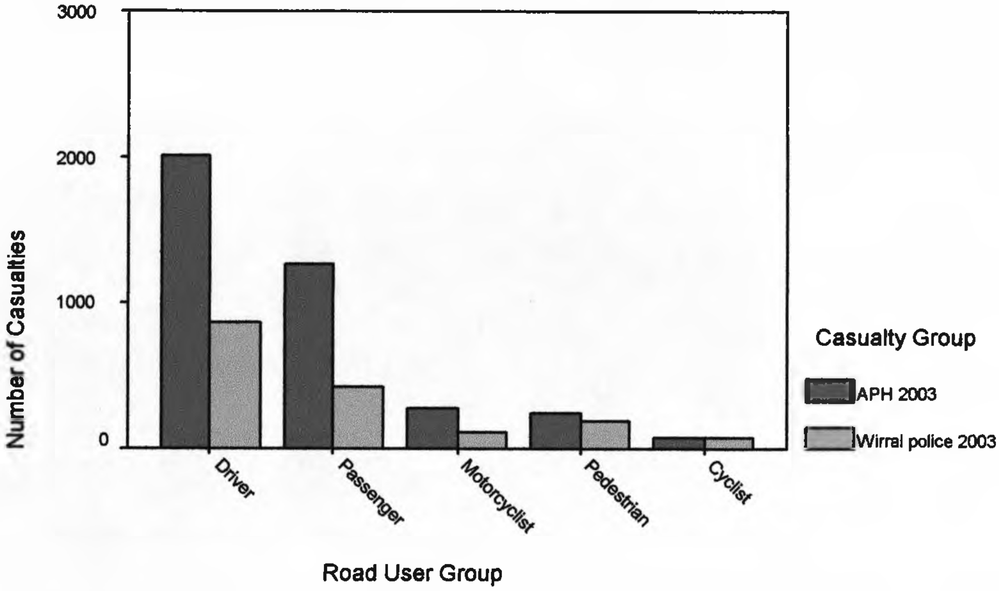


Examination of age categories revealed that the 20-29 age group were the largest casualty group from both data sources (Appendix 8), although the proportion attending hospital was much higher than in the Police records. A significant correlation was established between the age categories in the hospital and police records (Pearson Correlation 0.993 sig < 0.001, 2 tailed), irrespective of differences in the total casualty numbers. The greatest discrepancy in casualty numbers appeared amongst the 20-59 age categories (Figure 12), with less in these age groups reporting their crash to the police.

Vehicle users were the major casualty group in both records. Drivers represented 52% of hospital and police recorded casualties (Figure 13) whereas passengers accounted for 33% of A&E casualties, but only 25% of the Police casualties.

Vulnerable road users were proportionally less represented in the hospital records than in the Police data, accounting for 15% of the hospital group compared to 23% in the police records. However, the correlation between the two sets of data was significant (Pearson Correlation 0.98 sig 0.003 2 tailed), despite the slightly different trends in some of the user categories.

Figure 13: Comparison of RTC by road user category for Police and A&E



Discussion

This study highlighted the systematic Police records, compared to the paucity of most hospital RTC data systems with only half of the region's A&E departments able to provide RTC attendance figures. A wide range in A&E attendances was reported with the cumulative attendances from only half the region's departments exceeding all the casualties reported by the northwest Police. More people attended A&E, than informed the Police of a crash although this difference was less pronounced amongst some road user groups. Comparisons between the co-terminus Police and A&E services of the again identified a discrepancy between casualty numbers. Hospital A reported 2.3 times more casualties than the Police, with drivers in the A&E data, greatly exceeding the Police records. Despite their differences in total casualty numbers, significant correlation was found between many key variables, including age groups, gender and road user type between the police and A&E.

In terms of services to meet the needs of RTC casualties, it appeared that A&E offered greater opportunity to reach crash casualties due to the under-reporting to the Police particularly for the 20-59 age groups.

The results from this study refuted the hypothesis that: *Police RTC data (STATS19) correctly recorded the total number of people injured annually in a road traffic crash.*

The Police (STATS 19) data, whilst reliable due to a standardised system, inaccurately recorded the total RTC casualty population for the Northwest and the local region. Since the northwest region had the second highest number of casualties in the UK, it would have also impacted upon the national STATS19 data, limiting its value to inform the development of a service platform. Therefore, further investigation was necessary to develop the requisite understanding of the RTC population and crash consequences.

Study A3

Study A3 Background

The previous study (A2) identified under-reporting to the Police in the northwest. To reliably inform the development of a psychological service for RTC casualties, a more accurate and detailed understanding of the patterns of crashes and their consequences for individuals was necessary.

Study A2 also suggested that A&E departments dealt with more casualties than the Police and thus, A&E could reach a larger RTC population. Due to limitations in RTC casualty information, with both the Police and NHS records, no single existing source of information could provide a detailed understanding of the population. Consequently, it was necessary to build a mosaic impression of the target population in order to develop both an expansive and detailed understanding of RTCs and their consequences from the extant data sources.

A series of research questions (A3i-iv) were developed to address the research question A3 and therefore inform the service platform design.

Study A3 Overall Research Question

A3)What were the demographic patterns of the RTC population?

Study A 3 Specific Research Questions

A3i)Who was involved in road crashes (attendance numbers, age, gender, role in crash)?

A3ii)Why did the crashes occur (fault, alcohol, drugs, illness)?

A3iii)When did the crashes occur (time of day, day of week, time of year)?

A3 iv)What happened after the crashes (type and severity of injuries)?

Study A3 Method

To address these research questions, access to detailed A&E data was necessary. Study A also reported the difficulty some departments had retrieving basic attendance information so a sub-sample of A&E departments was judiciously identified using pre-selected criteria.

To draw a representative sample from the Northwest region, the inclusion criteria specified that annual RTC attendances fell within the range 1966-4224, (mean attendance +/- SD). All hospitals with attendances in this range were contacted to request details about their A&E record systems and assess the second inclusion criterion, which was the ability to retrieve the necessary data to inform the research questions. An assessment of the quality of the A&E record system was conducted for every hospital that returned the requested information (Appendix 4). If the hospital was willing to participate and its record system was satisfactory, Caldicott approval was then obtained, as more than two identifiers were present in the data. The complete A&E records for all RTC casualties were obtained from each hospital in paper format or electronic files. All the variables were entered and recoded to permit comparison between the datasets using SPSS 16 (SPSS Inc, 2009).

Amongst the participating hospitals, one had a comprehensive electronic record system. For this reason further detailed analysis of the data was feasible using both the electronic data and a consecutive quota sample of original hand-written casualty notes. Ethical approval was required to access to the original non-anonymised casualty notes. This was obtained from the LREC in the context of ethical approval for Study B and C. The casualty notes for a sample of 100 consecutive adult RTC attendees were examined by the researcher and the data extracted using a standardised pro-forma (Appendix 3) for consistency. The data was then coded and entered into SPSS for further analysis.

Study A3 Results

Twelve departments had between 1966 - 4224 RTC attendances per annum and six hospitals were willing to participate further in the study (Appendix 4). The quality of the electronic records for these A&E departments varied and, although none achieved the full conditions (Appendix 2), three hospitals met the minimum inclusion criteria and were selected to participate in the study (Appendix 4). Other hospitals, although meeting the inclusion criteria were not able to participate due to ongoing A&E service changes.

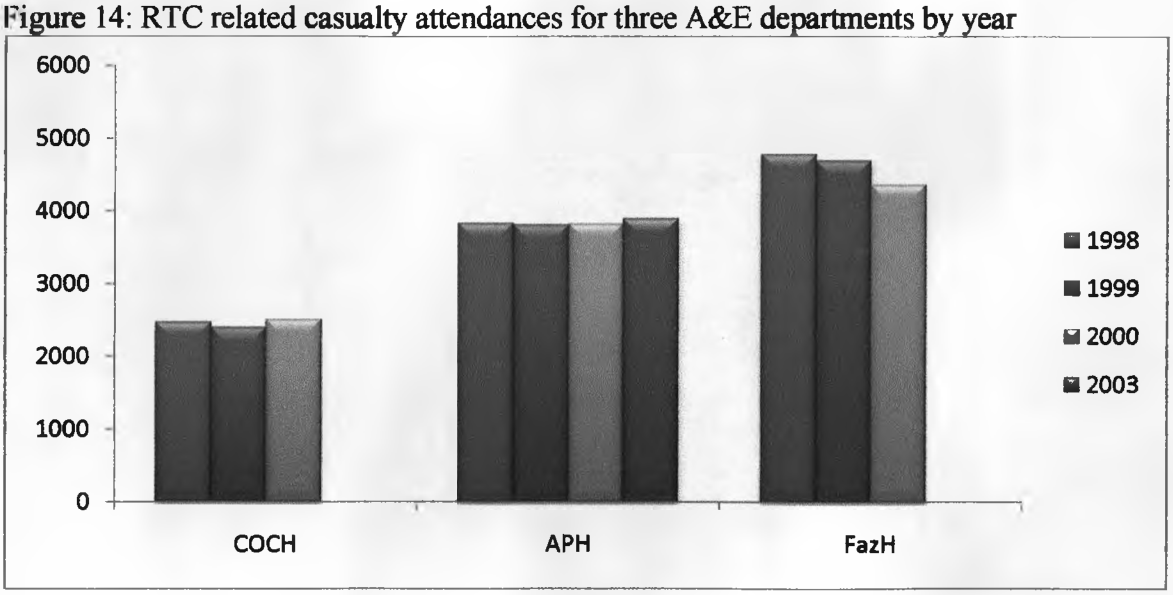
Hospital A had the highest score for quality (Appendix 2). Hospital B and C scored 2 /4. None of the departments scored injury severity for patients through either the recognised Abbreviated Injury Scale (Copes, Sacco, Champion and Bain, 1969) or an idiosyncratic system. Speed of impact was not included in any of the computer systems, despite relevance to the injuries sustained. This quality assessment revealed that, amongst these hospitals, there was no standardised A&E information system and a range of information in non-comparable formats was recorded.

None of the A&E departments were able to provide all of the desired information and considerable amounts of data were missing (Appendix 5), which reduced the overall reliability of the datasets. Whilst treatment was extensively documented at Hospital C, with no missing data, 74% of this data was missing for Hospital A and not recorded electronically in Hospital B. The three hospitals together treated a sizable number of RTC casualties (total 10,676) each year, with RTC attendances constituting a similar proportion (4.6% -5.5%) of the annual A&E casualties (Appendix 5).

A3i) Who was involved in road crashes (attendance numbers, age, gender, role in crash)?

The attendance figures varied, but the selection criteria limited the possible range. However, cumulatively they demonstrated the scale of the RTC problem in the region. A marked consistency in attendance figures for each department, (Figure 14) over multiple years was evident.

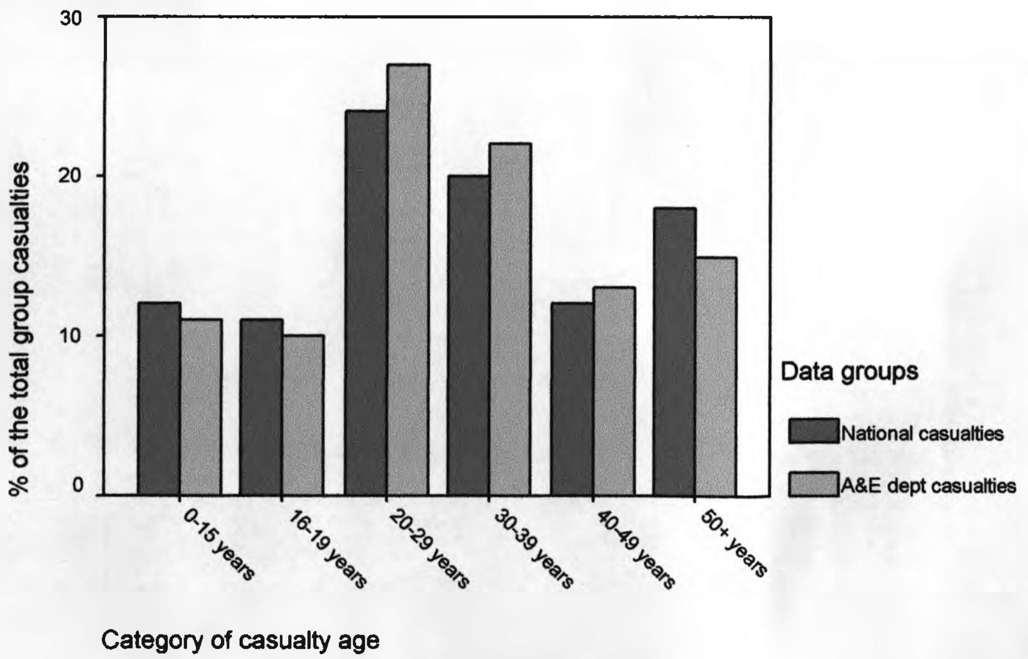
Figure 14: RTC related casualty attendances for three A&E departments by year



Age could only be analysed for Hospital C and Hospital A. Age was reliably recorded by these two departments with the same mean age recorded for Hospital A (32 years, SD ±17) and Hospital C (32 years, SD ±16). When A&E attendance age was grouped into four bands (child, young adult, adult and older adult) a significant correlation (Pearson Correlation 0.408 sig <0.01, 2 tailed) was found between the two datasets.

Whether the mean attendance age for the hospitals was typical of the national A& E profile could not be determined, due the STATS 19 only reporting age by category, although similar peak ages (20-29) were reported for both A&E departments and the national STATS19 (Appendix 7and Figure 15). The young age of the adults involved in crashes was apparent, with almost half the casualties under 30 years of age in both departments. When reported as a percentage of total attendances the age categories were broadly similar for both hospitals and a significant correlation (Pearson Correlation 0.953 sig. <0.01, 2 tailed), was established between the age groups for the A&E RTC casualties and those reported nationally by the Police (Figure 15).

Figure 15: Comparison of age for national (STATS19) casualties with Hospital A & C casualties (N=6,320)



RTCs primarily involved young adults, although all age groups were affected. In all three hospitals, males constituted the majority of attendees (mean 56%), despite males only representing 48% of the northwest population (Office of National Statistics, 2001).

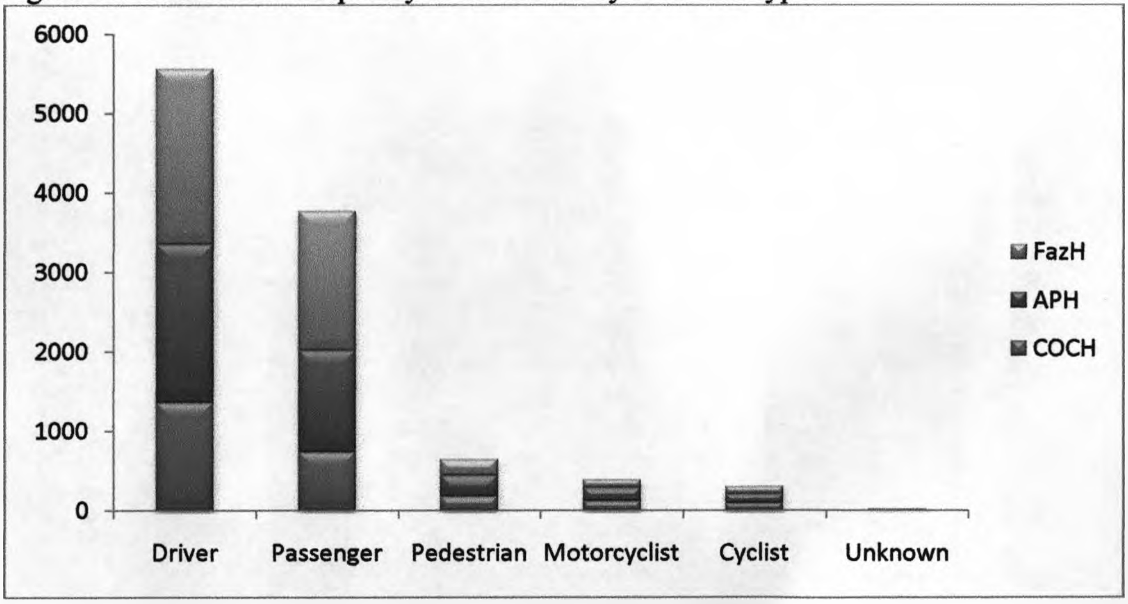
This male prevalence was comparable to a 57.5% male population in the national Police records. The implications for a service of the preponderance of male casualties must be considered in view of the reported differences in social support patterns.

All three A&E units reliably recorded road user type, with minimal (0.3%) missing data. Drivers were the largest group (mean 56%) reported by A&E departments (Appendix 6), followed by passengers, cumulatively representing 87% of all crash casualties. In contrast, vulnerable road users constituted only 13% of the casualties. When comparing the A&E data (Figure 16) with the national STATS19, similar road user patterns were established, (Appendix 7, Figure 17), with a significant correlation (Pearson Correlation 0.982 sig 0.002 2 tailed) between the hospital and Police data patterns.

A3i) Summary

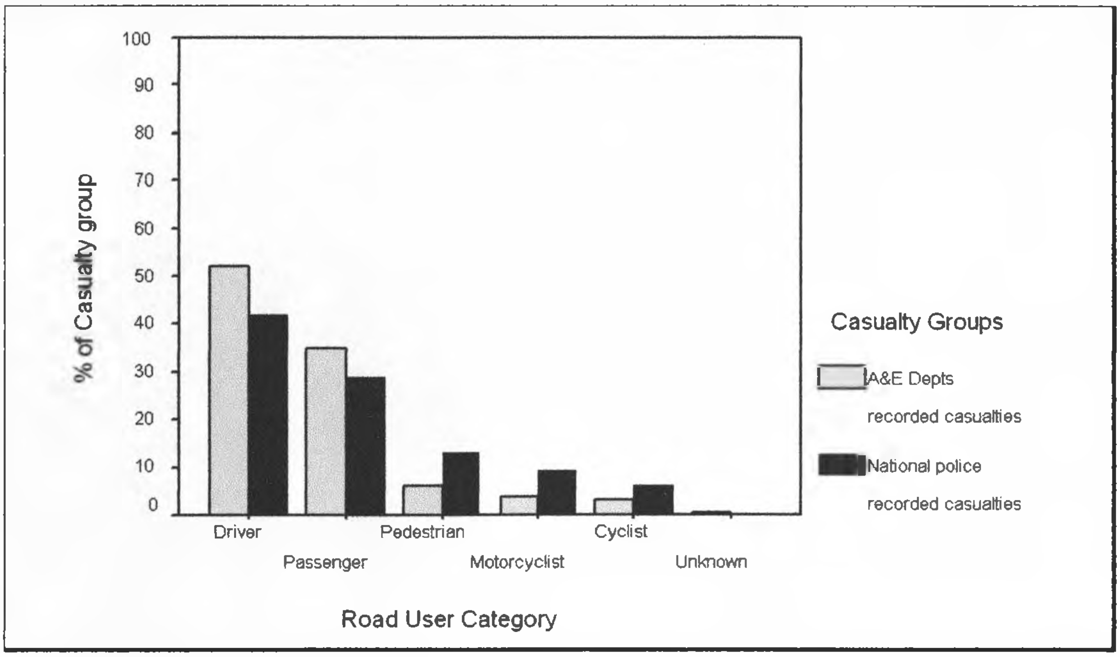
Attendance figures for the participating departments were influenced by the selection criteria, although variation existed across the three units. Cumulatively, their attendances were 10,676 for a single year, demonstrating the immense scale of the RTC problem within the area and highlighting, the need for a strategic approach to equitably address the problem.

Figure 16: Cumulative frequency of casualties by road user types



Services would be predominantly involved with young adults with the average age for RTC casualties in these hospitals being 32years. However, the very young and old still require consideration as they may be more vulnerable road users.

Figure 17: Comparison of National (STATS19) casualties with 10,676 northwest A&E casualties in 2000



Congruent with the local and national Police data, males were over-represented amongst crash casualties and compared to the local population. Therefore, gender differences must be considered when designing services for RTC casualties. Car users were the most frequent attendees at A&E, whereas vulnerable road users only accounted for a small proportion of attendances, which has implications for the type and severity of injuries typically sustained.

This sample was consistent with the national and international profile (World Health Organization, 2004), with the young and men being the most common categories. Hence psychological services must focus on how to engage this profile of service users. As extant data was used in this study, the noted flaws in the quality and reliability of the information limited the strength of the conclusions drawn and further research is necessary to validate these findings.

A3ii) Why did the crashes occur (fault, alcohol, drugs, illness)?

The STATS 19 system collects information on the potential causes of RTCs, such as road conditions, fault, drug or alcohol use. The STATS 19 for 2000 reported that 6% of all RTC casualties involved someone over the legal alcohol limit, with ~3000 annually killed or seriously injured through drink-drive related crashes. None of the A&E electronic data recorded fault or contributing factors such as alcohol consumption.

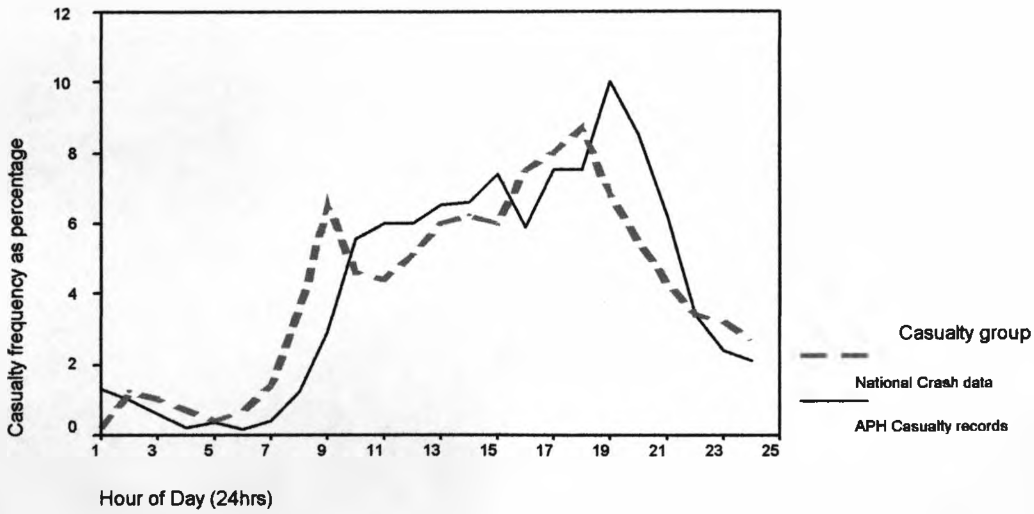
Summary

This data suggested that only a few RTCs were alcohol related, but further investigation within A&E departments must be undertaken to validate this data. Involvement of contributory medical conditions should be investigated further since they may influence the intervention required and the attendant risk of developing PTS disorders.

A3iii) When did the crashes occur (time of day, day of week, time of year)?

Hospital B and C electronic records did not specify attendance time, only date. Therefore, only Hospital A data could inform this question. The Police were unable to extract details of the time that crashes occurred, so the national STATS 19 data for the corresponding year was the only comparator available.

Figure 18: Comparison of STATS19 and Hospital A casualties by hours of day



Although the National data may be expected to be a weak comparator when casualty admissions times for Hospital A were compared to the National STATS 19 data (Figure 18), a common pattern was evident with a" lag" time between the police and A&E admission records. The peak casualty frequency occurred at 18:00 hours for the police data and 19:00 hours for the A&E data. Overall daytime or "working hours" 07:00 – 20:00 encompassed the majority of casualties, as attendance declined sharply at night. When the monthly local Police and A&E (Figure 19) records were compared, congruent fluctuations were evident, despite considerable variation in monthly attendances. Statistical comparison between the two sources found a significant correlation (Pearson Correlation 0.863, sig< 0.001, 2-tailed).

When the monthly casualties were viewed as percentages to eliminate the different casualty totals, their synchronicity emerged (Figure 20). The casualty records were also analysed by seasons, but no significant difference was established in either dataset. The Police did not code attendances by day of week and this information from Hospital A is reported in Study B.

Figure 19: Police and Hospital A recorded casualties by month

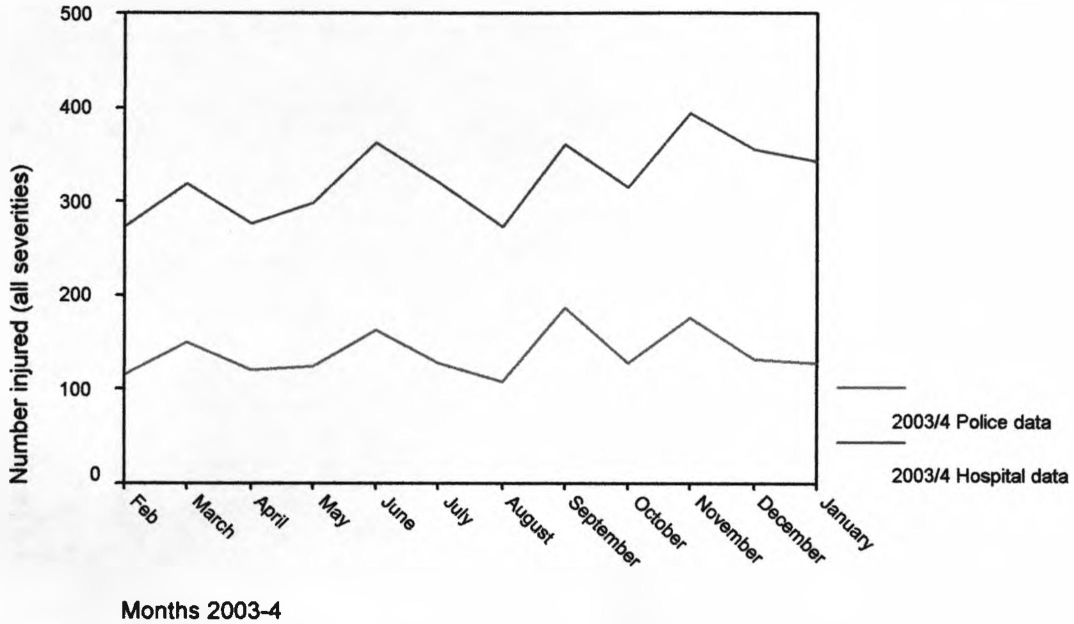
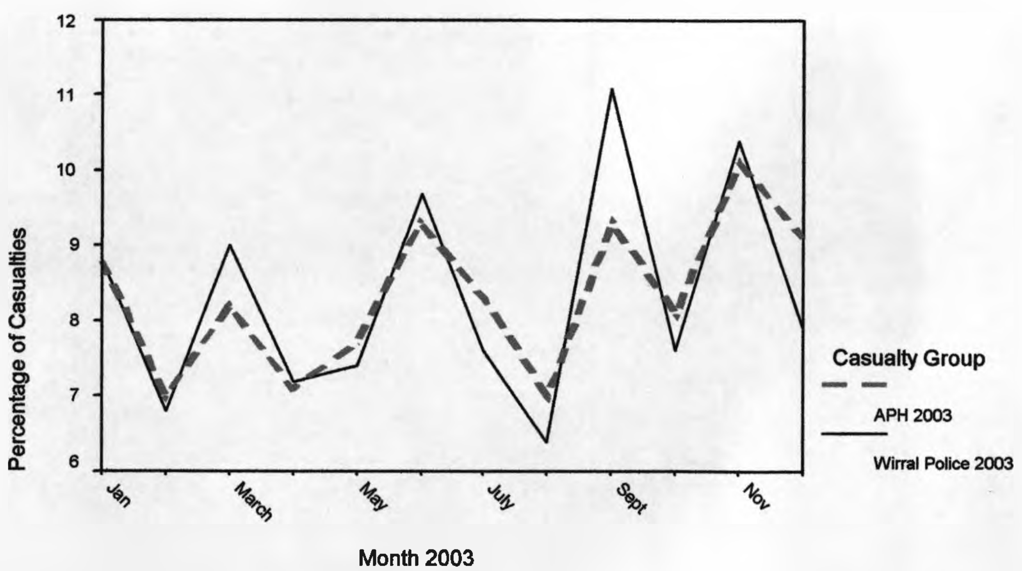


Figure 20: Casualties as percentage of total by month of year



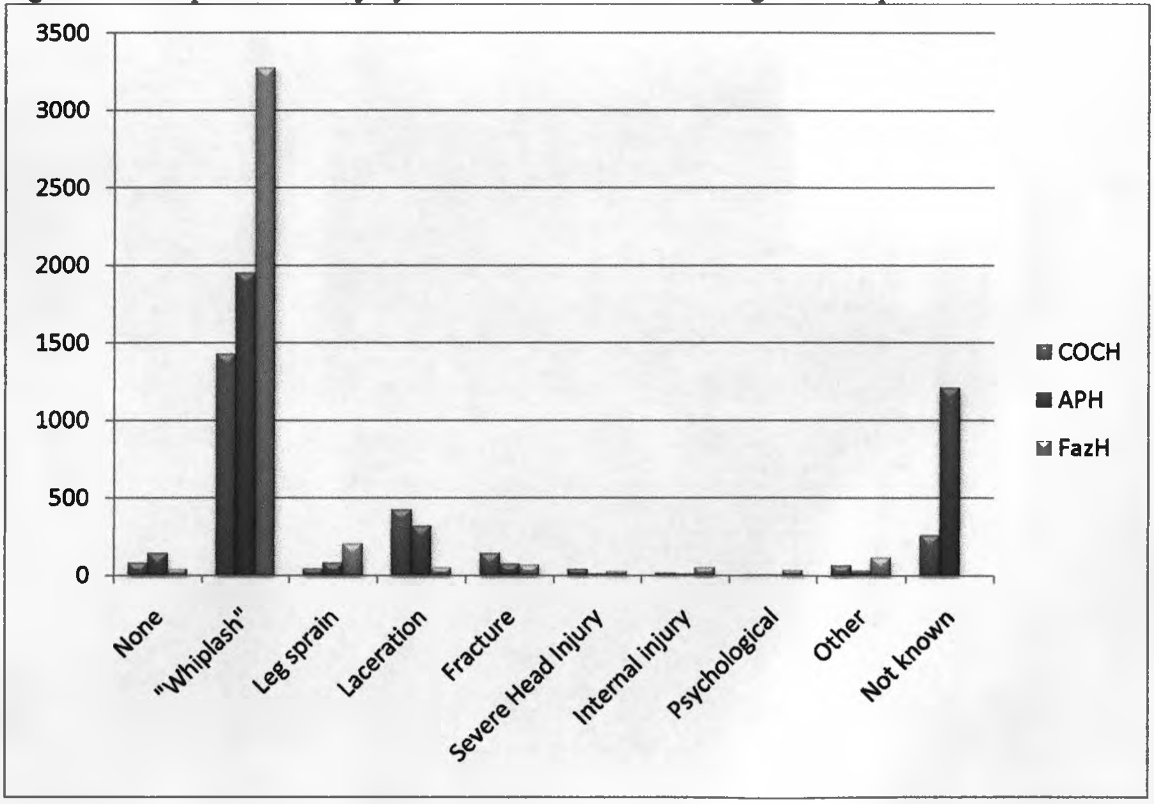
Summary

The local casualty attendances fluctuated markedly in frequency between months, although no significant difference between seasons was established, which suggested that RTC services must operate similarly throughout the year, but also respond to monthly variation. Examination of A&E casualty frequencies by time of day, found a similar daily pattern to the national police data, with a lag time possibly due to travel time. From both the national and Hospital A data it was apparent that the large majority of casualties occurred during day-time, peaking in the early evening. Services would, therefore, need to accommodate these diurnal variations in attendance, particularly during the early evening peak period.

A3 iv) What happened after the crashes (type and severity of injuries sustained)

The Police system only recorded severity (fatal, severe & slight), rather than actual injury, whereas the hospitals only recorded injury and not severity. Overall 18% of the injury data was missing, with 32% absent from Hospital A. None of the departments pre-coded their injury data, relying on free text entry. This resulted in inconsistent terms used within and across hospitals. Hence, the quality of injury data was compromised by missing data and lack of pre-coding.

Figure 21: Frequencies of injury in RTC casualties attending A&E departments



"Whiplash" including upper limb and spine, sprain and strain injuries, was the most frequent problem, accounting for 62% of all injuries (Figure 21), whereas minor lower limb injuries only accounted for 3% of the injuries. More serious injuries, such as fractures and major head injuries, cumulatively, only amounted to 4% of all casualties. The patterns of injury for the three departments were very similar, although the amount of missing data prevented firm conclusions being drawn.

Unlike the Police, the A&E departments did not record injury severity despite coding systems that could be used (Copes, Sacco *et al.*, 1969). From the injury details recorded, inferences could be drawn about injury severity, with sprains and strains being considered minor, whilst internal injuries, fractures and significant head injuries would be classified as severe. However, such proxy assessment is inferior to the use of established coding systems or pre-coded ratings completed during assessment.

Summary

From this sample, it appears that the majority of injuries sustained were minor. Whiplash type injuries were the most frequently problem recorded, for all three hospitals, consistent with previous reports on crash consequences (Quinlan, Annest *et al.*, 2004) although the amount of missing data and inconsistent injury reporting limited the validity of these emergent patterns. Further investigation to clarify the reasons for the missing data and the introduction of injury severity coding systems would be necessary to inform the development of services.

A3 Discussion

The results of this study reiterated the scale of RTC casualties who attend A&E annually and hospital attendances were 2.3 times greater than the annual data published from the Department for Transport (2008) which was consistent with the study undertaken by Lyons and Thoreau (2006) that found serious injuries were twice as frequent in hospital records compared to those of the Police. Since RTCs, in the main, appeared to involve young adults who were likely to be relatively fit, active and in their most productive years, then their impact may also affect their families, dependents and wider social networks. This profile was consistent with the international picture (World Health Organization, 2004) and highlights some of the immense public health burden attributed to crashes (Roberts, Mohan *et al.*, 2002), irrespective of psychological considerations.

The wider impact could not be explored through this study, necessitating further investigation to assess the wider consequences of crashes upon casualties. From a service development perspective, it was important to understand the factors influencing why crashes occur. However, examination of the electronic and original A&E records found no evidence that such assessment occurred. Therefore, only the Police STATS19 system offered insight into crash contributory factors. Their records suggest that a proportion of RTC are alcohol or substance abuse related, which is an important consideration in terms of designing appropriate services for this population (Zatzick and Galea, 2007). However, the Police do not include contributing medical or psychological conditions. This understanding would be important when considering platform development as referral pathways may need to be established to medical specialists.

Exploration of the local casualties revealed strong diurnal patterns. The majority of crashes occur during daytime hours, with rush-hour peaks evident, which were particularly pronounced in the early evening with inherent service implications. Whilst monthly attendances fluctuated, they correlated between the Police and A&E and no seasonal patterns were established. This suggests that a service platform for RTC casualties must operate consistently across the year, but additionally accommodate sizeable daily and monthly fluctuations.

The results from this study informed a mosaic impression of who crashes and when, through investigation of multiple information sources. However, it was not possible to explore why crashes occurred due to the absence of A&E data. The results were limited by the quality and content of the original data sources which is a common when using extant records (American Society for Training and Development, 2009). However, it has been possible to gain an overview of 10,676 A&E casualties and develop an initial understanding of the age, gender, road-user type and injury profile, together with monthly and daily patterns of A&E RTC attendees, information critical to develop the PlaTO service.

Study A4

Study A4 Background

Acute psychological responses following traumatic events have been widely documented and although often the initial distress subsides, for some people it persists.

Initial symptoms of heightened autonomic arousal, such as increased heart rate (Kuhn, Blanchard *et al.*, 2006), blood pressure (Bryant, Harvey *et al.*, 2000), dissociative symptoms (Brewin, Andrews *et al.*, 2000; Fullerton, Ursano, Epstein, Crowley, Vance *et al.*, 2001) and exaggerated startle response (Ladwig, Marten-Mittag, Deisenhofer, Hofmann, Schapperer *et al.*, 2002) have previously been linked with PTS disorders. These varied symptoms of arousal may manifest clinically as behaviours such as shaking, hyperventilating, confusion, crying or indifference that indicate underlying distress heralding subsequent PTS disorders. The diagnostic criteria for PTSD specify that the event caused a reaction of intense fear, helplessness & horror (American Psychiatric Association, 1994). Therefore the presence of such symptoms may indicate an increased risk of PTS disorders.

RTC casualties attending A&E departments are assessed in triage to determine priority and clinically to assess the crash consequences. It was postulated that distress when present would have been documented in the triage or clinical notes. These records could help to estimate the number of people at risk of PTS disorders, thereby informing the development of PlaTO. As police records only record physical injury, they did not inform this study.

A series of specific research questions (A4i-iii) were developed to address the overall research question A4.

Study A4 Overall Research Question

A4)What was the prevalence of psychological distress amongst RTC casualties?

Study A4 Specific Research Questions

A4i)How many RTC casualties were recorded in the A&E electronic records as "distressed"?

A4ii)How many RTC casualties were recorded in the original casualty notes as "distressed"?

A4iii)Were there any gender differences when recording psychological problems in the A&E records?

Study A4 Method

The three hospitals forming the northwest sub-sample from Study A3 also participated in this study. The electronic records from 10,676 A&E crash casualties was analysed to identify casualties who fulfilled the criteria for psychological distress. Distressed in this context was defined to include very broad terms indicative of intense fear, helplessness and horror such as crying, speechless, shock, shaking etc. This criterion was given an intentionally low specificity, to ensure that all casualties with any form of psychological distress were included. Such cases constituted positive evidence of psychological "distress". Analysis of the data was undertaken using SPSS16.

A consecutive sample of 100 adult original casualty records from Hospital A was obtained (Study A3 Method) and examined for any evidence of psychological "distress" present within the clinical information.

Casualty records consisted of four information sections

-Ambulance report (if appropriate)
-Clerk's record of personal and incident details
-Nurse Triage details
-Medical Notes

A standardised form was used to extract all information from the casualty records (Appendix 3) with notes pertaining to "distress" identified using the same inclusion criteria as the electronic records.

Study A4 Results

Examination of the original notes identified that, although the personal details, triage section and where appropriate the ambulance record, were generally completed, the medical information was, however, less comprehensive with the section frequently left blank or unclear.

A4i) How many RTC casualties were recorded in the A&E electronic records as "distressed"?

Despite taking a broad definition of distress such information was rarely present in any of the records. Potential "distress" related words were only recorded for 0.3% of the 10,676 casualties (Appendix 6). Shock was the most frequent descriptor of potential psychological problem. However, this term also refers to a medical condition, so "shock" could not be reliably used to indicate a psychological reaction.

References to possible psychological responses were identified for 33 casualties in FAH, three in Hospital A over two years and only one in Hospital C. However, 24 of the references in Hospital B were to the term "shock". In Hospital C, the casualty with potential psychological symptoms was recorded with "hyperventilating and social problems", although whether these concerns were crash related was unclear. In Hospital A, one casualty had depression recorded, but whether this referred to a pre-existing condition or response since the crash was also uncertain. The difficulty interpreting the free-text entries highlighted the merit of using coded data within the electronic records, in order to avoid ambiguities and consequently interpretation errors.

Whilst it appeared that psychological distress was very rare amongst these RTC casualties, the possibility existed that clinicians had assessed such problems, but they had not been included in the electronic records. Further investigation of the original casualty records was undertaken to test this assertion.

A4ii) How many RTC casualties were recorded in the original casualty notes as "distressed"?

Thorough examination of a series of original casualty records from Hospital A failed to identify any reference to psychological distress in the notes. These results support the findings from Study A4i, that the incidence of psychological distress amongst this sample was very low. However, it remained possible that the low rate reported arose from a failure to document such responses or to assess them.

A4iii) Were there any gender differences when recording psychological problems in the A&E records?

When the records for casualties with psychological problems were compared with the total A&E sub-sample, gender differences were noted. Whereas males accounted for 56% of the 10,676 A&E casualties, females accounted for 70% of those with potential psychological symptoms. However, 16 of the 26 women had "shock" recorded and it was uncertain whether this referred to a physical or psychological symptom. Therefore, it was not possible to conclude whether there were any gender differences in psychological problems. Further investigation was required to answer this research question.

A4 Summary

From this sub-sample of northwest A&E departments it appeared that psychological distress was very rare despite adopting very broad inclusion criteria for "distress". This suggested that this population was at very low risk of developing PTS disorders. Examination of the casualty notes from Hospital A failed to identify any evidence of psychological assessment or symptoms being recorded for RTC casualties. However, the paucity of information in many of the notes limited understanding of patients' clinical assessment.

Although gender differences for "distress" were evident the poor quality of this data prevented any firm conclusions being drawn. Further investigation was required through a prospective study involving a participant sample.

Further investigation was required to determine whether the low incidence of psychological distress apparent in this population of RTC casualties was a true outcome, or arose from a failure by clinicians to recognise or document psychological distress. Such investigation was essential to justify the development of a service to minimise the psychological consequences of RTCs. Direct assessment of prevalence amongst a sample of participants was necessary, to resolve the apparent discrepancy between this sample and previous studies (O'Donnell, Creamer *et al.*, 2008).

StudyA5

Study A5 Background

To promote the development of a follow-up service for crash survivors with psychological problems, it was necessary to determine existing treatment and follow-up and to consider how such services may integrate with the platform in the proposed PlaTO model.

A series of specific research questions (A5i-ii) were developed, to address the overall research question A5.

Study A5 Overall Research Question

What treatment and follow-up services did RTC casualties receive?

Study A5 Specific Research Questions

A5i) What treatments did RTC casualties receive whilst in A&E?

A5ii) What follow-up services did RTC casualties receive after discharge from A&E departments?

Study A5 Method

The three hospitals forming the northwest sub-sample from Study A3 also participated in this study. The electronic records obtained for Study A3 were further analysed to inform the above research questions. The crash casualty data was analysed using SPSS 16, to determine the types of treatment given by A&E staff and the frequency. Similarly, where indicated post-discharge follow-up intervention and its frequency was determined. Within Hospital A, the electronic records linked to in-patient treatment, so the length of stay (LOS) for RTC casualties was also analysed for this specific sample. The original casualty notes were not used to address these research questions, as previous examination had revealed the inadequate completion of such information.

Study A5 Results

A5i) What treatments did RTC casualties receive whilst in A&E?

Hospital B did not include any treatment details in their electronic database whilst treatment was recorded as free text by both Hospital A and C. In Hospital A treatment data was rarely completed, with 74% missing, which precluded further analysis of the information. In contrast, Hospital C records were established for clinical purposes and treatment was recorded for every casualty consequently only this data was used to address the research question.

Hospital C records (Appendix 6) found advice was the most frequent intervention (47%), with analgesia also indicated for a sizeable number of casualties (25%). However, it was unclear whether this indicated administration, a prescription or advice offered. Only a small proportion of RTC casualties required specific medical interventions. However, another small proportion of casualties (11%) required no treatment. The data recorded for treatment was very limited and the lack of clinical coding again risked interpretation errors occurring.

Summary

WAD was the most frequently reported injury in Study A3iv, so most casualties were not expected to require specialist medical treatment. Educational advice (Spitzer, Skovron *et al.*, 1995; Haines, Gross, Burnie, Goldsmith and Perry, 2009) and pain management (Peloso, Gross, Haines, Trinh, Goldsmith *et al.*, 2007), although of uncertain benefit have been recommended for the early management of WAD and the results in this study were consistent with such intervention. No evidence was found that suggested psychological interventions had been provided, although this could have been encompassed with "advice".

A5ii) What follow-up services did RTC casualties receive after discharge from A&E departments?

Hospital A was the only unit that electronically retrieved length of stay (LOS) details for casualties. Analysis of this data found that only 5% of casualties were admitted and the mean casualty stay was less than a day (mean 0.32 day). However, there was a wide range in stay length (0-129 days) and LOS was significantly correlated with age (Pearson correlation 0.114, sig <0.01, 2-tailed), with more, older patients being admitted and staying longer than their younger counterparts.

Hospital A did not have a specific variable that was used consistently to detail discharge information and, therefore, only Hospital B and C data was analysed, with 98% of this information complete. "No follow-up" was the most frequently recorded (57- 69%) across the two hospitals and 2% left before assessment. "Referral to general practitioner" was the second most frequent outcome category (20-24%), but it was not possible to distinguish from the records, whether this equated to a direct referral, or was merely advice given. These differences have service platform implications, as a referral letter may raise the likelihood of ongoing GP involvement and therefore monitoring after discharge.

Summary

The short length of stay for most people afforded only a brief opportunity for RTC casualties to be referred to a proposed PlaTO service. Such a service would need a rapid response rate, if casualties were to be screened whilst in A&E. The electronic hospital records suggested that only 6-9% of RTC casualties received additional hospital intervention, either through admission or outpatient clinics. A sizeable proportion of casualties were directed to their GP.

Whether DP contact was a suggestion or a direct referral was unclear. From this study it appeared that the majority of RTC casualties were not formally offered post-discharge follow-up. The lack of formal follow-up recorded for this population highlighted the potential difficulties implementing the NICE recommendations for watchful waiting and monitoring of psychological distress in the month after a trauma (NICE, 2005; NICE, 2007) when casualties had been discharged from healthcare services.

Discussion: Study A

Study A set out to test the accuracy of existing RTC data and to develop an understanding of RTC casualties, the consequences of a crash and the healthcare provided to individuals. Such a detailed portrayal of the impact of a RTC was essential for the development of the service platform. In order to achieve this purpose a series of five linked studies were undertaken and the results interpreted (Figure 22 and Figure 23)

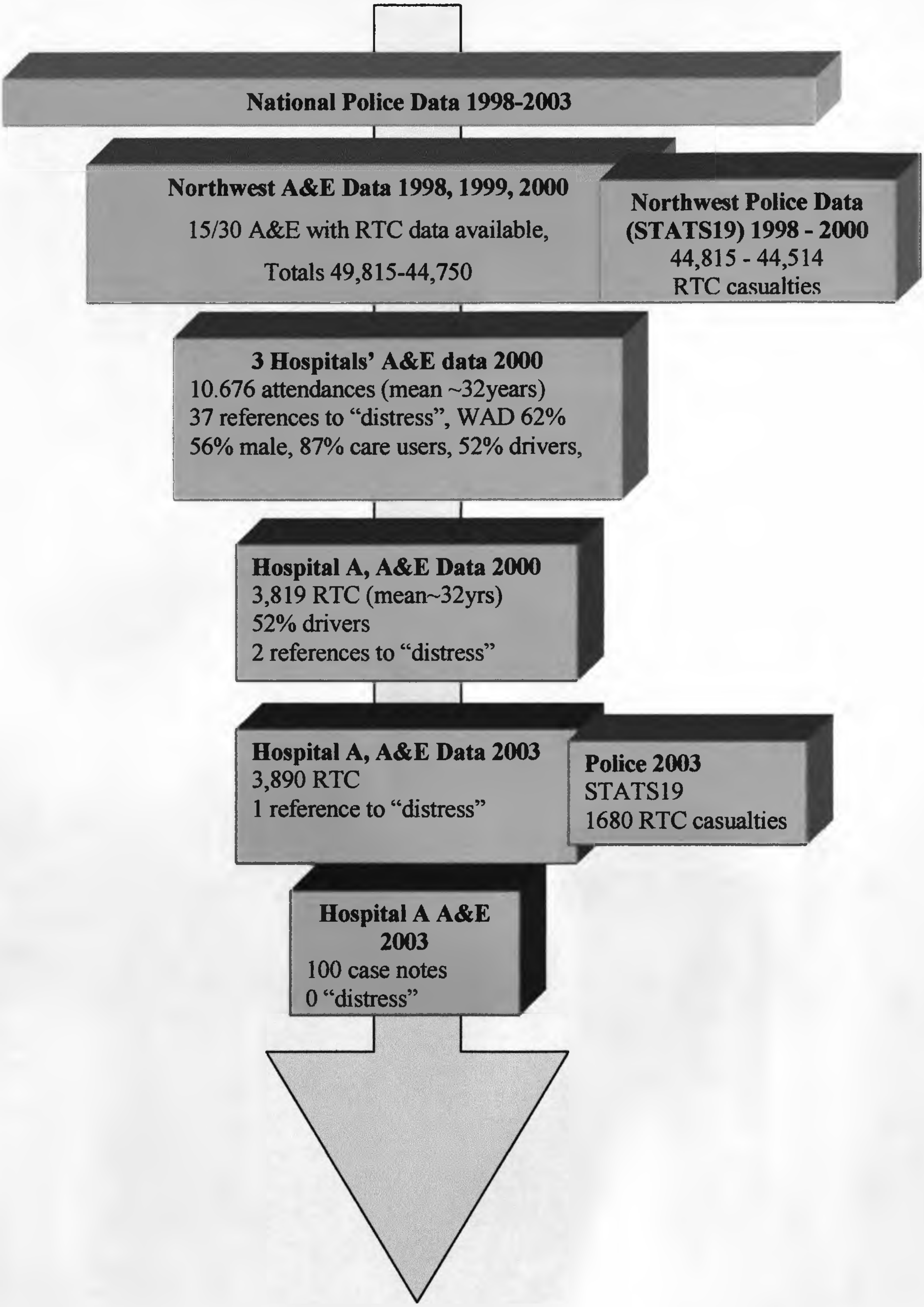
Although two national databases recorded RTC information, both had significant limitations for estimating the size of the target RTC population. The HES data only included in-patient statistics, which in view of the LOS results in Study A5 would have excluded nearly 90% of RTC casualties. STATS19 system was operated by the police and was expected to include all personal injury crashes. However, when the Police data was compared with the corresponding A&E electronic records, the Police reported less than half the number of A&E casualties. This level of under-reporting was consistent with a recent study conducted by the Department for Transport (Department for Transport, 2007), despite the legal requirement to report RTC involving injury (Great Britain, 1988). This Police data informs strategic government bodies and European road safety monitoring, but the scale of the under-reporting undermines its value and risks misinforming services using the information without having any awareness of its flaws.

Although the A&E attendances exclude injured individuals who only attended their GP, they contained the more extensive RTC casualty data than the police. Therefore, A&E data was more appropriate to inform some aspects of the service platform. However, the difficulties encountered in retrieving even basic RTC attendance numbers prohibited a national census of A&E departments to elucidate a more complete profile of the characteristics and scale of the target population. Since no single RTC data source could provide all the requisite information, a mosaic impression was assembled based on an analysis of multiple data sources.

Figure 22: Study A Results Overview

Study No	Results
A 1	National RTC records are kept by the police service (STATS 19) which primarily focus on crash details with limited reporting of injury details National RTC records are kept by the NHS (HES) which focus on in-patient treatments. A&E records are not included in the published HES records
A 2	Only half of contacted Northwest Hospitals could report the number of RTC casualty attendances for (1998-2000) Examination of data from the Northwest and Local suggests that Police records underestimated numbers of RTC casualties compared to A&E data. A&E had over twice as many casualties as police (3890 compared to 1680) Police & A&E records showed similar patterns in terms of age, gender, road user type and month of attendance. Injury severity could not be compared between police & A&E
A 3	No single source of RTC data can inform and validate the findings for all categories so a mosaic impression was developed from NHS &police data. Mean age = 32years, Peak age category = 20-29 years, Male gender = 56%, Vehicle users = 87%, Drivers = 52%, No peak month of year, Peak casualty times of day = 07.00 – 20.00, Injury was poorly recorded using free text impairing quality of results "Whiplash associated disorders" = 62% injury, Severe Injury = 4%, No injury = 2%
A 4	Psychological "distress" rare (0.3%), predominantly female (70%) and drivers (59%) Poor clinical records impaired results' quality
A 5	Length of stay in hospital < 1 day. LOS correlates with age No follow-up offered to ~ 63%, GP follow-up ~ 22%, In &Out-Patient follow-up ~9%

Figure 23: Sequential RTC studies to inform platform



Although the police and A&E data differed considerably in the magnitude of RTC casualties, many of the variables investigated showed significant correlation between the sources. From the multiple sources and levels of data obtained (Figure 23), an image emerged of the typical RTC casualty characteristics .This mosaic impression offered an elementary understanding of a typical PlaTO service user. The most commonly reported features were:

- Young adult (20-29 yrs, mean 32yrs)
- Male
- Vehicle user (driver)
- Sustained "whiplash associated disorder"
- Not psychologically "distressed" by crash
- Attends A&E between 07.00-20.00
- Received advice
- Discharged without follow-up

Whilst the noted quality concerns with the data limit the reliability of these results, they were broadly consistent with previous studies and showed some similar patterns between sources. The peak age range in Study A was congruent with the National and European data (European Road Safety Observatory, 2008), but the mean age from these sources was not available for comparison. From a service perspective, the wide age range in the study suggests that different severity and patterns of injury are likely to arise. Evans (2004) found that increasing age after 20 yrs elevated the risk of severe injury and fatality. In this study, similarly, LOS significantly correlated with age. Injury patterns and severity have been reported to be influenced by gender with women being more prone to chronic disorders e.g. whiplash, back pain and post-concussional syndrome after a RTC (Bring, Bjornstig *et al.*, 1996; Dufton, Kopec *et al.*, 2006). However, men greatly exceed women in terms of serious injuries and fatalities despite the rising numbers of female drivers (Evans, 2004; Department for Transport, 2008). Similarly, in Study A, men were over-represented in A&E compared to the region's population, but more women were reported with symptoms of "distress", which suggested they may be at greater risk from the psychological consequences of crashes, which was consistent with other reports of elevated PTSD prevalence in women (Norris, Foster *et al.*, 2002). However the ambiguities in this data limit these suppositions.

Typically, RTC injuries were minor with 62% reporting whiplash type problems. Galasko Murray, Pitcher *et al* (1993) have reported the incidence of WAD after RTCs as 42%.

Despite being considered a minor injury, WAD is a complex disorder with two thirds of patients still experiencing pain and disability at 4-6 weeks post crash (Crouch, Whitewick, Clancy, Wright and Thomas, 2006). Therefore, some expected early resolution of symptoms may lower the incidence in this sample nearer to the previously reported value (Galasko, Murray *et al.*, 1993). WAD is associated with sizeable societal costs from loss of productivity (Haines, Gross *et al.*, 2009), estimated to amount to 0.4% of GDP (Galasko, 1998), particularly as the typical casualty is a young adult of working age. Furthermore, WAD has also been linked to the development of other chronic pain disorders and PTSD (McLean, Clauw, Abelson and Liberzon, 2005), with psychological factors providing the strongest predictors of poor recovery (McClune, Burton *et al.*, 2002).

Identification of individuals "distressed" after a crash could lead to earlier engagement of casualties, to ensure monitoring and timely access to psychological intervention recommended following trauma (NICE, 2005) and the adoption of a stepped-care approach to WAD (Spitzer, Skovron *et al.*, 1995), thus addressing psychological and physical recovery in tandem. Given the potential for the mutual influence of pain and psychological problems (Sharp and Harvey, 2001), it is important that these conditions are both addressed early in recovery. However these results suggested that psychological distress after a crash was rare hence monitoring RTC casualties for PTS disorders was not justified. This result was inconsistent with previous studies, (O'Donnell, Creamer *et al.*, 2008) and although it may have arisen from a true difference in this sample it could have occurred due to assessment and recording omissions.

The study highlighted that follow-up after discharge was rare. Consequently, adherence to the NICE recommendations to assess and monitor trauma casualties in the month after the incident (NICE, 2005) or implementation of a "stepped care" pathway for WAD would be logistically difficult without the development of a robust service platform. On the other hand, the possibility remains that casualties requiring additional intervention, independently access appropriate healthcare services to resolve their difficulties. This possibility needs further investigation before implementing any proposed service development. A&E attendances provided a larger estimate of RTC casualty numbers than police data, difficulty obtaining information from many hospitals prohibited estimation of the total RTC attendance for the region and consequently the target population.

In view of the recognised distortions inherent in the HES and STATS19 systems, improvements in retrieval of A&E records maybe the easiest method of determining a more accurate assessment of the total RTC casualty population.

The reliability of the reported mosaic impression was also affected by the inconsistent and idiosyncratic completion of the clinical records. The hospital systems also lacked the rigorous coding systems integral to STATS19, resulting in problems interpreting, coding and analysing the extant data. The use of existing data sources did enable large volumes of casualty data, recorded within typical clinical settings and free from the influence of collection during a research study. However, the original purpose of these records differed from the study aims and not all the requisite information was recorded or comparable between data sources. Adoption of a consistent national A&E coding system would permit more ready comparison of RTC consequences across the UK and hence build a more robust understanding of RTC casualties, essential to the development of future services.

Study A identified the limitations in currently used national RTC data and proposed A&E as a more inclusive source of RTC information than that offered by the STATS19 system. The A&E data, together with the other information sources, was used to develop a more extensive understanding of RTC casualties. A range of information was explored since the design of the proposed service model required understanding of:

- Who crashes?
- Why they crash?
- What happens after a crash?

The study revealed that on average over 3000 RTC casualties attended northwest A&E departments annually. To address the needs of a population of this size therefore requires a strong information infra-structure and service pathways that correspond to the profile of its service users (Platform). Whilst the image of the typical service user was developed, the study also revealed the strong involvement of both genders and the wide age range of casualties. Thus gender and age appropriate services must be developed, particularly as the results suggested greater risk of psychological distress amongst women and their reported risk for chronic whiplash and pain after a crash (Dufton, Kopec *et al.*, 2006). Whilst a minority of casualties had severe injuries and were admitted to hospital, the majority were discharged without follow-up.

Development of strategies to offer "stepped care" pathways, consisting of advice, monitoring and early intervention, must be undertaken to achieve the recommended clinical guidelines for WAD (Spitzer, Skovron *et al.*, 1995), PTSD (NICE, 2005) and depression (NICE, 2007).

The study failed to obtain an understanding of the contributory factors for RTCs from an A&E perspective, whereas the Police reported detailed information on road conditions, speed, and substance misuse. Further research to investigate this area from a clinical perspective would aid understanding of how pre-crash psychological factors, such as risk taking, (Norris, 2000), stress and low self-esteem (Dobson, Brown, Ball, Powers and McFadden, 1999) or social factors such as social deprivation (Department for Transport, 2008) impact on causation and the recovery environment.

Study A revealed that most casualties sustained minor injuries, particularly WAD which is often enmeshed with psychological issues (Mayou, Tynde and Bryant, 1997; Stirling, Jull *et al.*, 2005). This suggested there may be benefits in integrating the physical and psychological needs of this population in the early stages of recovery. Although it was postulated that a sizeable proportion of casualties would be distressed after a crash, placing them at risk of subsequent PTS disorders, the results of Study A4 indicated that most casualties showed no signs of distress, suggesting very low risk in this population. Thus, further evidence was required to test the need for the PlaTO model and investigate whether this population was at low risk of PTS disorders.

To overcome the limitations in using retrospective extant data, a prospective study of casualties was necessary to augment the understanding already gained about RTCs and their consequences. Additional research was required to investigate the prevalence of PTS disorders after a RTC, thereby, overcoming the intrinsic difficulties involved in using the proxy measure of "distress".

The enhanced understanding through Study A regarding the volume of RTC casualties (~ 10 per day) and their limited follow-up healthcare, suggested the need to investigate pre and peri-crash risk factors capable of predicting subsequent psychological problems. Given the rarity of follow-up identified, predictive screening would be most beneficial, if it was undertaken whilst casualties attended the A&E department. Study B endeavoured to address these further concerns through a prospective primary research study.

This chapter has described the process undertaken to develop an understanding of the prevalence of RTCs and their consequences, within the UK. This study as primarily used extant data, although poor quality or limited reporting of key information has been identified as a limitation of this study, which was partially addressed through the development of a mosaic impression of the topic, from overlapping and comparison of key information between sources.

CHAPTER 7

Study B: Design and Method

This chapter will describe the design considerations and method undertaken to complete Study B, the outcomes of which aimed to build on the understanding gained through Study A and investigate directly the prevalence of PTS disorders, associated risk factors and the consequences for road crash casualties following their discharge from A&E.

Study B (Targeting issues)

Previous published studies have reported the occurrence of PTSD after a RTC, although the reported prevalence varied (10-30%) (O'Donnell, Creamer *et al.*, 2008) and few studies have investigated the prevalence of other PTS disorders (O'Donnell, Bryant *et al.*, 2008). In contrast, Study A found limited evidence of signs of "distress" noted within casualty records. Immediate emotional distress forms part of the diagnostic criteria for ASD and PTSD (American Psychiatric Association, 1994) so such responses were anticipated to indicate subsequent risk of PTS disorder. The results from Study A contradicted the need to develop a strategic RTC psychological service. It was therefore essential to conduct primary investigation to directly investigate the prevalence of PTS disorders amongst RTC casualties and compare the results with previous prevalence studies and Study A.

Clinical guidance for the management of PTSD, anxiety and depression recommended that individuals should be assessed and monitored in the early stages of the disorders (McIntosh, Cohen *et al.*, 2004; NICE, 2005; NICE, 2007). However, the annual incidence of RTC casualties and the lack of follow-up healthcare after A&E, revealed by Study A, suggested that strategies were necessary to establish post-impact psychological care pathways (European Road Safety Observatory, 2007). Previously, the majority of risk factors analysed have only had modest effect sizes (Brewin, Andrews *et al.*, 2000; Ozer, Best *et al.*, 2003) with insufficient power to predict individuals at high risk of PTSD. By focusing attention exclusively on risk factors for the RTC population, the study aimed to determine whether it was feasible to predict PTS disorders amongst crash casualties whilst attending A&E. By investigating the feasibility of screening for risk of PTS disorders in A&E the results were able to inform a crucial design element (Targeting phase) for the PlaTO service.

Road crashes can impact upon individuals at both a physical and psychological level with the potential to impair functioning in daily life (Holbrook, Anderson *et al.*, 1999). Such outcomes, whilst of great significance to individuals are often neglected within research studies. Due to high propensity for whiplash injuries in this population, noted in Study A, it is important that the prevalence of functional impairment within daily life was examined alongside the prevalence of psychological problems for RTC casualties.

Whilst existing clinical guidance (NICE, 2005) recommends specific monitoring and early intervention for people following a traumatic event, for everyday traumas such as RTCs NICE suggest it should occur through routine primary care services. Whilst Study A identified that directed follow-up healthcare was rare upon discharge from A&E, it remained possible that casualties independently accessed appropriate psychological support and healthcare. It was therefore necessary to investigate the services RTC casualties received after discharge from A&E, before determining whether the establishment of another service was justified.

Gender differences have been previously reported following many different types of traumatic event and in general females have a greater incidence of PTSD, even when exposure type was controlled (Norris, Foster *et al.*, 2002). Consequently investigation of gender differentiated risks may enhance increase the predictive power of any emergent models of PTS disorder and promote a more personalised understanding of assessment and support necessary within the proposed PlaTO service model.

Women have also been reported to be more vulnerable to chronic WAD and back pain (Bring, Bjornstig *et al.*, 1996; Dufton, Kopec *et al.*, 2006), conditions with a psychological dimension (Mayou and Radanov, 1996; Stirling, Jull *et al.*, 2005), commonly reported by casualties in Study A. Furthermore women have been reported to be more vulnerable to injury and 25% more likely to be killed than men, in the same collision (Evans, 2004). Further exploration of the prevalence and range of differences in risk factors for physical and psychological problems between men and women was indicated, in view of the literature and the drive within the NHS, to improve the personalisation of healthcare services (Lord Darzi of Denham, 2008). Study B has previously reported the limitations encountered in the risk factor models for PTS disorders.

All of these aspects of RTCs needed to be investigated in order to ensure that the PlaTO model was designed to be fit for purpose and relevant to the needs of potential service users.

Study B Purpose

The purpose of the study was to investigate the prevalence of PTS disorders, associated predictive factors and consequences of a RTC for a sample of road crash casualties. There was an additional need to analyse the results from a gendered perspective in view of the recognised differences in prevalence, risk factors and injury patterns between men and women (see Chapter 2 and 3).

Study B: Research Questions

A) What was the prevalence of PTS disorders following a RTC?

B) What predictive factors were associated with PTS disorders following a RTC?

C) What were the consequences of a RTC?

D) Were there gender differences in the prevalence of PTS disorders, predictive factors and consequences of a RTC?

Study B: Design Considerations

A quantitative research approach was necessary to achieve the purpose and inform the research questions. In addition to Robson's framework (Robson, 2002), prevailing legal and ethical considerations strongly influenced the study design. To understand about crashes and their consequences, Study B required information from the perspective of RTC casualties, but also aimed to generalise the findings to the target population. Whilst the utilisation of extant data in Study A permitted large volumes of data to be analysed, the results were typically limited by the type and quality of the original data entered (David and Sutton, 2004). To collect the data of concern, primary participatory research was undertaken to avoid the difficulties with extant data (American Society for Training and Development, 2009). As repeated measurements were required, interview would have reduced the number of participants. Interviews place high demands on participants and casualties may have found it difficult to return to the hospital for an interview.

In contrast, a survey enabled a greater number of casualties to participate, thereby offering both breadth and depth to the data. A longitudinal survey method was selected, since they are useful for tracking the psychological impact of events over time (Fife-Shaw, 2000), particularly necessary when assessing ASD and PTSD, since they require measurement at two different time-points. However, such studies risk attrition with each repeated measurement (Fife-Shaw, 2000), so strategies were implemented to maintain the sample integrity at the second measurement period. RTC casualties were considered vulnerable by the hospital ethics committee (LREC) and their immediate involvement whilst in A&E was not permitted. As this A&E population historically had low participant rates for research, the survey had to be brief, the questions simple and the time limit of Study B reduced to one month to maximise participation. Due to the diagnostic criteria for PTS disorders the surveys had to be conducted within rigid time constraints, with the potential to further constrain the response rate. As RTCs happen unpredictably, it was necessary for the A&E reception staff to be trained in the recruitment and assessment of casualties' eligibility for participation in the study, to maximise the response rate. Reception staff were vital to the distribution of the research packs to eligible casualties, in order to ensure the sample recruited was representative of all casualties admitted, around the clock and throughout the week.

A judiciously selected hospital sample was necessary, since efficient IT systems were required to support the project and Study A had revealed that few hospitals had adequate computer systems. It was estimated that a minimum quota sample of 200 RTC casualties would be necessary, consistent with previous power calculations that recommended sample sizes of 200 for this population (O'Donnell, Creamer, Bryant, Schnyder and Shalev, 2003). To obtain the sample, it was estimated from similar studies in the same department that a minimum of 1000 consecutive eligible RTC attendees were required based upon a 20% response rate.

Two different self-report surveys required development, to correspond with the diagnostic timescale of ASD (2-28 days) and PTSD (after one month). For practical reasons and to obtain an early assessment of ASD, data collection points of one week and one month were selected. The questionnaires in the study had to fulfil several purposes. The tools had to be able to determine the prevalence of PTS disorders, identify predictive factors and report the immediate and prolonged consequences of an RTC.

It was essential that the survey was as short as possible and used simple questions that were worded in a format amenable for use within triage/screening in A&E, to investigate their merit within a routine screening process.

Study B Method

This study followed a quantitative approach and consisted of a prospective design using a survey method with two data collection points. A judicious quota sample, of participant casualties who attended Hospital A after a RTC, was recruited for the study, since this hospital had the necessary infra-structure to support the project and the co-terminus boundaries between the police and hospital, aided the comparison of RTC data. The study was undertaken according to the sequence outlined in Figure 25. The design for Study B and C was developed through dialogue with A&E and the local research ethics committee, to ensure its feasibility through the development of the necessary infrastructure within A&E before commencing the study. This included liaison with IT and A&E departments, training A&E staff and publicising the study through presentations and posters displayed in A&E.

Ethics

The dialogue with LREC focused on the potential vulnerability of the participants when in A&E, necessitating that recruitment involved an opt-in process after discharge from A&E and that the initial commitment was limited to one month. This was to minimise the intrusion in A&E and the potential to exert pressure on casualties to agree to participate, whilst they were receiving treatment from the department. An ethically robust consent process was developed through consultation with the relevant ethics committee and the hospital research department. This involved the receptionists not clinical staff, making casualties aware of the study on arrival in A&E and distributing information on participation to those deemed eligible. Casualties were provided with detailed information to assist them in the decision of whether to participate, through an "opt-in" process after they were discharged from hospital. They received this via the study information sheet, consent forms and direct access to a member of the research team who could answer their queries about the study. Ethical approval was granted for the study by the relevant LREC (Appendix 9).

Recruitment

This was conducted by the A&E reception staff, following training to familiarise them with the eligibility criteria (Figure 24). The A&E reception staff screened all attending RTC casualties for eligibility and those deemed appropriate were provided with a research pack containing an introductory letter, patient information sheet, consent forms and the Screening Questionnaire (Appendix 10), together with a first class, stamped addressed envelope. One thousand and fifty seven RTC casualties who attended Hospital A for treatment were considered for participation, in order to achieve the required quota of 200 eligible adult participants.

Data Collection

The screening questionnaire was developed to assess key aspects of the participant's pre-crash history, peri-crash experiences and ASD symptoms, a week after the crash through the inclusion of questions addressing pre and peri-trauma variables, along with the Acute Stress Disorder Scale (ASDS) (Bryant, 1999).

Pre-Crash Factors

Age and gender have been linked to the development of PTS disorders, (Ehlers, Mayou *et al.*, 1998; Brewin, Andrews *et al.*, 2000) so they were included within the screening questionnaire. Smoking was included since PTSD has been linked to nicotine dependence (Morrisette, Tull, Gulliver and Zimering, 2007). Alcohol use was included, because of its association with RTCs and PTSD (McFarlane, 1998). Employment was included as an indicator of pre-crash functioning and in view of the impact crashes have on productivity (Elvik, 2000).

Social support has been linked to both physical and psychological trauma recovery (Dean and Lin, 1977; Cohen and Symes, 1985; Holeva, Tarrier *et al.*, 2001). A subjective rating scale was included, since individual perception, appears more important. Previous physical health, in terms of chronic ill health was included since injury due to the crash may exacerbate such underlying health issues. Previous trauma history, personal and family mental health problems have been associated with increased risk of PTSD (Brewin, Andrews *et al.*, 2000; Ozer, Best *et al.*, 2003).

Peri-Crash Factors

Ehlers and Clarke's model (2000) highlighted the significance of idiosyncratic warning cues, for the development of intrusive memories and so individual crash perceptions were obtained. The participant's perception of their injury severity, their level of unreality (dissociation) and arousal were assessed. Scaled responses were used to rate severity of dissociation and injuries sustained. Free text was used to describe perceptions of the crash and a dichotomous response assessed fear. The term terror was used to ensure positive responses related to high levels of arousal and not mild anxiety.

The final section of the questionnaire consisted of the Acute Stress Disorder scale (ASDS). This is a validated 19 item self-report inventory, which assessed symptoms of Acute Stress Disorder and aims to predict PTSD (Bryant and Harvey, 2000). The ASDS possessed good sensitivity (95%) and specificity (83%) compared with the ASD interview with civilian trauma survivors. It had been validated with adults in mixed trauma populations including RTC casualties with good overall psychometric properties, dependent on the diagnostic cut-off points applied (Bryant and Harvey, 2000). Test–retest reliability of the ASDS scores between 2 and 7 days was strong ($r = 0.94$).

Table 4: Screening Questionnaire factor types

Question	Factor Type
A1 Gender	Pre-trauma
A2 Age	Pre-trauma
A3 Employment	Pre-trauma
A4 Social support	Pre-trauma
B1 Physical Health	Pre-trauma
B2 Smoking	Pre-trauma
B3 Drinking Alcohol	Pre-trauma
B4 Previous mental health	Pre-trauma
B5 Family mental health	Pre-trauma
B6 Previous Traumas	Pre-trauma
B7 Trauma type	Pre-trauma
B8 Additional information	Pre-trauma
C1 Date of crash	Background information
C2 Subjective severity of Injuries	Peri-trauma
C3 Subjective feeling unreal/strange	Peri-trauma
C4 Subjective description of Crash	Peri-trauma
C5 What did you think would happen?	Peri-trauma
C6 Did it terrify you?	Peri-trauma
C7 ASDS	Post trauma

As the purpose of the study was to examine symptoms of PTS reactions in the population and not to obtain a firm psychiatric diagnosis, the lower cut-off score of 50 was used to determine stress "caseness". The higher cut off point of 56 was used as a predictor of PTSD (Bryant and Harvey, 2000).

One Month Questionnaire

The second questionnaire distributed after one month assessed PTSD (IES-R), depression (BDI), general psychological health (GHQ 12), daily functioning (WAS) together with health and legal services used in the month after the crash. Social support structure and function (MOS) and dissociative experiences (PDEQ) were also included, to evaluate the impact of these in the post-crash period.

Health Care Appointments Log (HCA)

This was designed specifically for the study (Appendix 11) and required participants to report healthcare attendances, treatment and involvement with legal procedures in connection with their crash.

General Health Questionnaire (GHQ-12)

The GHQ-12 was developed in the UK as a brief self-report measure to detect new "cases" of psychiatric disorder in community and non-psychiatric settings (Sturgis, Thomas, Purdon, Bridgewood and Dodd, 2001; Shelvin and Adamson, 2005). It only takes a few minutes to complete and was considered to have high diagnostic validity (Goldberg and Williams, 1988).

The twelve questions, report mood, anxiety symptoms, and sleep problems compared to normal, using a four point scale. The GHQ bimodal scoring was used, based on a four point response scale (symptom present: 'not at all' = 0, 'same as usual' = 0, 'more than usual' = 1 and 'much more than usual' = 1) with the cut-off point for "caseness" was a score of three or more (Goldberg and Williams, 1988), although a higher level cut-off score of six can be used to indicate severe disorder (Sturgis, Thomas *et al.*, 2001). This GHQ12 had high validity, with good sensitivity to detect cases appropriately (71-91%) and specificity to identify non-cases (71-91%) (Goldberg and Williams, 1988).

Work and Social Function Scale (WAS)

Function, although problematic to patients, is often overlooked in research studies in favour of symptom measurement (Mundt, Marks, Shear and Greist, 2002) so was included here. Participants stating they had some overall impairment, were completed the five items of the WAS. The use of the WAS has been tested with anxiety and depression (Mundt, Marks *et al.*, 2002). Internal consistency in the depression study has been reported with a Cronbach's α from 0.70 to 0.94 and the test-retest correlation was 0.73. The WAS offers a profile of functional impairment, where any score above zero indicates a functional deficit in a particular area. Scores of ≥4 were taken to indicate a significant impairment.

Beck Depression Inventory (BDI)

The Beck Depression Inventory (BDI) rates the intensity of depression (Beck, Steer and Carbin, 1988) and has been used as a community screening tool (McDowell and Newell, 1996). The internal consistency was reported between 0.73-0.92. Concurrent validity with clinicians' ratings of depression, range from 0.62– 0.66 (Beck, Steer *et al.*,1988). Sensitivity measured against the diagnostic interview schedule was 84.6% and specificity 84.6% (McDowell and Newell, 1996). The following BDI cut-off scores have been recommended; none or minimal depression is < 10; mild to moderate depression 10-18; moderate to severe depression is 19-29; and severe depression is 30-63 (Beck, Steer *et al.*, 1988). In this study, the threshold for low mood "caseness" was taken as a ≥10 or but to include individuals with low mood rather than only depression.

Impact of Events-Revised (IES-R)

The Impact of Events Scale-Revised (IES-R) is a short 22 item questionnaire designed to parallel the DSM-IV criteria for PTSD (Weiss and Marmar, 1997). This revised version was designed to maintain comparability with the IES whilst including hyperarousal (Weiss and Marmar, 1997). Respondents had to endorse each item using a scale of 0-4. The IES-R had a test-retest correlation co-efficient for intrusion 0.57-0.94, avoidance 0.51-0.89 and hyperarousal 0.59-0.92. (Weiss and Marmar, 1997). Testing of a community sample of war veterans found that the IES-R subscales and total scores correlated with the PTSD checklist (PCL) total score (Creamer, Bell and Failla, 2003). Despite warnings against using it diagnostically (Weiss, 2004) it has become customary to use "cut-off" scores (Creamer, Bell *et al.*, 2003) with scores above 24 considered indicative of PTSD. Creamer et al (2003) report that the highest diagnostic power (0.88) for the IES-R was achieved, applying a cut-off score of 33. This point had a sensitivity of 0.91, specificity of 0.82 a positive predictive power of 0.9 and a negative predictive power of 0.84. The recommendations of Creamer Bell and Failla (2003) were followed in this study.

Peri-traumatic Dissociative Experiences Questionnaire (PDEQ)

The PDEQ is a 10 item questionnaire, rating severity of peri-trauma dissociative experiences (Marmar, Metzler and Otte, 2004). It offers a comprehensive assessment of dissociation, but was too lengthy to include within the screening questionnaire. Symptoms were rated and the average score obtained with values greater than 2 indicative of dissociation.

Medical Outcomes Social Support (MOS) and additional VAS social support measures

The MOS measures social support (Sherbourne and Stewart, 1991) originally developed for an ambulatory sick population. It has one structural support item and four dimensions of functional social support, measured using a five point scale. The MOS has been reported to have correlations between the subscales ranges from 0.69 – 0.82, with good stability over a year (overall test-retest = 0.78) (Sherbourne and Stewart, 1991). A further three specific questions were included that focused on support received and satisfaction. Two questions used a 10cm visual analogue scale to probe complex perceptual constructs. Values were recorded to one decimal place. A further free text question was used for participants to describe the most valuable support they had received. This was coded and analysed thematically.

Both the screening and one month questionnaires were presented to the participants as a booklet, with detailed instructions provided for their self-completion, although telephone assistance was also made available to those requiring such support. Casualties, who agreed to participate, initially completed and returned the consent forms and screening questionnaire 2-7 days after the crash (Figure 26). A second research pack was sent to any casualties, who had not returned their questionnaire after 5 days. Questionnaires returned more than 10 days after the crash were excluded from the study to ensure comparable completion times.

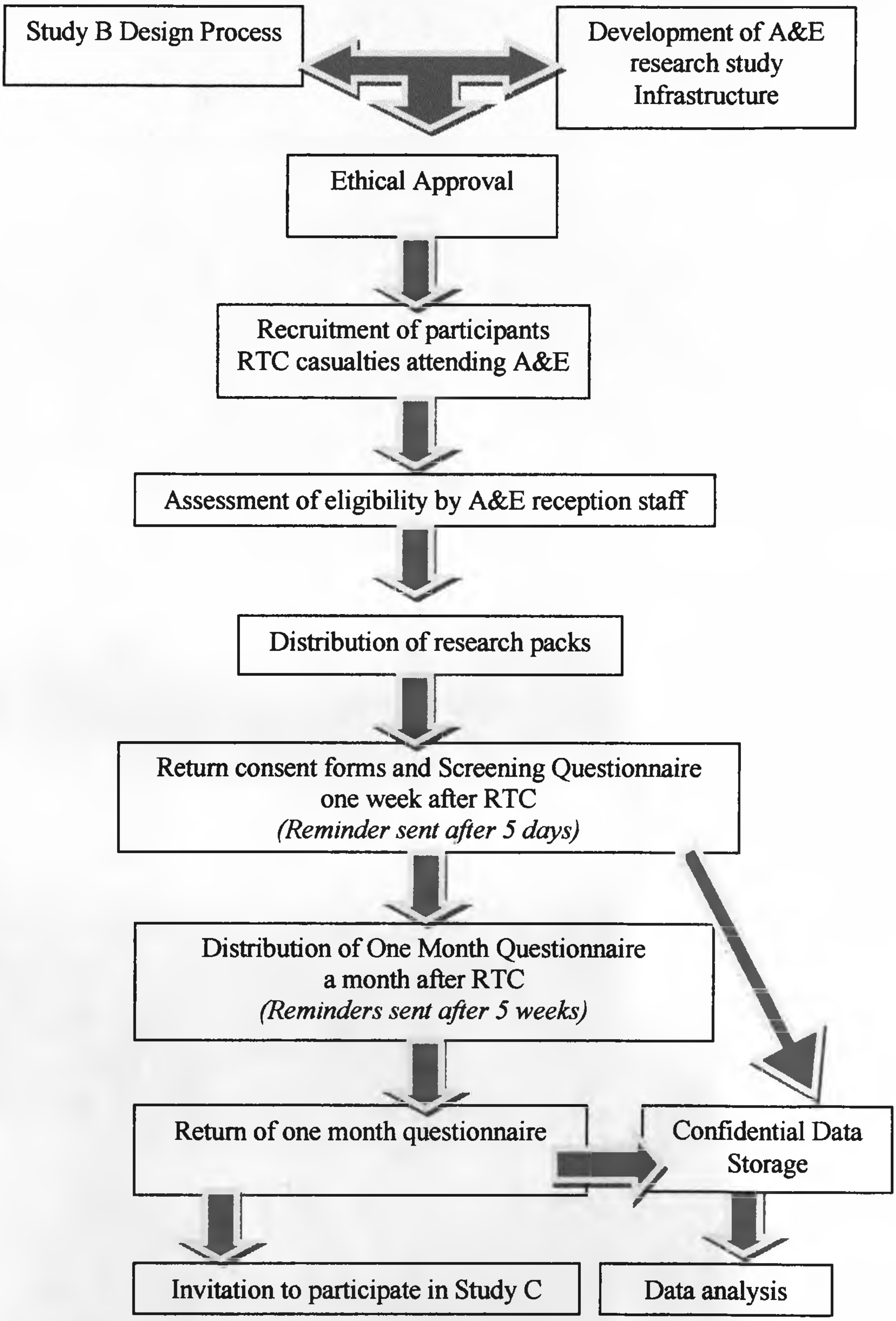
Participants subsequently completed the One month Questionnaire, which was sent out to them at one month. Participants not returning the One month questionnaire by the following week were sent a reminder. A phone call was also made to ensure the participant had received the information. Questionnaires returned more than 6 weeks after the crash, were excluded from the study to ensure comparable completion times amongst participants.

Confidentiality

The personal nature of the information required from participants necessitated rigorous confidentiality throughout the study. Storage of all data complied with the Data Protection Act (1998) and all questionnaires were coded prior to distribution. The consent forms and the participants' code numbers were stored securely and separately from the questionnaires to prevent any breach of confidentiality. The researcher was required to comply with their professional code of conduct and research ethics whilst undertaking the study.

Figure 24: Study B and C Inclusion / Exclusion Criteria	
Participant Inclusion Criteria	
1.	Attended Accident & Emergency Department of Hospital A
2.	Involvement in a road traffic crash
3.	Involvement in the crash as one of the following; driver, rider, cyclist, passenger, pillion, pedestrian
4.	18 years of age or above
5.	Able to give valid consent to participate in the study following attendance at A&E
Participant Exclusion Criteria	
1.	Clinical and /or scan findings indicative of severe head injury
2.	Presence of pre-existing organic brain disorder
3.	Major diagnosis of substance abuse
4.	Left A&E before being assessed
5.	Emergency services personnel attending an RTC
6.	Road traffic crash was deliberate
7.	Road traffic crash was more than 5 days before attending hospital
8.	Unable to give valid consent to participate in the study

Figure 25: Study B Research Method Flowchart



Data Analysis

The data from the two questionnaires was coded (according to the numerical codes on the questionnaires, apart from the free text questions), cleaned and analysed using SPSS 16. Free text questions were categorised by emergent themes and verified by mutual agreement with two independent researchers. The demographic characteristics of the participants were analysed for comparability with the annual population of crash casualties attending the A&E department.

The specific statistical tests performed are reported with the results for each study.

Approaches to Data Analysis

Significance for all statistical tests was set at the 0.05 level.

Where data was not normally distributed non-parametric tests were applied.

To avoid errors arising from small cells numbers within χ^2 analysis, cells were merged, which therefore results in some analyses involving less categories than originally were available on the questionnaires.

When undertaking regression analyses the main aim was to identify factors with an independent association with the identified outcome variable. A parsimonious approach was taken throughout, to provide the most useful clinical tool, hence throughout the multiple regression analyses the data were entered "stepwise" (Field, 2005).

All regression was undertaken using an ordinary least squares (OLS) linear regression analysis through SPSS16. The dependent variables used were continuous and scatter plots were used to test for a linear profile against continuous independent variables. Categorical independent variables were coded as "dummy" variables with a zero base in order to enable differences to be treated "similarly" to continuous variables. Multi-collinearity was tested for using the Tolerance statistic and values below 0.2 were considered to be of concern.

This chapter has provided details of Study B carried out to achieve its stated purpose. A detailed description of the method carried out in order to obtain the requisite data was included, together with steps taken to ensure ethical and legal obligations were adhered to.

Figure 26: Road traffic crash and research Study B assessment timescale

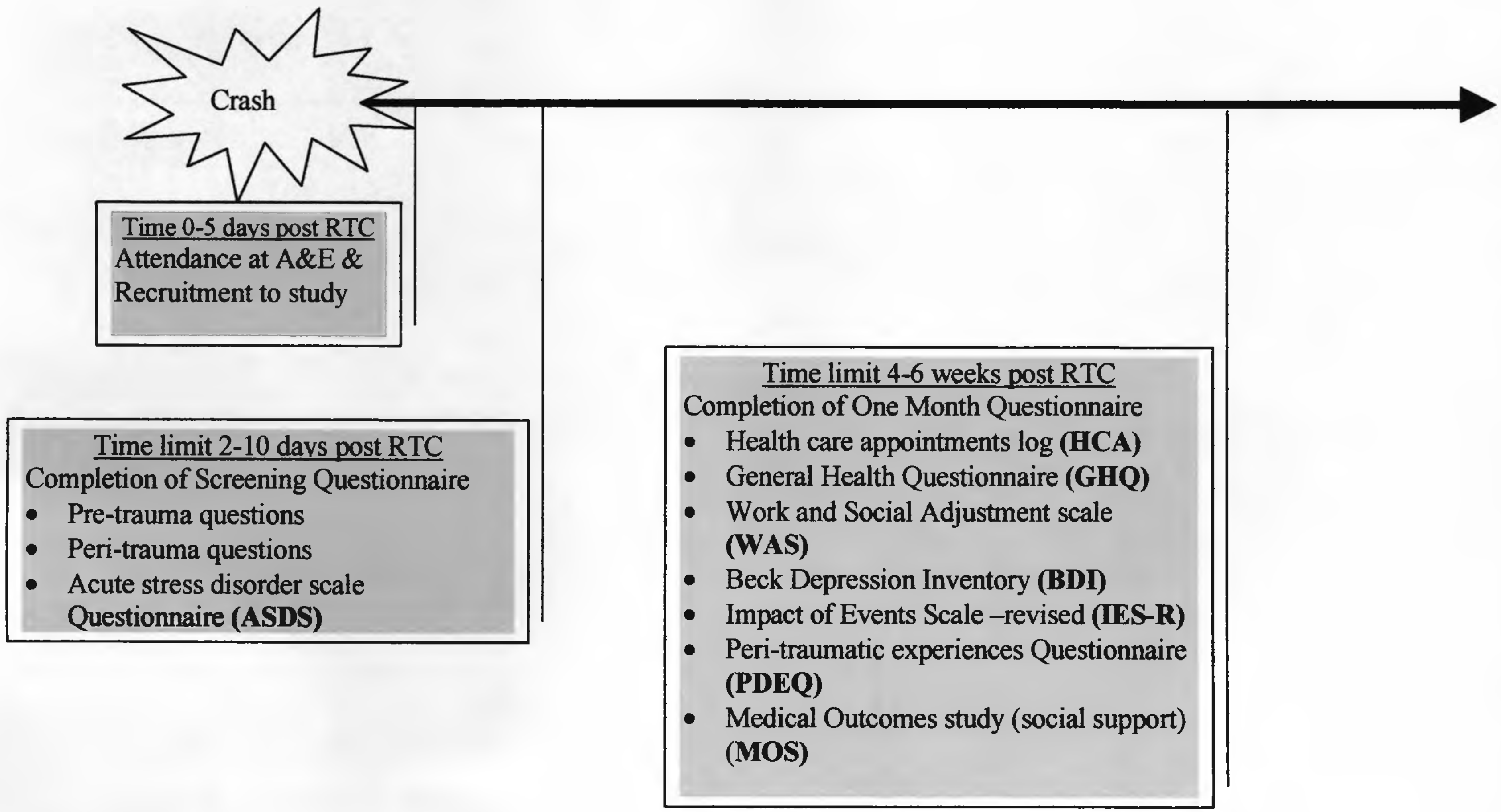


Figure 27: Summary of Study B Research Questions

Study	Study B Research Questions	Analysis
A	**What was the prevalence of PTS disorders following a RTC?**	Analysis of frequencies for B1i – B1vi
	What was the prevalence of ASD following a RTC?	Frequency of ASD scores of ≥ 50 at one week
	What was the prevalence of PTSD following a RTC?	Frequency of IES-R scores of ≥ 33 at one month
	What was the prevalence of depression following a RTC?	Frequency of BDI scores of ≥ 10 at one month
	What was the prevalence of psychiatric disorder following a RTC?	Frequency of GHQ scores of ≥ 2 at one month
B	**What predictive factors were associated with PTS disorders following a RTC?**	Analysis of variance and OLS regression
	What predictive factors were associated with ASD following a RTC?	Correlation between ASD score, demographics, pre-crash and peri-crash factors
	What predictive factors were associated with PTSD following a RTC?	Correlation between IES-R score and screening questionnaire scores and other one month measures
	What predictive factors were associated with depression following a RTC?	Correlation between BDI score and screening questionnaire scores & other one month measures

C	**What were the consequences of a RTC?**	
	What functional impairment was reported by RTC casualties a month after a crash?	Frequencies of WAS scores ≥4 at one month
	What healthcare services did RTC casualties receive after discharge from an A&E department?	Frequency of reported attendance, medication use and litigation involvement
D	**Were there gender differences in the prevalence of PTS disorders, predicative risk factors and consequences of a RTC?**	Analysis of frequencies, Analysis of variance and multifactor regression
	Were there gender differences in the prevalence of PTS disorders?	Independent t test, χ^2
	Were there gender differences in predictive risk factors for PTS disorders?	Independent t test, χ^2 Analysis of variance and multifactor regression
	Were there gender differences in the consequences of PTS disorders?	Independent t test, χ^2

CHAPTER 8

Study B: Results

This chapter will present the results for Study B, undertaken to investigate the impact of a RTC and its consequences for a participant sample of casualties who attended their local A&E department after a crash. The results explored the psychological, functional and healthcare impact a month after the crash and potential risk indicators for subsequent pathology.

The purpose of Study B (page 113) was addressed through four research questions.

Participation

Out of the 1057 people screened for eligibility, 154 were excluded due to age and 36 due to injury severity. A total of 867 casualties were given an invitation to participate in the study (Figure 28). Consent forms and completed screening questionnaires were returned from 201 casualties within the required time-period, although only 200 completed the ASDS. This gave a response rate of 23% for Time 1.One month questionnaires were distributed to 201 participants and 144 were returned within the required time period giving a 72% response rate for Time 2. The recruitment rate, although low, was not atypical for the department, particularly given the rigid time constraints. Although attrition rate was a concern from a design standpoint, the follow-up measures adopted, enabled a good response rate for Time 2.

The two groups of casualties (participant group and the annual adult RTC casualty group from Hospital A) were compared across key variables (Figure 29). The participants had a higher mean age than the annual population (40yrs vs. 32yrs) and a reversal of the gender profile with participants being predominantly female (54%) in the sample, with the potential to inflate the overall frequency of PTSD and injury severity. When analysed, these differences were statistically significant. A higher proportion of drivers and fewer passengers participated in the study than the annual population and whilst the different proportions were numerically small, they were significant. Treatment also differed, with slightly less hospital admissions and more participants with no treatment in the study sample.

Figure 28: Participant Flowchart for Targeting Study B

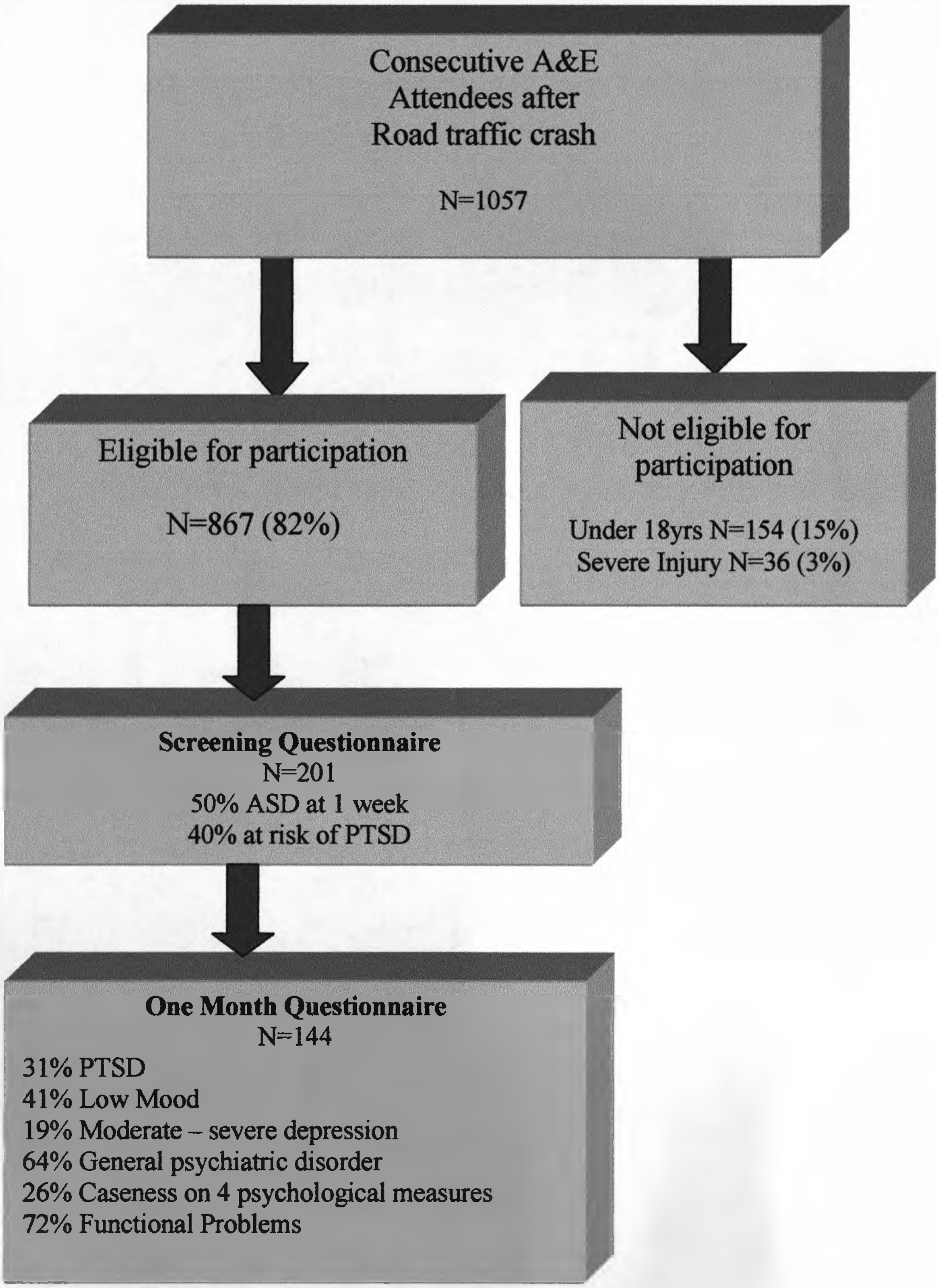


Figure 29: Comparison of Participating to Annual Hospital A Crash Casualties in Targeting Study B

Variable	Total Attendee Group (18+yrs)	Participating Group	Difference between	Statistical test
N	**3283**	**201**		
Age (Mean +/-SD)	37 +/- 15.2	40.2 +/- 15.2	Yes	t -2.9, df 3109, sig 0.003 , 2 tailed
Gender (%Male)	55%	46%	Yes	χ^2 6.7, df 1, sig 0.009, 2 tailed
Road User Type			Yes	χ^2 22.538, df 3, sig 0.001, 2 tailed
Driver	58%	65%		
Passenger	26%	21%		
Motorcyclist	7%	6%		
Pedestrian	5%	4%		
Cyclist	2%	3%		
Injury			No	χ^2 4.533, df 4, sig 0.339, 2 tailed
Upper limb strain	6%	3.5%		
Contusion/ Bruising	0.6%	0		
Lower limb strain	0.7%	2%		
Fracture	2%	2%		
Major Head Injury	0.2%	0		These categories were merged for further analysis
Internal Injuries	0.5%	0		
Other	0.6%	0.5%		
Not Known	90%	93%		
Psychological	0% (n=1)	0% (n=0)		
Treatment			No	χ^2 10.984, df 3, sig 0.12, 2 tailed
None	2%	0.5%		
Advice	14%	18%		
Admit	2%	0.5%		
Fracture	3%	5%		

Analgesia	2%	3%		These categories were merged for analysis
Dressings	2%	1%		
Unknown	68%	72%		
Follow-up			No	χ^2 2.596, df 4, sig 0.628, 2 tailed
None	36%	41%		
GP	2%	2%		
Clinic	3%	4%		
Admit	5%	4%		
Not Known	47%	50%		
Length of Stay Range (days)	0.4 SD+/- 3 Range 0 - 78	0.1 SD+/- 0.8 Range 0 - 8	No	t = -1.31, df 3710, sig 0.189, 2 tailed
A&E Attendance day			No	χ^2 2.962, df 6, sig 0.814, 2 tailed
Monday	15.1%	13.4%		
Tuesday	15.2%	13.4%		
Wednesday	14.4%	13.4%		
Thursday	12.8%	16.8%		
Friday	15.7%	16.3%		
Saturday	13.4%	13.4%		
Sunday	13.4%	13.4%		
Hour of Day			No	χ^2 1.66, df 2, sig 0.558, 2 tailed
04.00-17.59	65%	67%		
18.00-21.59	27%	25%		
22.00-03.59	8%	8%		

Although the recorded treatment differed significantly between the groups, the quality and reliability of the records was poor, due to large amounts of missing data. No difference was found in terms of follow-up between the two groups, although again the quality of this data limits any statistical interpretation. The length of stay (LOS) did not differ between the two groups. This variable served as a proxy measure of injury severity, which conferred with the injuries recorded for the two groups. No significant difference was established between groups in terms of the day or time they attended the A&E department.

Therefore, when extrapolating the outcomes of Study B, the potential impact of the response rate and the key differences in participant characteristics must be considered, as women and elderly may be at increased risk of PTSD and physical injury and both these groups were over-represented in the sample.

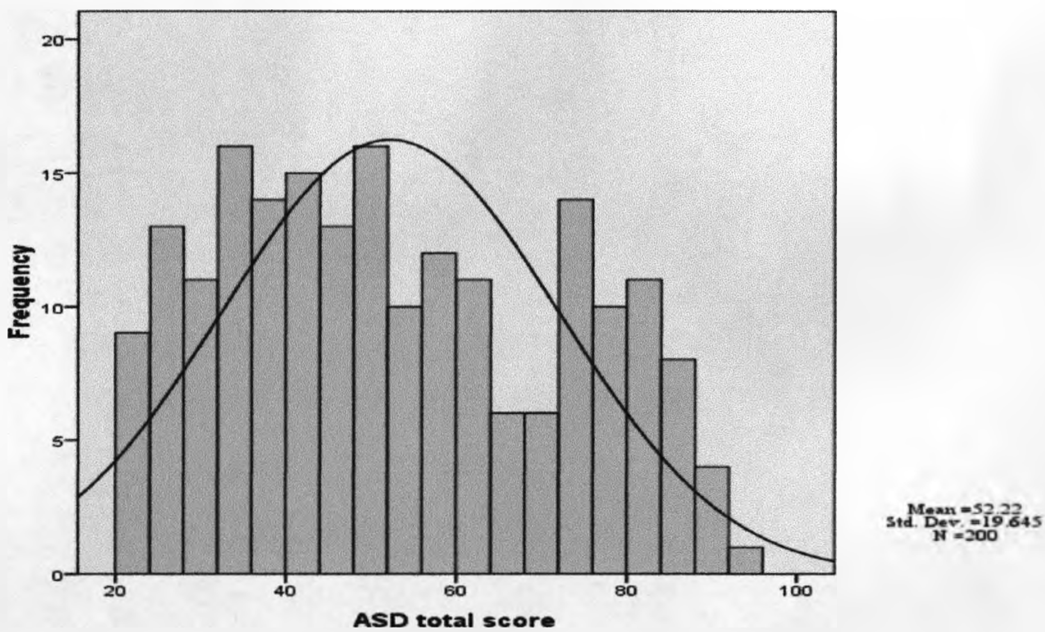
What was the prevalence of PTS disorders following a RTC?

This question was informed through four specific research questions (Figure 27).

What was the prevalence of ASD following a RTC?

Analysis of the total scores on the ASDS completed by the participants showed that they reported a full range of scores (Figure 30).

Figure 30: Range of ASDS scores for RTC casualties at one week



The mean score was 52.2 (SD± 19.6), which fell above the ASD "caseness" threshold of 50. Above "caseness" symptoms of ASD were reported by 50% of the participants. Using the higher cut-off point of 56 on the ASDS to identify PTSD risk (Bryant and Harvey, 2000); it was found that 40% of the participants were at risk (Figure 30), with a quarter of the participants reporting severe ASD symptoms^{W}[1] ($\geq$ 70).

Summary

In contrast to the results of Study A4, acute psychological distress was widely experienced by the participants in the week after a RTC and 40% were at risk of developing PTSD. When considering whether a service was justified to meet the psychological needs of this population, these results indicated that in the first week very high levels of acute distress were typical and services to monitor people at risk of PTS disorders, would require clearly defined care pathways. Extrapolation from this study equated to 1558 adult RTC casualties per annum (based on 2003 data) experiencing ASD and 779 at risk of PTSD, who may benefit from support and early intervention.

The results of this study indicate that 50% of RTC survivors who attended an A&E department reported symptoms indicative of ASD a week after a crash .Further research was required to determine the prevalence of PTSD after one month, in this sample, compared to the numbers highlighted as being "at risk" at one week.

What was the prevalence of PTSD following a RTC?

The IES-R^{W} (Weiss and Marmar, 1997) contained in the One month questionnaire, was used to assess PTSD symptoms. Participants reported the whole range of scores (Figure 31) with a mean value of 25.7 ± 21.3 and a positively skewed distribution. Using the recommended case level cut-off score of 33 (Creamer, Bell et al., 2003), 31% of participants reported symptoms indicative of PTSD.

Summary

A month after a RTC [45], 31% of participants reported symptoms consistent with PTSD. Some participants with ASD had improved over the month, but nearly a third had PTSD. Previous ASD scores suggested that 40% of the sample were at risk of PTSD, although only 31% developed PTSD after a month.

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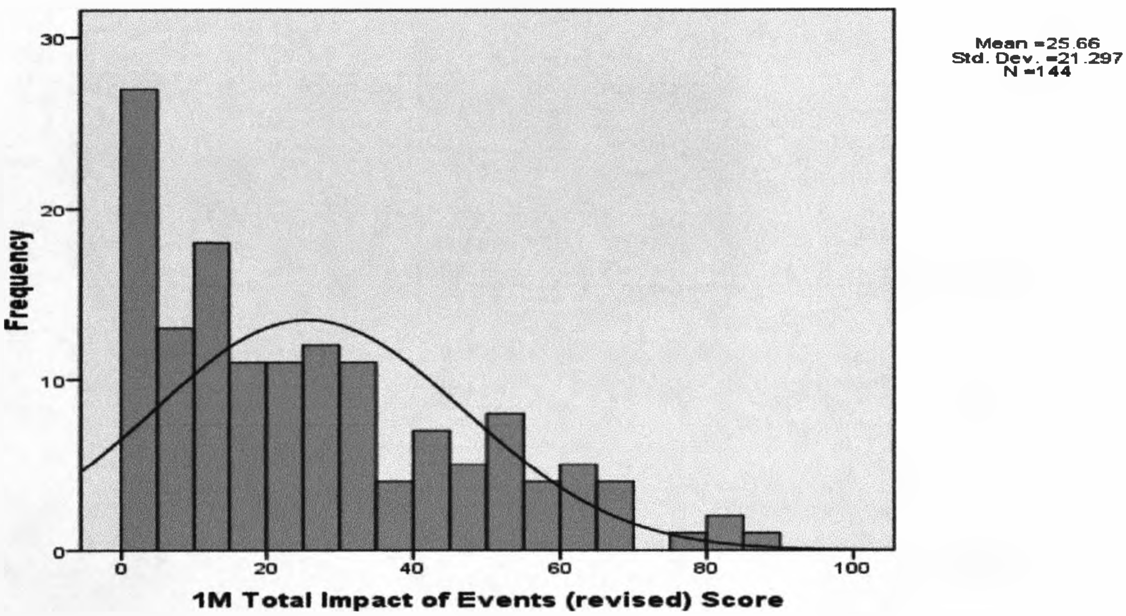
[1] ^{W} denotes assessments taken at one week and ^{M} those taken at one month

Extrapolation from this study to the annual RTC population at APH, equated to over 966 casualties per annum developing PTSD. Further research was required to investigate any comorbidity associated with PTSD at one month.

Figure 31: Range of IES-R scores of RTC casualties one month post RTC



What was the prevalence of depression following a RTC?

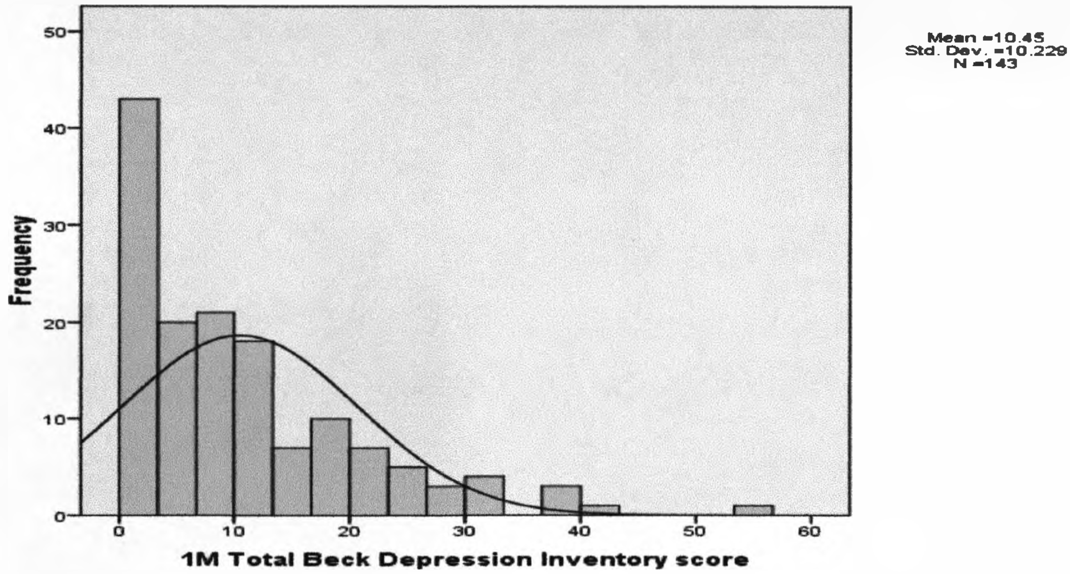
The BDI was used within the One month questionnaire to measure symptoms of low mood and depression. Whilst the distribution of scores was positively skewed and 23 participants (16%) reported no mood problems, the mean score on the BDI was still above the depression cut-off score of $\geq$ 10 indicative of low mood (mean=10.45 ±10.23).

Using the cut-off score of $\geq$10, 41% of participants reported low mood (McDowell and Newell, 1996), whilst using the cut-off score of 19 suggested that 19% of participants had moderate-severe depression (Figure 32), whilst 9 participants reported severe depressive symptoms (score of $\geq$30).

Summary

Although the majority of participants had no mood problems after a month, 41% reported low mood and a small group had severe depression. However, it could not be determined whether casualties were already depressed prior to their crash, or whether it developed subsequently.

Figure 32: Range of BDI scores of RTC casualties one month post RTC



Whilst the link between depression and trauma exposure has been acknowledged, these results indicate the importance of investigating depression after a RTC in addition to more trauma specific disorders. Extrapolation to the annual population suggested 1278 casualties would develop low mood each year. Further research was required to investigate the comorbidity between depression and PTSD within the sample.

What was the prevalence of psychiatric disorder following a RTC?

The GHQ-12 was used to detect symptoms of psychiatric disorder (Goldberg and Williams, 1988) within the One month Questionnaire. There was a full span of scores reported (Figure 33) with 26 reporting no current problems (18%), whilst 13 (9%) reported the maximum score. The mean score was 4.68 ± 3.95, which fell above the caseness cut-off score of 3.

Summary

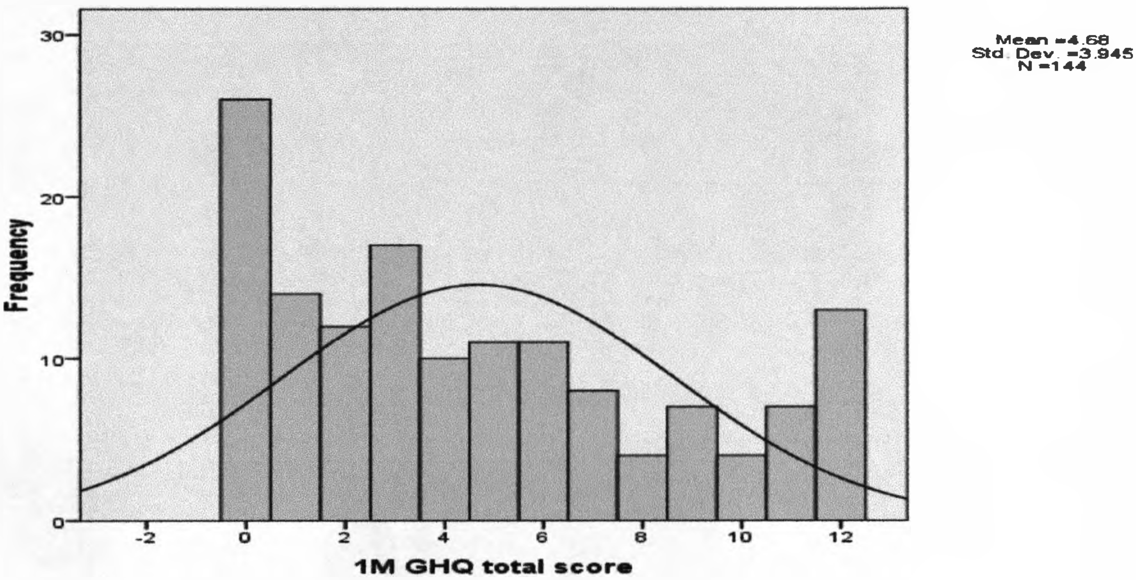
Over half the sample (52%) had scores indicative of psychiatric disorder[2] after a RTC and 38% had severe clinical symptoms[3]. Extrapolation of the results equated to 1621 casualties developing psychiatric disorder after a RTC (Figure 33) per annum. However, some symptoms, e.g. sleep problems could also have arisen from physical injuries.

[2] Using the cut off point of 3on the GHQ-12

[3] Using the higher cut-off point of 6 on the GHQ-12

Study A and B established that the majority of casualties sustained minor physical injuries, but these may not have been fully resolved by one month (Dufton, Kopec *et al.*, 2006). Further investigation was necessary to determine comorbidity of psychiatric disorder with PTSD and depression.

Figure 33: Participants' GHQ-12 Scores one month post-RTC



Co-morbidity amongst PTS disorders

Reviewing the incidence of the individual measures, it was apparent that some participants experienced symptoms of several disorders, together with functional impairment (Table 5). The use of the term "caseness" here does not indicate the individual would be definitely diagnosed with that disorder, but rather the "caseness" criterion was used to offer an indication of the symptom severity.

The majority of respondents (66%) endorsed above threshold symptoms on at least one psychological measure (Table 5), equating to 2057 Hospital A adult RTC casualties developing case level disorder per annum. More participants achieved above threshold symptoms with the GHQ-12 than any of the other measures. This was expected, since this measure assessed broad psychological dysfunction and morbidity (Goldberg and Williams, 1988), rather than a specific psychiatric disorder. Persistent physical complaints may also have inflated the prevalence. No new "cases" were identified through the GHQ that were not case-level scores for depression or PTSD. Co-morbidity between PTSD and depression was common.

Only 6 participants with PTSD did not have a case level BDI score, whereas 21 participants who had a BDI score ≥10 did not have case level PTSD symptoms. A core group of participants (26%) experienced above-caseness symptoms on all four measures.

Table 5: Participants with symptoms equivalent to a "caseness" score

Questionnaire (caseness cut-off score)	n "cases"/ *(out of N respondents)*	%
ASDS^{W} (+50 cut off)	100/200	50%
ASDS^{W} (+56 cut off)	80/200	40%
IES-R^{M} (+33 cut off)	45/144	31%
BDI^{M} (+10 cut off)	59/143	41%
GHQ^{M} (+3 cut off)	92/144	64%
GHQ^{M} (+6 cut off)	54/144	38%
Above threshold score on any of the three one month measures	95/144	66%
Above threshold score on all four measures	37	26%

Summary

Psychological problems were widespread within this sample, with 66% having "case-level" disorder on at least one psychological measure General psychiatric morbidity (GHQ) was more common that depression or PTSD. Mild depression was more reported than PTSD, although moderate to severe depression was less frequent than PTSD. Co-morbidity was the norm between PTSD and depressive symptoms. PTSD was almost invariably associated with depression, but there were 21 participants with depression without co-morbid PTSD. This suggests that after trauma depression can occur as both a co-morbid problem or independently from PTSD and should, therefore, be assessed separately. The imperative to assess RTC casualties for non-trauma specific disorders, particularly depression, was established.

Prevalence Discussion

It was predicted that the response rate for this study would be in the region of 20%, based on previous studies in the A&E department. The design of Study B was influenced by this prediction since there was a need to minimise the impact of a low response rate, particularly with the risk of attrition over two measurements periods (Fife-Shaw, 2000).

The time period of the study was reduced to one month to reduce the burden upon participants and a quota sample was used with its size chosen for consistency with previous recommendations (O'Donnell, Creamer *et al.*, 2003). The response rate may have been reduced, since avoidance of reminders of a traumatic event constituted part of the diagnostic features of ASD and PTSD (American Psychiatric Association, 1994). Recruitment may, therefore, have been negatively affected by a desire amongst casualties with severe anxiety symptoms, to avoid reminders of the crash. The counter argument was that participants returned the screening questionnaires before PTS disorders had become entrenched and the response rate for the one month questionnaire was high, suggesting that people did not avoid completing questionnaires, despite PTS disorders. However, if the response rate was influenced by avoidance of crash reminders, then the prevalence of traumatic stress reactions in the general RTC population may have exceeded that previously reported in Study B. Some key differences were found between the annual hospital RTC population and the participant sample.

Participants in Study B differed from the hospital's annual RTC population in terms of age, gender and role. Stroebe and Stroebe (1989) found that gender and mood influenced participation choices within bereavement research, with depressed men less likely to participate, whilst depressed women were more likely to participate, which may account for the greater proportion of female participants in this study. Whilst the overt difference noted here can be taken into account when appraising the results, the possibility of hidden differences also exists such as gender and mood interactions or psychological adjustment. In a high-demand study, Waite Claffey and Hillbrand (1988) found that volunteers were less anxious and better psychologically than non-volunteers. This raises concerns that people who are poorly-adjusted tended to avoid research studies, which may cause them stress or anxiety, which in this study, may have resulted in those with greater distress avoiding participation, resulting in a reduction in the prevalence of psychological problems reported.

Following a RTC, the results reported by the participants indicated that psychological symptoms associated with different psychiatric disorders were commonly encountered, even when their injury severity was generally minor. Within the study sample, 66% reported case level symptoms on at least one psychological measure after a month. This contrasted with the absence of psychological symptoms reported in Study A. Study B indicated that the onset of distress was delayed and occurred sometime after discharge.

However the DSM-IV classification of both ASD and PTSD (American Psychiatric Association, 1994) specified the occurrence of an initial intense emotional response. Although a small percentage of PTS reactions are known to show delayed onset, a recent review of the evidence found this to be very rare (Andrews, Brewin, Philpott and Stewart, 2007). Unless RTC casualties differed considerably from other traumatised people, it was therefore postulated that the results from Study A arose due, either to a lack of identification, or recording of psychological symptoms in A&E. The results from this study consequently found that the A&E records were not appropriate to inform an understanding of early trauma responses required to develop a psychological service.

ASD was the most reported specific disorder, with half the group endorsing symptoms indicative of the condition and the ASDS scores identified 40% of casualties to be at risk of PTSD. However, the number that developed PTSD was less than predicted (31%) by using the ASDS. This was consistent with the results of Bryant et al (2000), who found that a third of those expected to develop PTSD failed to do so, making early screening problematic. Although the ASDS was useful to identify participants with acute stress symptoms, it was less convincing as a predictive tool for PTSD. However, the prevalence results from this study were broadly consistent with previous RTC studies reporting prevalence as 10-30% (O'Donnell, Creamer *et al.*, 2008) and suggest that severe injuries may give rise to less psychological problems. Low mood was more frequently reported (41%) than case level PTSD. The notable mood problems in this sample highlighted the importance of assessing depression irrespective of PTSD. It was possible that some participants were depressed prior to the crash, which was reflected in the post-crash BDI scores, as Blanchard, Hickling, Taylor *et al* (1994) had previously found greater pre-existing depression amongst people that developed PTSD after a crash.
The GHQ identified more participants with case-level symptoms (64%) than the other one month measures. However, the GHQ did not identify any new "cases" over and above those recognised by the other measurement tools, which limited its merit as a generic assessment.

A sizeable proportion (26%) scored above caseness on all the psychological assessments. Co-morbidity amongst trauma populations has been reported to occur for around 80% of those with PTSD (Kessler, Sonnega *et al.*, 1995; Breslau, Davis, Peterson and Schultz, 2000; O'Donnell, Creamer, Pattison and Atkin, 2004). This concurred with the 86% co-morbidity reported with PTSD in Study B.

There has been some debate whether the strong co-morbidity between depression and PTSD is reflective of a single traumatic stress construct, common vulnerability pathways or separate disorders, both triggered by traumatic events. O'Donnell et al (2004) provide evidence to support the notion that depression is a separate construct in the acute, but not chronic aftermath of a traumatic event. This was further supported by the results of this study, in which PTSD without low mood was very rare, whilst mild depression without PTSD was more commonplace.

It is important to recognise co-morbidity amongst trauma populations as it can alter the intervention required (NICE, 2005). An understanding of the extent of co-morbidity was useful to inform RTC service design and resource allocation, since a broader range of interventions and longer duration of therapy may be required.

PlaTO Model Implications

This study of PTS disorder prevalence established that over half of the participants experienced psychological problems at some point in the month after a RTC and that a sizeable proportion experienced comorbid problems justifying the need to develop strategies to minimise the psychological consequences of road crashes.

The screening process undertaken in Study B received a low response from RTC casualties. This had potential implications for establishing such a service. However, as screening was carried out as part of a research study, it was uncertain whether a similar response would occur with a screening service, or whether the uptake level arose from the inherent demands of engaging in a research study, particularly for people with pain, ASD and physical injury.

Guidelines published for psychological trauma service provision focused primarily on the type and effectiveness of therapies. Whilst effective ordnance was necessary to alleviate the psychological suffering reported by the participants in this study, the number of casualties with PTS disorders necessitated a strategic approach in order to offer pathways to timely support and intervention. Whilst trauma services may focus on PTSD, this study has demonstrated that mood problems were more widespread and also occur independently from PTSD. However, the majority of participants with psychological problems had co-morbid problems with implications for the resources and expertise required to address such problems.

A quarter of participants reported ASD symptoms of notable severity in the week after the crash. The NICE guidelines suggest that psychological first aid and early intervention may be appropriate for those experiencing severe distress within the first month (NICE, 2005) and clinical pathways must allow for the detection and "fast-tracking" of a people towards therapy. Detecting ASD amongst casualties after discharge from A&E poses logistical problems given the limited existing follow-up received. Therefore, in the guidelines detection requires self-presentation and healthcare practitioners treating RTC casualties being sufficiently competent to recognise symptoms of PTS disorders and cognisant of available intervention services.

The results from this study suggest that, in order to equitably offer timely support to all traumatised casualties, it would be necessary to assess every survivor for severe symptoms of ASD proximal to the RTC. Based on the results from Study A and B, a hospital such as Hospital A would require the capacity to assess over 3000 adults per year, in addition to offering an intervention service. A pragmatic strategy would be to identify those most at risk of PTS disorders whilst they attended A&E. The complexity of psychological dysfunction, that can occur after a crash also necessitated that risk factors were established solely for the RTC population, since other traumatic events may not have the same physical, psychological and social factors associated with them.

Further research

In order to inform the design of a PlaTO service model, further research into risk factors for PTS disorders amongst RTC casualties was essential. Effective screening in A&E offered the potential to monitor individuals at high risk, whilst minimising intrusion for casualties unlikely to develop PTS disorders. In the absence of effective screening all casualties would have to be assessed after discharge from A&E.

For clinical screening to be effective, it needs to be able to reliably identify those with significant disorder (sensitivity) and those without (specificity) (McDowell and Newell, 1996). However, for screening to adhere to Wilson's screening criteria it must also lead to an acceptable, effective intervention and that therapy should be of more benefit when commenced early (UK National Screening Committee, 2008).

Study C will look at these issues in relation to an individual case exemplar and also provide an opportunity to explore in more depth, the functional problems encountered by individual RTC casualties.

What predictive factors were associated with PTS disorders after a RTC?

This question was informed through three specific research questions (Figure 27). Risk factors associated with GHQ "caseness" were not investigated separately, since the questionnaire did not recognise any additional individuals with psychiatric problems other than those identified by the BDI and IES-R.

What predictive factors were associated with ASD following a RTC?

ASDS total scores were calculated from the Screening Questionnaire and then, either analysed as a continuous variable or when investigating ASD caseness, converted to a dichotomous variable, with a cut-off score of 50 to indicate case-level symptoms (Bryant and Harvey, 2000). Associations were explored between pre and peri-crash factors and ASDS scores, (Figure 26) to identify relationships. All the risk factors that were significantly associated with ASDS scores were analysed further through multiple regression.

Gender

The relationship between gender and ASD caseness was investigated. More women (50%) had case level ASD than men (41%) (Figure 34). A significant association between gender and ASD was identified using Pearson's Chi-squared test ($\chi2$ 5.808, df 1, sig <0.05 2 tailed). Whilst more women reported case level symptoms, ASD was identified for both genders and suggests that, although gender was linked to ASD, other factors were influential on its development.

Figure 34: The relationship between ASD caseness and gender one week after a RTC

Age

The association between age and ASD score was investigated using Kendall's non-parametric tests, since neither variable was normally distributed. No significant correlation was established between the variables (τ = -0.60, sig 0.216), suggesting that ASDS score was not related to the participant's age.

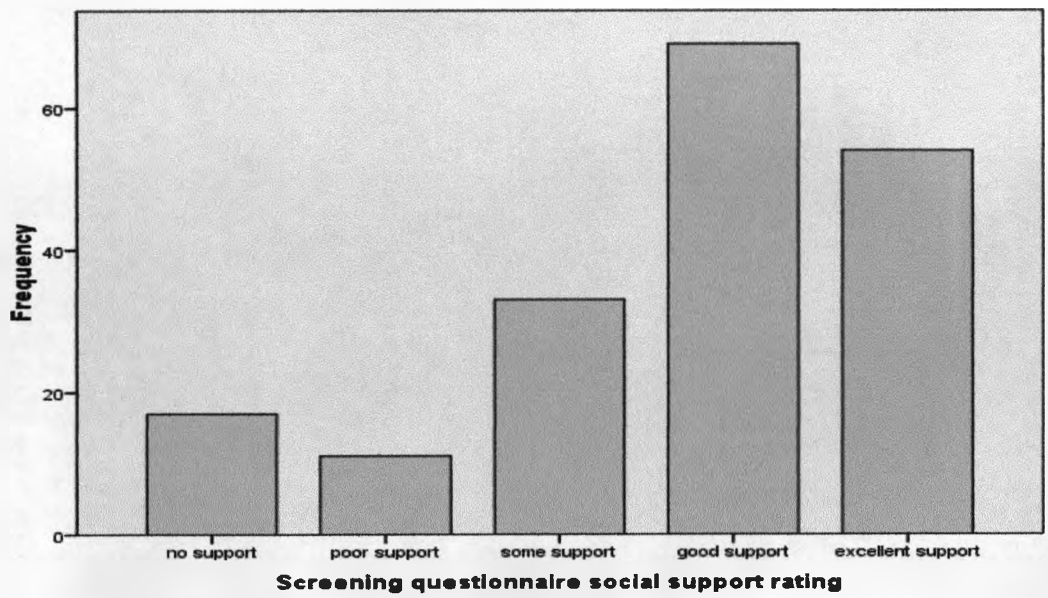
Employment

The participants were asked to endorse a yes/no response about their employment status. One hundred and ninety eight participants responded and 73% were employed, which was lower than for the 2001 census that reported 96% employment for the region. Employment status was not associated with ASD caseness when tested using Pearson's Chi-squared test ($\chi 2$ 1.262, df 1, sig 0.261 2 tailed).

Social Support

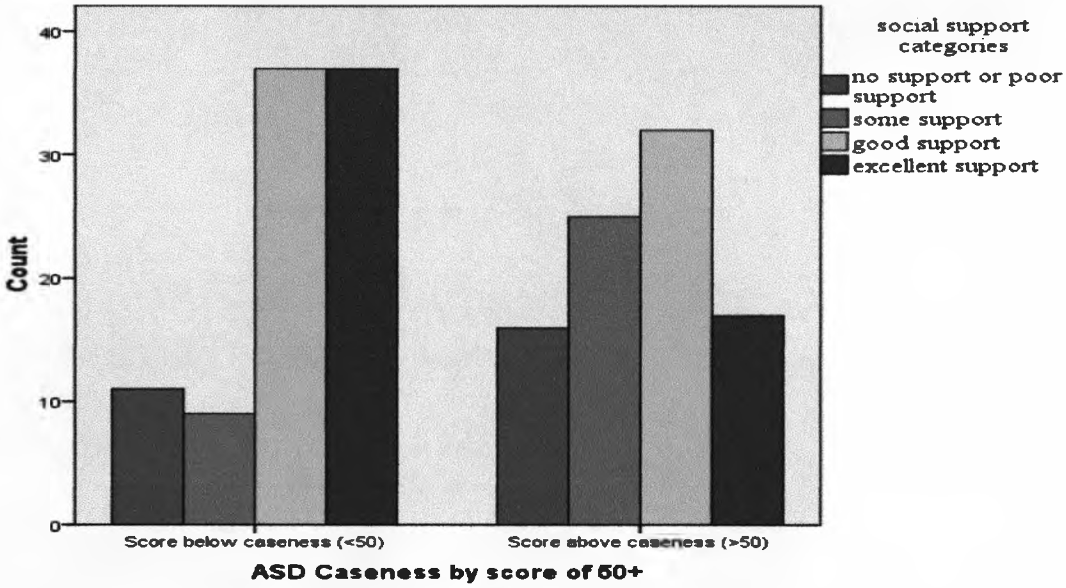
Participants were asked to rate the subjective quality of their social support in the immediate aftermath of the crash. Their ratings were negatively skewed with good or excellent support being more frequently endorsed (Figure 35).

Figure 35: Frequency of social support ratings taken from screening questionnaire



When the relationship between ASD caseness and social support rating was explored (Figure 36), higher support ratings were more frequently reported by those without ASD symptoms.

Figure 36: Relationship between ASD caseness and social support

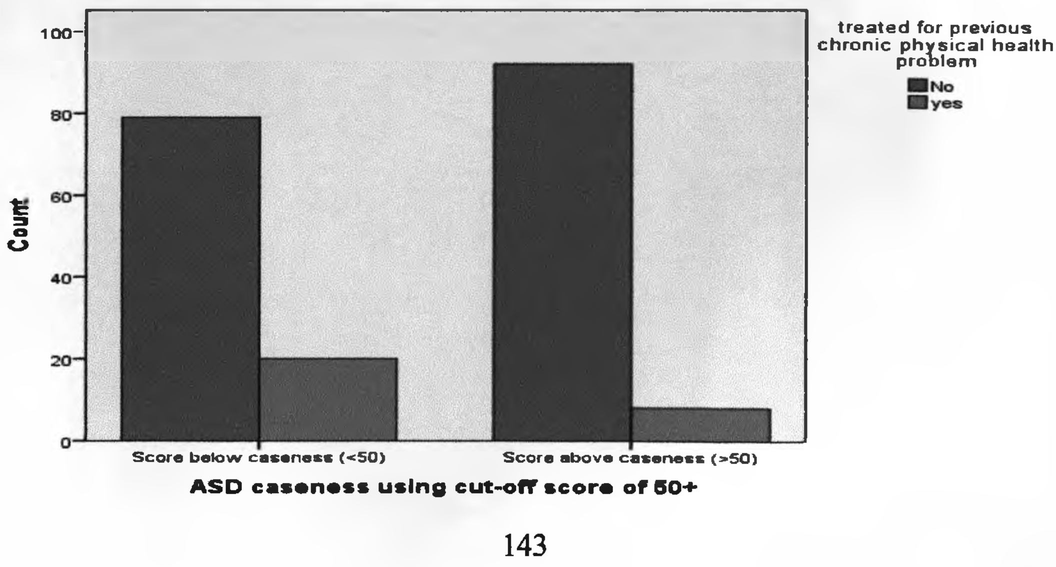


Conversely, poor or no support was more frequently reported by people with ASD. The association between ASD caseness and social support when analysed using Pearson's Chi-squared test, found a significant relationship between social support and ASD caseness ($\chi 2$ 16.146, df 3, sig 0.001, 2 tailed). These results indicated that poor or no support was associated with ASD (Figure 36).

Physical Health

Participants were asked if they had ever been treated for any chronic physical health problems and 28 people (14%) reported having treatment for a previous chronic health problem and 8 (28%) of these had symptoms consistent with ASD.

Figure 37: Relationship between chronic physical health problems and ASD caseness



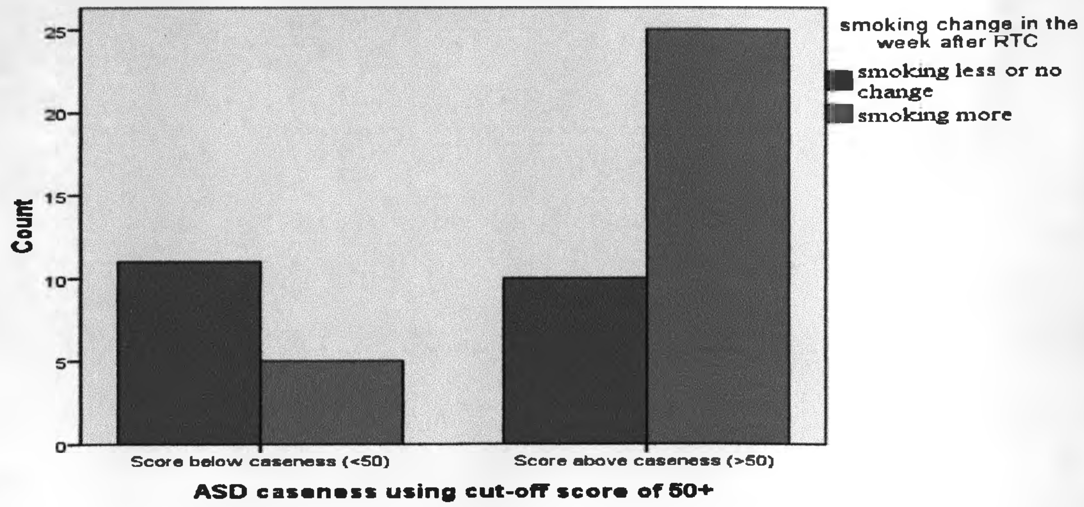
Fewer participants with chronic physical conditions developed ASD (Figure 37). A previous history of treatment for chronic physical health problems was negatively associated with ASD caseness when analysed using Pearson's Chi-squared test ($\chi2$ 6.126, df 1, sig = 0.012, 2 tailed). However, the limited number of participants, who reported previous treatment for a chronic health problem, limited this analysis.

Smoking

Participants reported whether they smoked and from 198 respondents, fifty one reported that they smoked (26%) compared to 22% in the region generally. Twice as many smokers had ASD, compared to the non-ASD group. The association between being a smoker and ASD caseness was found to be significant when explored with Pearson's Chi-squared test ($\chi2$ 8.1, df 1, sig < 0.005, 2 tailed). Although there was a significant relationship between smoking and ASD, not all smokers developed ASD and many non-smokers also reported case level symptoms.

Smokers were asked whether their smoking habits had changed after the crash. For further analysis, the categories were combined into two groups, participants whose smoking had increased and those, for whom it had not changed or decreased (Figure 38). A significant relationship was found between change in smoking and ASD caseness using Pearson's Chi-squared test and ($\chi2$ 7.318, df 1, sig 0.007, 2 tailed). An increase in smoking was linked with ASD, although not everyone whose smoking increased developed ASD and others with ASD reported no change, or a decrease in smoking.

Figure 38: Relationship between smoking change and ASD caseness

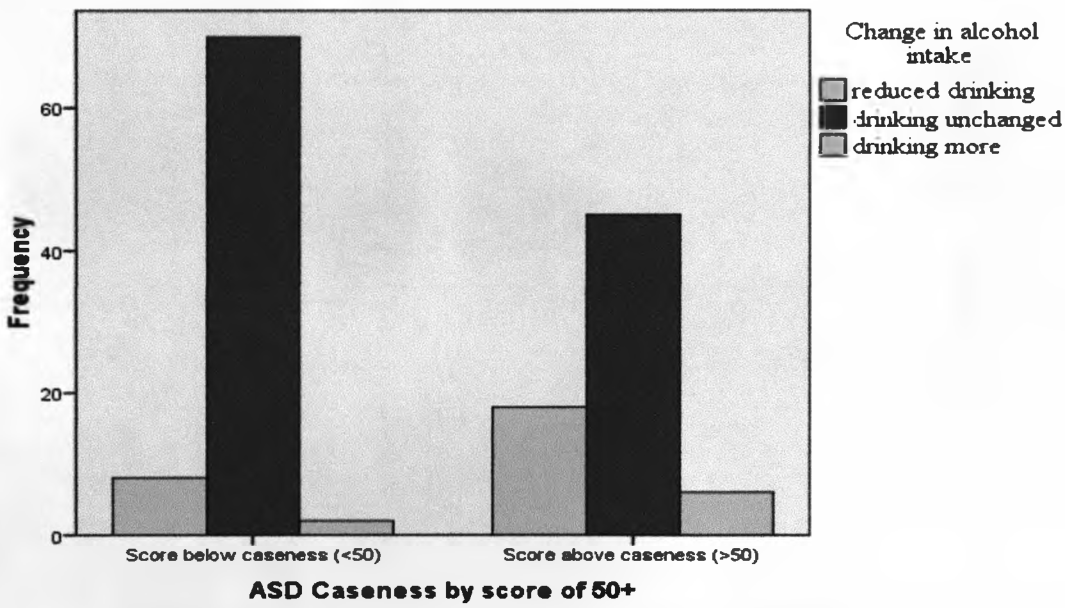


Retrospective reporting of smoking habits can be flawed and this may have influenced the results obtained. This criterion requires time to have elapsed since the crash, so could not provide a useful factor for screening within A&E, but it may be useful to consider within a post-discharge assessment.

Drinking Alcohol

Participants were asked whether they drank alcohol and 199 responded with 75% indicating they drank alcohol. No significant association was found between ASD caseness and drinking alcohol when the results were analysed using Pearson's Chi-squared ($\chi 2$ 2.315, df 1, sig 0.128, 2 tailed).

Figure 39: Relationship between change in alcohol consumption and ASD



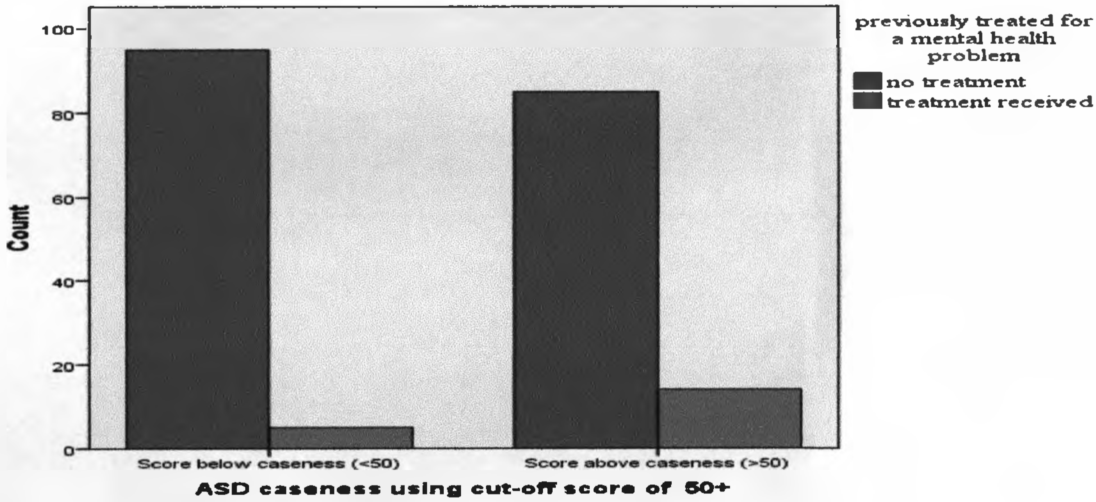
Participants who drank alcohol were asked whether their drinking pattern had changed since the crash. Participants without ASD level symptoms mostly reported no change in their drinking, whilst those with ASD reported both increases and decreases in alcohol consumption (Figure 39).This pattern was significant when analysed using Pearson's Chi-squared test ($\chi 2$ 10.526, df 2, sig 0.005). Reporting of changes in drinking was retrospective and may have been influenced by such a bias or the reluctance to report such information accurately, due to stigma or other concerns. From these results, it seems that alterations in alcohol consumption were associated with ASD, although changes can be in either direction.

Previous mental health problems

Participants reported whether or not they had previously received treatment for mental health problems. 19 reported receiving such treatment and 14 of these also reported above caseness ASD symptoms (Figure 40).

A significant association was identified between previous mental health problems and ASD caseness using Pearson's Chi-squared test ($\chi 2$ 4.81, df 1, sig =0.028, 2 tailed) suggesting a positive association between prior treatment for a mental health problem and ASD caseness. However, few instances of treatment were reported (<10%) and stigma around mental health problems may have influenced reporting. Although ASD and treatment for prior mental health problems were linked (Figure 40), individuals without such a history also reported ASD, suggesting that other factors were linked to its development.

Figure 40: Relationship between ASD caseness and previous mental health treatment



Family History of Mental Health Problems

23participants out of 195 respondents reported a family history of mental health problems and these were divided between those with and without ASD. Analysis using Pearson's Chi-squared test established that there was no link between family history of mental health treatment and ASD, ($\chi 2$ 0.062, df 1, sig 0.804, 2 tailed) amongst these participants. However, lack of knowledge or stigma could have influenced the results, since the number reporting a family history was less than 12% of the participant group, whereas the reported prevalence of neurotic disorders for the local region, was 220.5 per 1000 (Glover, 2008).

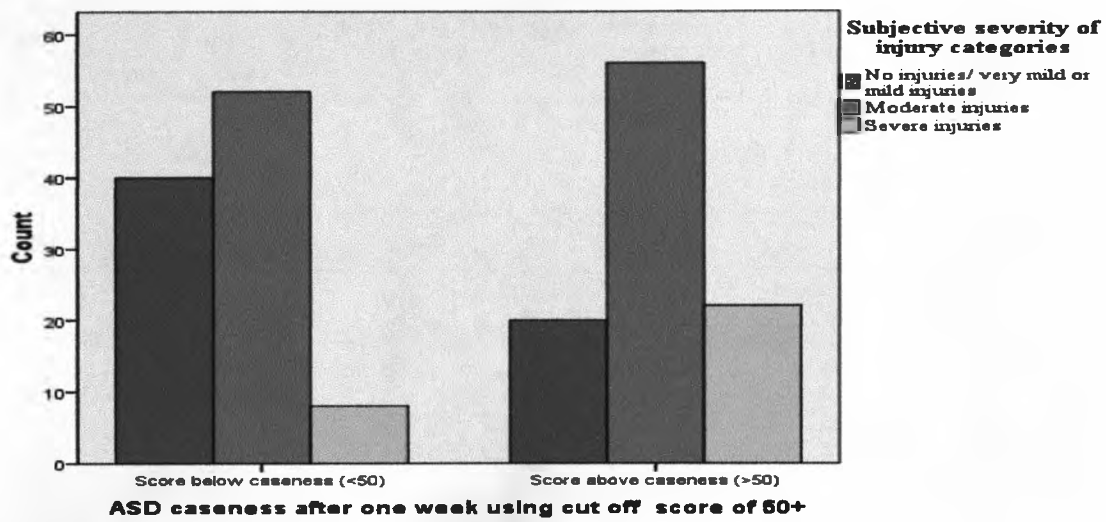
Previous Trauma History

Although many participants (53%) reported a previous trauma history, no significant relationship was established with ASD caseness ($\chi 2$= 1.285, df1, sig < 0.3, 2 tailed).

Subjective severity of injuries

Participants were asked to rate their injury from six categories which were condensed into three for analysis. Out of the198 respondents none to mild severity was more frequent amongst the non ASD group (Figure 41), whilst severe injury was more frequently reported amongst those with ASD.

Figure 41: Relationship between perception of injury severity and ASD[W]



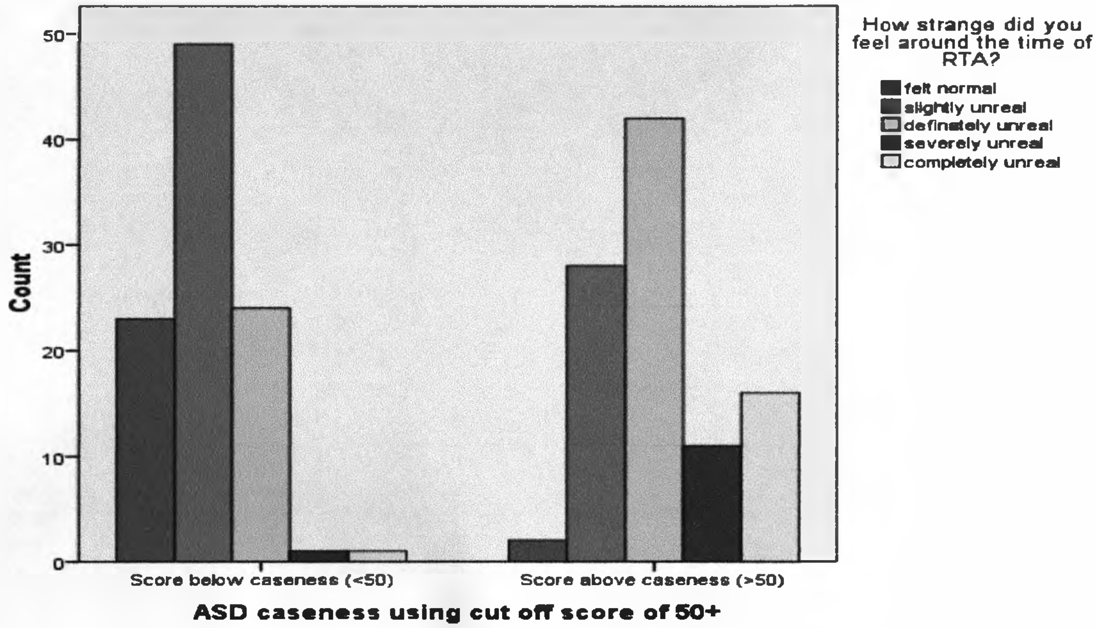
A significant association between subjective injury severity and ASD caseness was identified using Pearson's Chi squared ($\chi 2$ 13.329, df 2, sig $\leq$ 0.001, 2 tailed), indicating that the subjective severity of a RTC casualty's injury was related to ASD caseness, whereas the majority of participants had minor injuries, according to the A&E information.

Dissociation

Dissociative symptoms form part of the criteria of ASD (American Psychiatric Association, 1994) and usually occur around the time of a traumatic event. The participants rated their feelings of unreality around the time of the crash, as a pragmatic measure of peri-crash dissociation. Participants most frequently reported having slight feelings of unreality (39%), whilst 13% reported no unreal feelings. However, a further 15% reported severe or complete feelings of unreality.

Figure 42 illustrated the trend towards stronger dissociation amongst those with ASD, and there was a significant relationship between feelings of unreality and ASD when analysed using Pearson's Chi- squared ($\chi 2$ 49.841, df 4, sig <0.001, 2 tailed). These results were consistent with ASD (American Psychiatric Association, 1994), since dissociative experiences form part of the diagnosis.

Figure 42: Relationship between participants' reporting of dissociation and acute stress disorder one week after a RTC

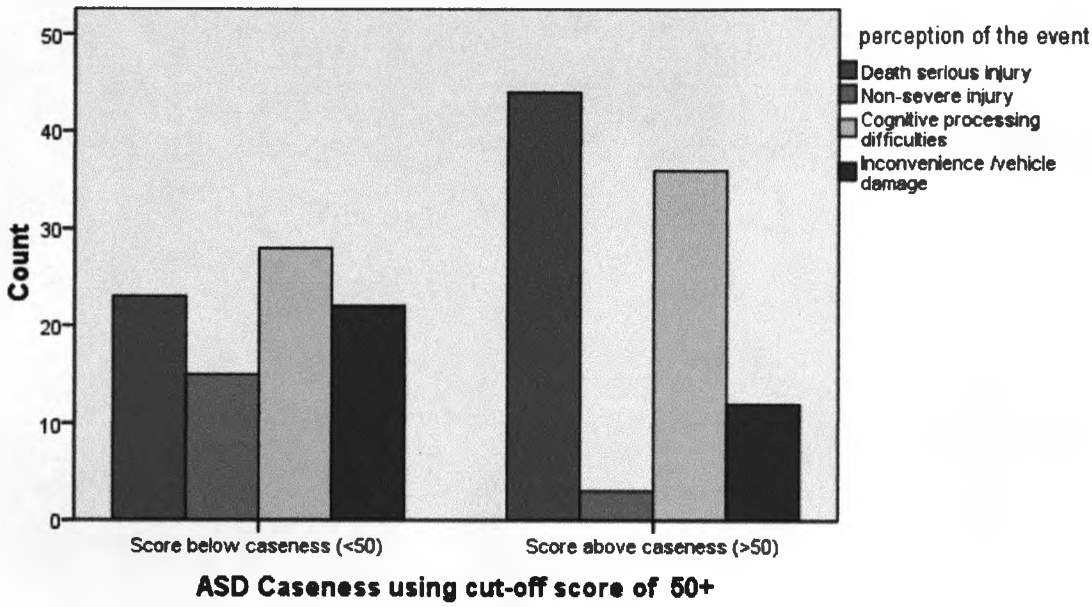


Perception of the crash

The crash and its perceived consequences were described by participants in their own words. The free text was coded and then verified by two independent researchers. Where discrepancies arose, mutual discussion was used to decide the category. Four emergent categories were related to beliefs of death/severe injury, minor injury/inconvenience and vehicle damage. The fourth was termed "cognitive processing difficulties" and encompassed an inability to process the event, distortions in time and sense of disconnection with the event. This category links to dissociative phenomenon and examples included *"I couldn't believe it was happening"* or *"My mind went blank"*. Examination of the coded categories (Figure 43) found death/serious injury to be the most frequently reported belief, whilst non-severe injury was reported the least, especially amongst those with ASD caseness. "Cognitive processing impairment" was common to both those with (n=36) and without ASD (n=28). A significant association was established between the subjective perception categories and case level ASD using Pearson's chi-squared ($\chi 2$ 18.282, df 3, sig < 0.001, 2 tailed).

These results suggest that peri-crash fear of death or serious injury was associated with subsequent ASD, consistent with the stressor criterion for ASD (American Psychiatric Association, 1994).

Figure 43: Relationship between ASD after one week and subjective perception of the RTC



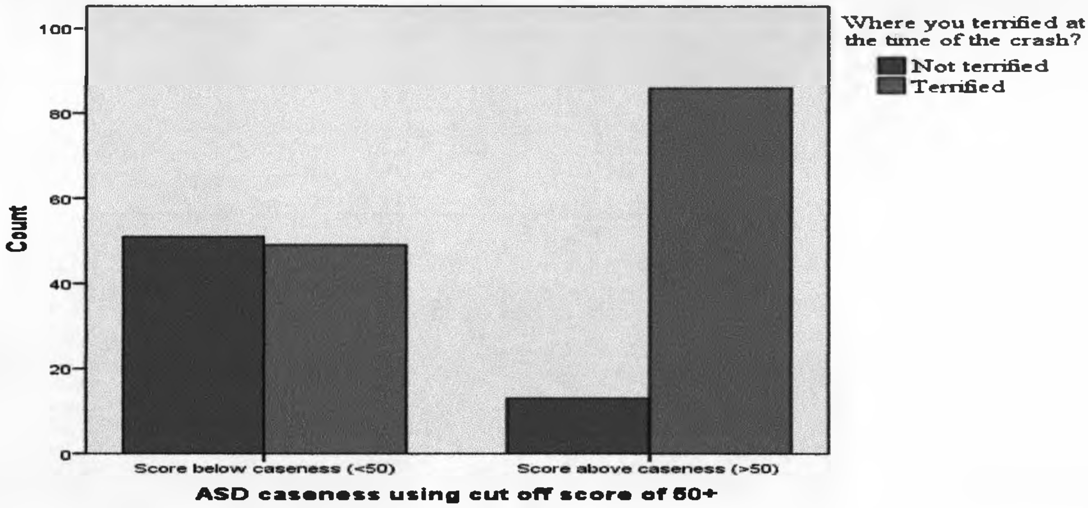
From the hospital records analysed previously the large majority of participants were objectively involved in minor RTCs and sustained only physical minor injuries as a consequence of them. These results indicate that the subjective appraisal of the crash consequences was linked with ASD, whilst the actual RTC consequences may have differed from participants' crash beliefs.

Terrified at the time of the Crash

The participants were asked to specify whether they were terrified during the crash using a dichotomous response. The majority of participants (68%) reported being terrified at the time of the crash. Terrified participants represented the major ASD group (Figure 44) and those who were not terrified less frequently reported ASD level symptoms.

ASD was strongly associated with terror at the time of the crash when tested using Pearson's Chi-squared test ($\chi 2$ 32.699, df 1, sig <0.001, 2 tailed). These results were consistent with the stressor criterion of the disorder (American Psychiatric Association, 1994).

Figure 44: Relationship between ASD caseness and being terrified at the time of the RTC



Summary of risk factors

Table 6 summarises the pre and peri-crash factors from the screening questionnaire and their association with symptoms reported using the ASDS.

Three pre-trauma factors were found to be significantly associated with ASD scores. These were gender (female), having a previous history of treatment for mental health problems and being a smoker. In contrast, previous treatment for a chronic physical health problem appeared to be protective against the development of ASD. More peri-trauma factors were linked to case level ASD symptoms than pre-trauma factors. Social support quality was negatively related to ASD caseness, with none/ poor quality support associated with ASD. The participants' subjective assessment of the severity of their injuries, feeling unreal and being terrified were positively associated with ASD level symptoms. Perceptions about the crash consequences were also linked to ASD, with a belief about death or severe injury being particularly associated with the disorder.

Despite the links between the pre and peri-crash factors and ASD none were singularly able to predict ASD caseness with the accuracy required for a clinical setting. The results suggested that ASD development was influenced by the interaction between pre and peri-crash factors, with more peri-trauma factors linked to case level disorder consistent with previous studies (Brewin, Andrews *et al.*, 2000; Ozer, Best *et al.*, 2003). The screening questionnaire in the study was designed to meet two aims; firstly to investigate the prevalence of ASD within the RTC population and secondly to test questions, that could be used to predict who was at elevated risk of PTS disorders.

Table 6: Screening factors and their association with ASD caseness

Factor	Pre Trauma Factors	Peri-trauma factors	Significant at 0.05 level
Gender*	$\chi2$ 5.808, df 1, sig <0.05 2 tailed		Yes
Age	τ = -0.60, sig 0.216		
Employment	$\chi2$ 1.262, df 1, sig 0.261 2 tailed		
Physical Health*	$\chi2$ 6.126, df 1, sig = 0.012, 2 tailed		Yes
Smoking*	$\chi2$ 8.1, df 1, sig < 0.005, 2 tailed		Yes
Drinking Alcohol	$\chi2$ 2.315, df 1, sig 0.128, 2 tailed		
Previous mental health problems*	$\chi2$ 4.81, df 1, sig =0.028, 2 tailed		Yes
Family Mental Health Problems	$\chi2$ 0.062, df 1, sig 0.804, 2 tailed		
Previous traumas	$\chi2$ 1.285, df 1, sig <0.3, 2 tailed		
Social Support*		$\chi2$ 16.146, df 3, sig 0.001, 2 tailed	Yes
Subjective severity of injuries*		$\chi2$ 13.329, df 2, sig ≤ 0.001, 2 tailed	Yes
Dissociation*		$\chi2$ 43.751, df 2, sig <0.001, 2 tailed	Yes
Subjective perception of crash consequences *		$\chi2$ 18.282, df 3, sig <0.001 , 2 tailed	Yes
Terrified at time*		$\chi2$ 32.699, df 1, sig <0.001, 2 tailed	Yes

** Denotes significant association between factor and ASD. Some factors were negatively associated with ASD.*

Analysis of participants' responses with ASDS scores identified the following questions with potential to inform a clinical assessment and the early identification of ASD within an A&E service.

- Gender?
- Do you smoke?
- Have you previously required treatment for a mental health problem?
- How severe do you think your injuries are?
- How strange and unreal do you feel?
- What did you think was going to happen in the crash?
- Were you terrified?

The following questions could not be used in A&E but may be of additional value to highlight ASD risk in someone being screened after discharge.

- Has your smoking increased?
- Has your drinking of alcohol altered?
- How supportive have people been since the crash?

Since no single strongly predictive factor emerged for ASD caseness, statistical modelling of multiple factors was performed by combining the factors found to be significantly related to ASD.

Multiple regression risk factor analysis

The analysis was undertaken according to the principles stated earlier (p111). In developing the models for ASD risk, consideration of their screening purpose was vital. Study A and B had previously established that the majority of RTC casualties attending A&E were discharged home the same day, with no formal follow-up. Casualties cannot be diagnosed with ASD until two days after the crash, after the majority have been discharged home. To minimise the substantial logistical difficulties of assertively following-up casualties after discharge, it would be advantageous to be able to screen casualties during their attendance in A&E.

Different predictive models were developed and tested to establish whether they met the profile for a screening service. Factors identified on the screening questionnaire^{W} associated with ASD^{W} fell into two categories; pre-existing and peri-crash variables[4]. The ASD model endeavoured to test significant pre and peri-trauma factors to establish the strength of the relationship they had with ASD. The potential models were developed from the univariate analysis of pre and peri-trauma risk factors reported previously.

The Pre-trauma Model included the variables gender, treatment for physical health problems, smoking and treatment for mental health problems. The Peri-trauma Model included the variables, social support^{W}, severity of injury, feeling strange/ unreal, perception of death /severe injury and terror. A Combined Model was tested that consisted of the significant pre and peri-crash variables from ASD Models 1 and 2. These exploratory models were analysed through multiple regression conducted using SPSS 16. From a clinical perspective, the most parsimonious model was required so variables were entered stepwise into the models (Field, 2005; Brace, Kemp and Snelgar, 2006).

[4] ^{W} denotes information obtained after one week. ^{M} denotes information obtained after one month.

All variables entered into the models were tested for collinearity to ensure that multi-collinearity did not bias the regression models. Tolerance values indicate the correlation between the variables and range between 0-1, with lower values indicating greater correlation between the variables in the model. A tolerance value of below 0.2 was set to identify collinearity concerns (Field, 2005).

Checks were made to ensure that a maximum of 15 cases per predictor were entered into the models which equated to no more than 13 variables for the ASD models and 9 variables for the other models. However, it is acknowledged that this general rule has its limitations (Field, 2005). To counteract this, the minimum possible variables were entered into the models to protect the effect size. Since R^2 can over-estimate the model's application in the real world, the adjusted R^2 values were calculated, which takes into account the number of factors entered into the model and the number of cases in the study (Brace, Kemp *et al.*, 2006) and to cross-validate the predictive merit of the model in another sample (Field, 2005).

ASD Model 1: Pre-trauma

Adjusted $R^2 = 0.115$; $F_{3,193} = 9.522$, $p<0.001$.

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Smoking (being a smoker)	.257	$p<0.001$	.982
Gender (female)	.191	$P=0.005$	.987
Previous treatment for physical health problems (receiving treatment)	-.179	$P=0.009$	.989

(Previous treatment for mental health problems was not a significant predictor in the pre-trauma model).

The pre-trauma model for ASD, when tested using multiple regression, found that only 11.5% of the variance in the ASDS scores were accounted for by this model. These results indicate that the pre-trauma variables entered into this model were weak predictors of the ASDS^W score and, as such, would not merit use as screening factors for the development of ASD^W. In this model being female and a smoker were predictors of ASD and treatment for chronic physical problems was protective against ASD.

ASD Model 2: Peri-trauma

Adjusted $R^2 = 0.362$; $F_{2,150} = 44.195$, $p<0.001$.

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Feeling strange/unreal (dissociation)	.397	$p<0.001$	.937
Being Terrified	.373	$p<0.001$	.937

(Social support rating^W, subjective severity of injuries and perception of death or severe injury were not significant predictors of ASDS^W scores in this model)

The peri-trauma model for ASD, when analysed by multiple regression accounted for 36% of the variance in ASDS scores, accounting for a greater proportion of the variance than the Pre-trauma Model. The variables that remained in the model were fear and dissociative experiences, which both form part of the diagnostic criteria for ASD. Although fear of death or severe injury was a key diagnostic criterion, it did not significantly predict ASD. The categorical coding process may have influenced the significance of this variable in this model. Providing casualties with selected categories about crash consequences may avoid the inherent difficulty interpreting free text.

Although ASD Model 2 was a better predictor of ASDS scores, once more it was not sufficiently robust for use in a clinical setting to accurately screen for ASD risk, since it only accounted for a minor portion of the variance in ASD scores.

ASD Model 3: Combined Pre and Peri-trauma

Adjusted $R^2 = 0.418$; $F_{4,190} = 35.767$, $p<0.001$.

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Feeling strange/unreal	.397	$p<0.001$	.905
Being terrified	.343	$p<0.001$	.922
Smoking	.137	$P=0.015$	.962
Treatment for physical health problems	-.134	$P=0.016$	.968

(Gender was not a significant predictor in this pre and peri-trauma model of ASD)

Gender no longer significantly contributed to the model, although the other two pre-crash variables remained in the model. Within this combined model peri-trauma variables were the stronger predictors of ASDS scores, consistent with the findings with ASD Models 1 and 2.

Out of the three models tested, this model was the strongest predictor of ASD. In this model of combined pre and peri-trauma variables the four factors accounted for 42% of the variance in $ASDS^{W}$ scores. From a clinical perspective, it is important that everyone with the potential to develop ASD could be identified and this model did not account for sufficient variance in ASDS scores and hence was not robust enough for routine clinical use.

Summary of risk factor models

This study aimed to investigate "what predictive factors were associated with ASD following a RTC?"This was achieved firstly by examining significant associations between individual factors on the screening questionnaire and $ASDS^{W}$ scores. Several pre and peri-trauma factors were linked to ASD and these were used to develop three exploratory models for ASD. These models were tested using multiple regression analyses. None of the models were strong enough predictors of ASD for direct clinical use, although ASD Model 3 was the best predictor and accounted for 42% of the variance. Through this model, several questions emerged that may prove useful for A&E clinicians to incorporate into their assessment of RTC casualties, since they appeared to be associated with ASD.

Fear and dissociation are diagnostic features of ASD (American Psychiatric Association, 1994) and these screening questions were significant predictors in the ASD Model 3. Smoking also formed part of this model. Amongst those with PTSD, smoking as a coping strategy to alleviate symptoms, has previously been reported (Thorndike, Wernicke, Pearlman and Haaga, 2006). A critical review has suggested that PTSD and possibly trauma exposure are both linked to nicotine dependence (Morrisette, Tull *et al.*, 2007). Previous studies have also established a link between PTSD and prior nicotine dependence amongst trauma exposed male veterans, where smokers were at twice the risk of PTSD (Koenen, Hitsman, Lyons, Niaura, McCaffery *et al.*, 2005). Since ASD and PTSD are closely linked, it would appear logical that smoking may also be associated with increased risk of ASD, although no research to support this was identified.

Within this model receiving treatment for a chronic physical health problem was negatively associated with ASD. Information was not collected about the nature of such disability or treatment amongst the participants, which impeded any interpretation. It is possible that individuals who have previously experienced chronic ill-health may have developed resources or strategies to manage stress and pain.

Further research is required to investigate how previous physical health treatment could buffer against ASD following a RTC in a population with greater incidence of such a health history.

ASD Model 3 was the best predictor, but it did not contribute to the major variance in ASDS scores. Some pre and peri-trauma factors for ASD development were identified, but further work is required to identify other factors that account for a greater proportion of the variance in ASDS scores. In the absence of a strong predictive model of ASD, it would be particularly imprudent to "screen out" individuals from a monitoring service on the basis of these risk factors, since casualties at risk may fail to receive appropriate assessment and monitoring.

PlaTO

These results suggested that all RTC casualties should be tested for ASD, as the selected risk factors were not sufficiently strong predictors of ASD. This has implications for the design and capacity of such a service requiring tracking of all casualties in the week after their discharge from A&E to offer them an ASD assessment. Individuals with ASD could then be monitored or offered supportive intervention immediately, if their level of distress and dysfunction warranted it.

What predictive factors were associated with PTSD following a RTC?

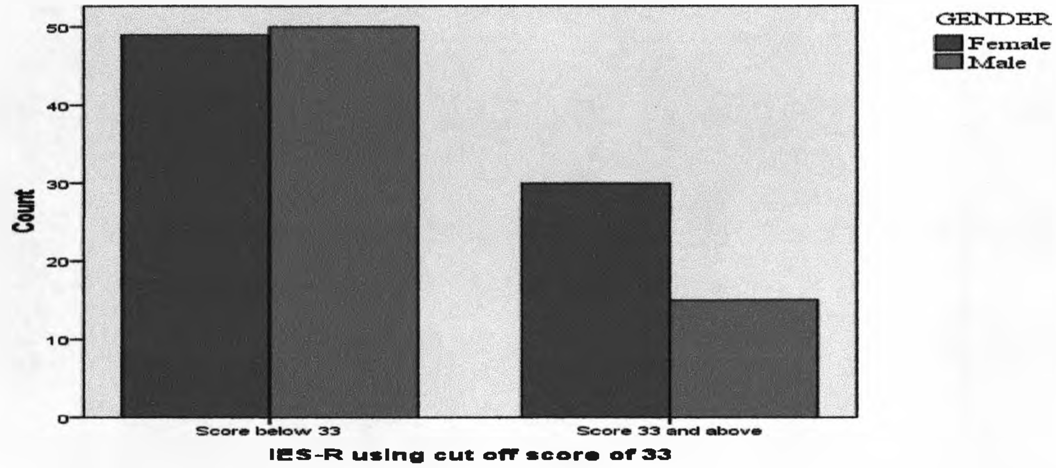
PTSD was assessed using the IES-R as part of the one month questionnaire. Case-level symptoms were established using the cut off point of 33 (Creamer, Bell *et al.*, 2003) which in Study B resulted in 31% of the participants reporting case level PTSD symptoms. As the IES-R was completed a month after the RTC, it was possible to investigate post-crash in addition to pre and peri crash factors for their association with PTSD caseness. The relationship between IES-R caseness was also compared with the results of the other psychometric measures, to investigate links between PTSD and other psychological problems.

Gender

144 participants returned the One Month Questionnaire and 79 were female. 30 women (21%) and 15 men (10%) reported above cut-off scores on the IES-R indicative of PTSD, suggesting that PTSD was linked to gender (Figure 45).

However, when this relationship was analysed using Pearson's Chi-squared test, it was not significant ($\chi 2$ 3.684, df 1, sig 0.055, 2 tailed) which contrasted with the significant relationship found previously between ASD and gender

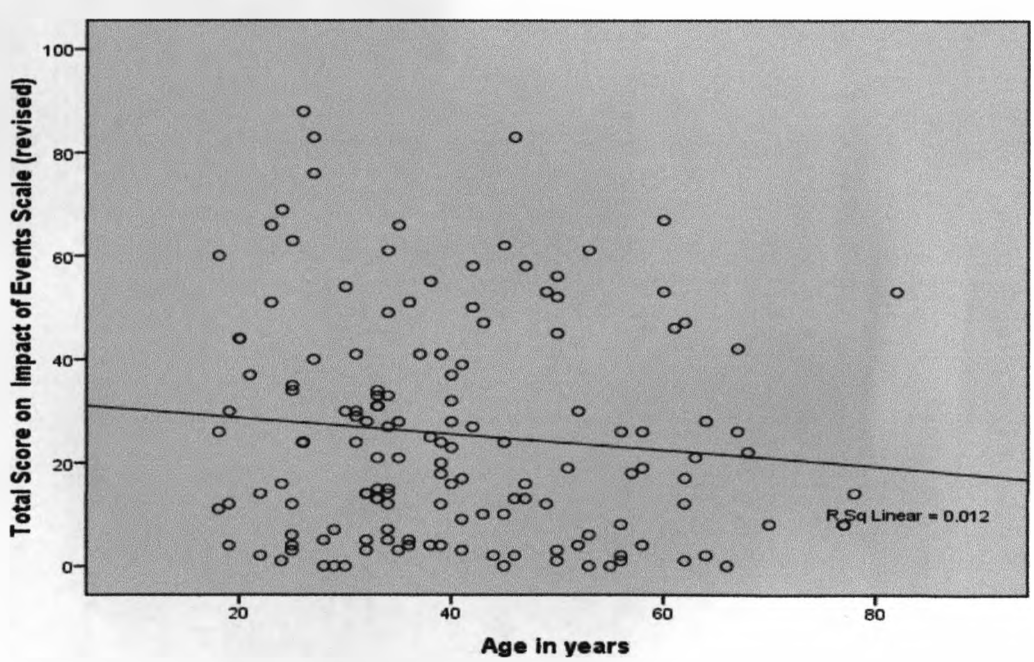
Figure 45: Relationship between Gender and IES-R Score one month after a RTC



Age

Age provided from the screening questionnaire was explored as a continuous variable. The relationship between age and total IES-R score was investigated using Kendall's tau_b since age was not normally distributed (Figure 46). No significant correlation was found between age and IES-R scores (τ = - 0.72, p = 0.206, n=144).

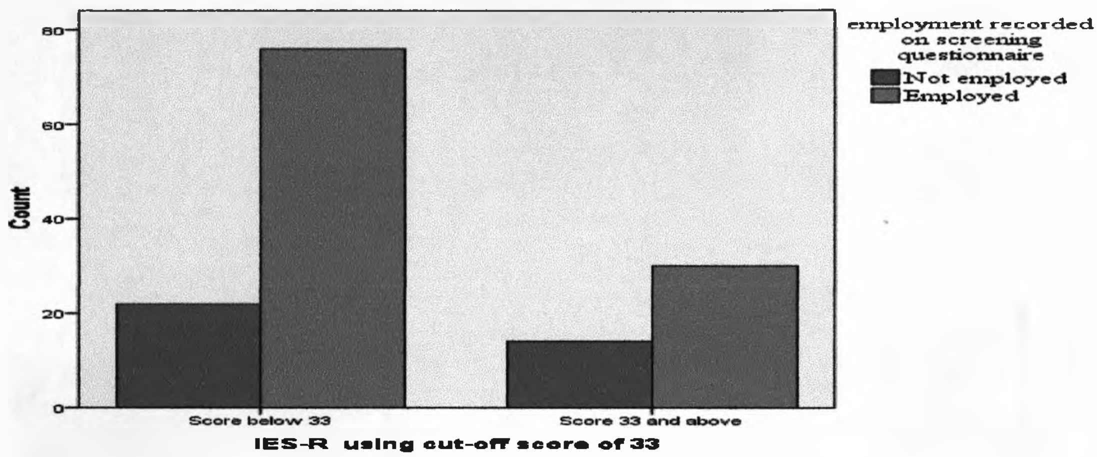
Figure 46: Relationship between age and IES-R scores one month after a RTC



Employment

Employment status was reported on the screening questionnaire. Amongst the participants completing the one month questionnaire, 75% were employed. Although more employed participants had above caseness symptoms (21%) compared to the unemployed group (10%), no significant relationship was established between employment status and PTSD after a RTC, using Pearson's Chi-Squared test ($\chi 2$ 1.409, df 1, sig 0.235, 2 tailed).

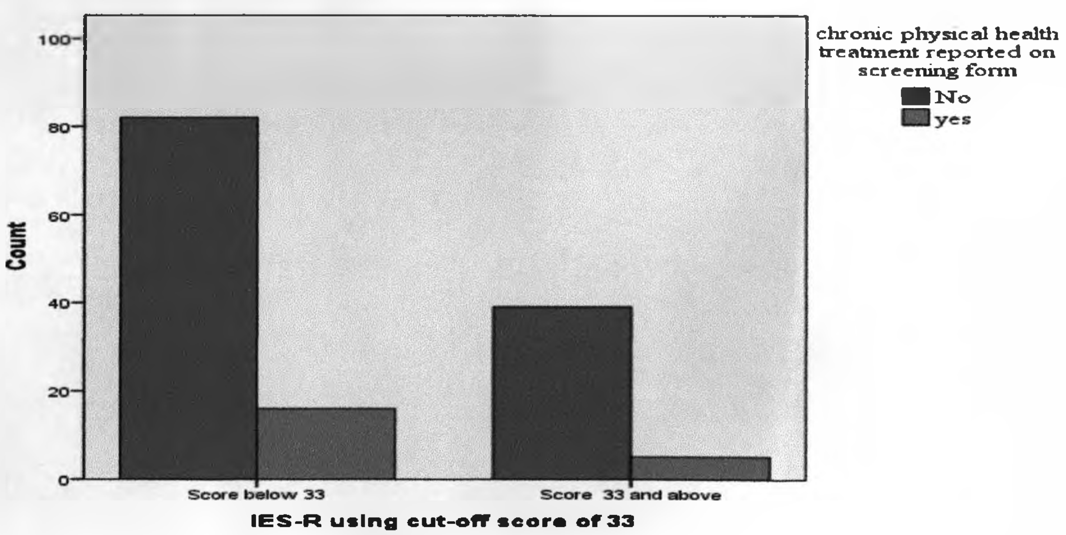
Figure 47: Relationship between employment at one week and IES-R score at one month



Chronic Physical Health Problems

On the screening questionnaire, participants reported past treatment for chronic physical health problems.

Figure 48: Relationship between chronic physical health problems and IES-R one month after a RTC

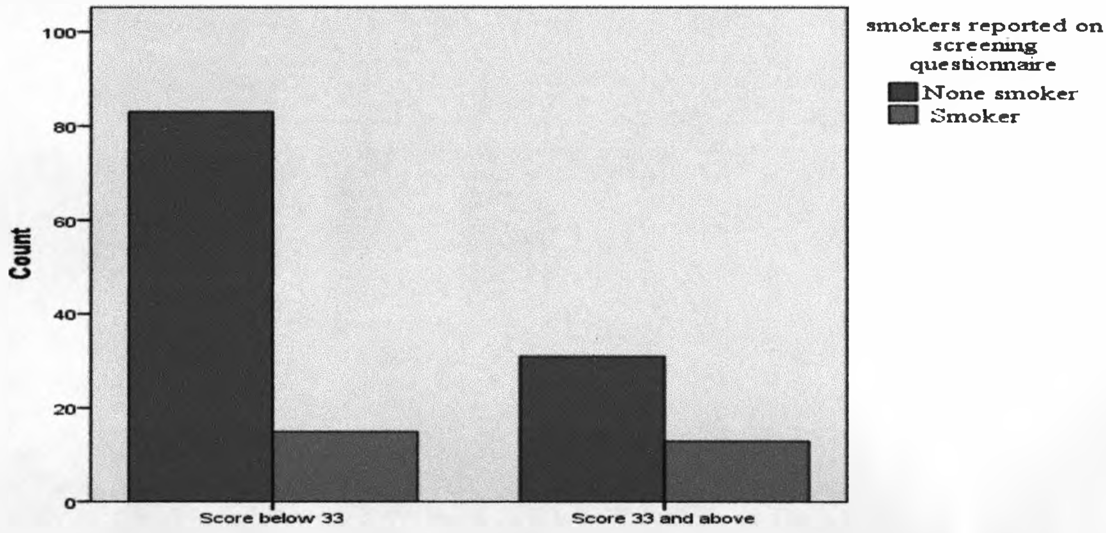


Amongst one month respondents 15% had previously been treated for a chronic physical health problem. 21 participants had received previous treatment (Figure 48). No significant relationship was established between the variables ($\chi 2$ 0.594, df 1, sig 0.441, 2 tailed).

Smoking

28 out of the participants (20%) smoked and 13 smokers (9%) had case level PTSD symptoms compared to 31 (22%) non-smokers (Figure 49). A significant association was found between case-level PTSD symptoms and smoking, using Pearson's Chi-squared test ($\chi 2$ 3.889, df 1, sig 0.049, 2 tailed), where not being a smoker was associated with not having ASD.

Figure 49: Relationship between smoking and IES-R one month after a RTC



Drinking Alcohol

112 one month respondents reported that they drank alcohol (79%) and 32 also reported case-level PTSD (Figure 50).

No significant relationship was found between being an alcohol drinker and reporting above case level symptoms on the IES-R measure using Pearson's Chi-squared test ($\chi 2$ 1.445, df 1, sig 0.229, 2 tailed).

Figure 50: Relationship between IES-R caseness and drinking alcohol

Previous Treatment for Mental Health Problems

A total of 15 participants had previously received treatment and 7 reported above threshold symptoms on the IES-R, compared to 36 people without such a history. Although there appeared to be a trend for people with previous mental health treatment to develop PTSD, no significant relationship was established using Pearson's Chi-squared test ($\chi 2$ 2.133, df 1, sig 0.144, 2 tailed).

A previous history of mental health treatment was not related to the development of PTSD after a RTC. This result contrasts with the relationship found with ASD caseness. Relatively few participants reported having such treatment (11%), which was lower than the 15% rate of psychiatric caseness found in the UK sample of the psychiatric morbidity survey (Singleton, Bumpstead, O'Brien, Lee and Meltzer, 2001). This discrepancy between psychiatric caseness in this study and the national survey could have arisen from self-selection by the participants, or a reluctance to report a psychiatric history within this study's context, both of which could have distorted the results.

Family history of treatment for mental health problems

18 (13%) of the 138 respondents to this question endorsed a family history of treatment for mental health problems. No significant association between their family history of mental health problems and PTSD case level symptoms was established using Pearson's Chi-squared test ($\chi 2$ 1.703, df 1, sig 0.192, 2 tailed).

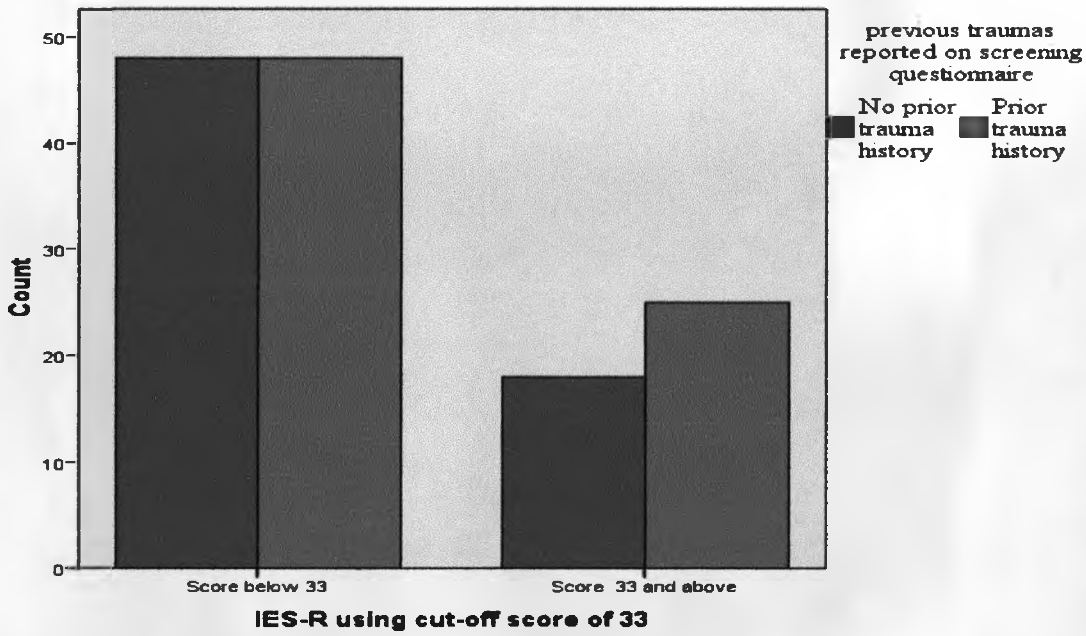
However these results could have been influenced by the ability of participants to be fully acquainted with and willing to report their family history.

Previous Trauma History

A previous trauma history was reported by 53% of participants. Previous exposure to trauma was compared with case level scores on the IES-R. Amongst those with PTSD, slightly more participants reported previous trauma exposure, although no significant relationship was established between the variables using Pearson's Chi-squared test ($\chi2$ 0.789, df1, sig 0.374, 2 tailed).

Participants who indicated involvement in a previous traumatic event were then asked to report the number of years since the incident. The mean number of years was 8.5 ± 9.9 (n=96) with a range from one month to 60 years. The non-parametric Kendal's tau_ b was used to analyse the relationship between IES-R score and time since prior trauma, as the data was positively skewed. No significant correlation between the time lapsed and IES-R score was established (τ = 0.057, p = 0.509). The results indicate that neither a previous trauma nor time elapsed since exposure was related to PTSD.

Figure 51: Relationship between previous trauma history and IES-R a month after a RTC

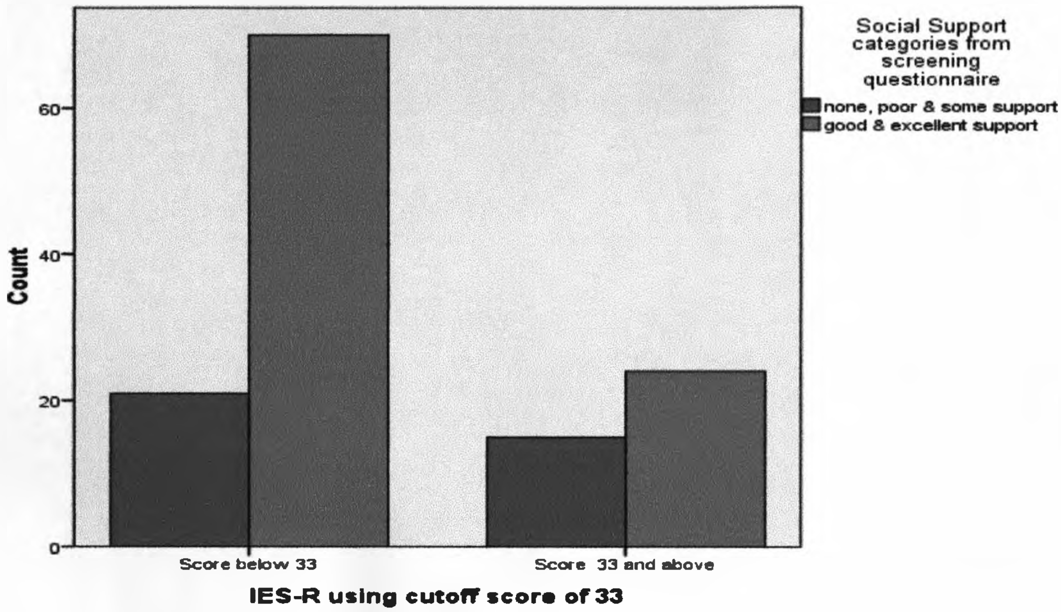


Quality of social support at one week

Participants (n=130) rated their social support[W] and their responses were grouped into two categories to enable further analysis. 94 rated their social support as very good or excellent and 70 of this group did not have case-level PTSD symptoms (Figure 52).

No significant relationship between support[W] and PTSD[M] caseness was identified using Pearson's Chi-squared test ($\chi2$ 3.227, df 1, sig 0.072, 2 tailed). Although social support[W] had been significantly associated with ASD caseness, it did not link to PTSD[M]. 14 participants did not complete this question after a month, which may have influenced the results obtained.

Figure 52: Relationship between categories of social support and IES-R one month after a RTC

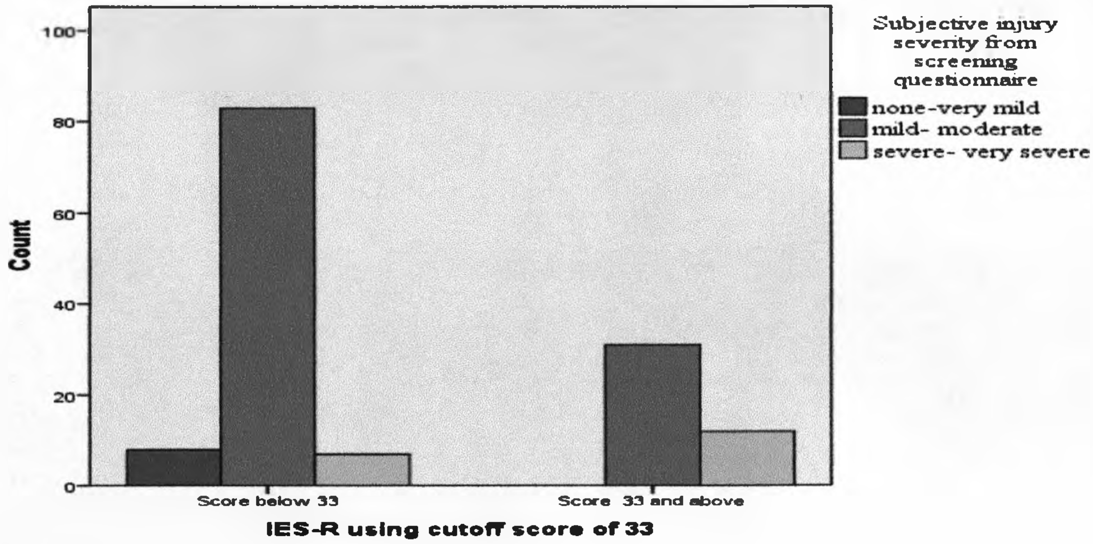


Subjective severity of injuries

Injury severity[W] was rated using a six point scale and re-coded into three categories for further analysis. The majority of the one month respondents (81%) reported mild/moderate injury severity, whilst 14% reported severe/very severe injuries. None of the participants that reported none/very mild injuries developed PTSD case-level symptoms. The majority of participants reporting severe injuries developed case level PTSD (Figure 53).

A significant relationship between PTSD caseness and subjective injury severity was established using Pearson's Chi-squared test ($\chi2$ 13.66, df 1, sig 0.001, 2 tailed). Thus, the RTC participant's subjective perception of injury severity was associated with both case-level ASD and PTSD.

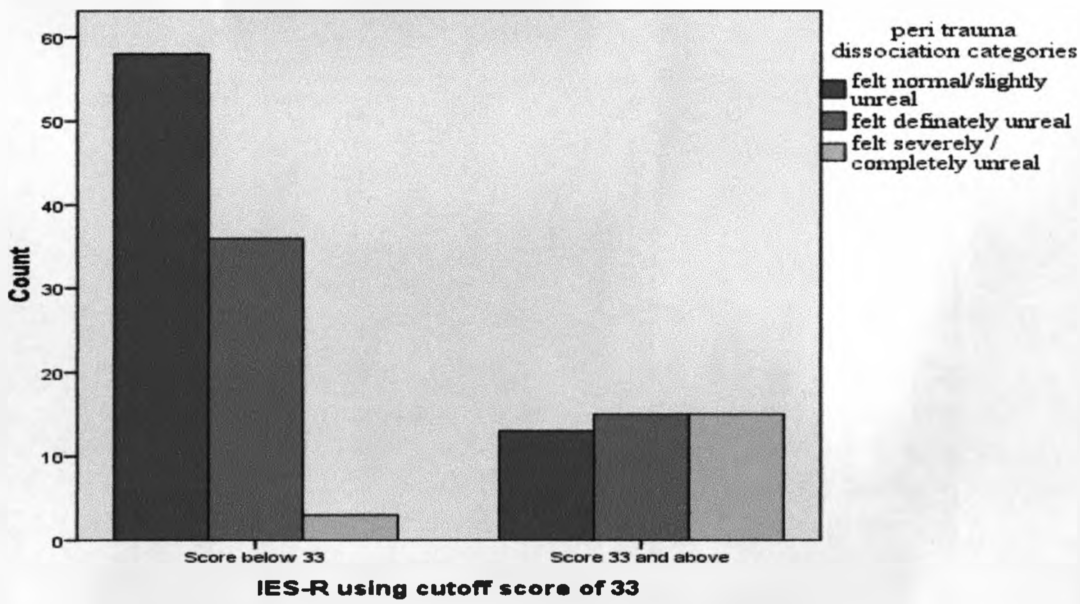
Figure 53: Relationship between subjective injury severity and IES-R after one month



Dissociation

Participants rated feelings of unreality from around the time of their crash. For analysis, the data was re-coded into three categories of severity.

Figure 54: Relationship between feelings of unreality and IES-R after one month



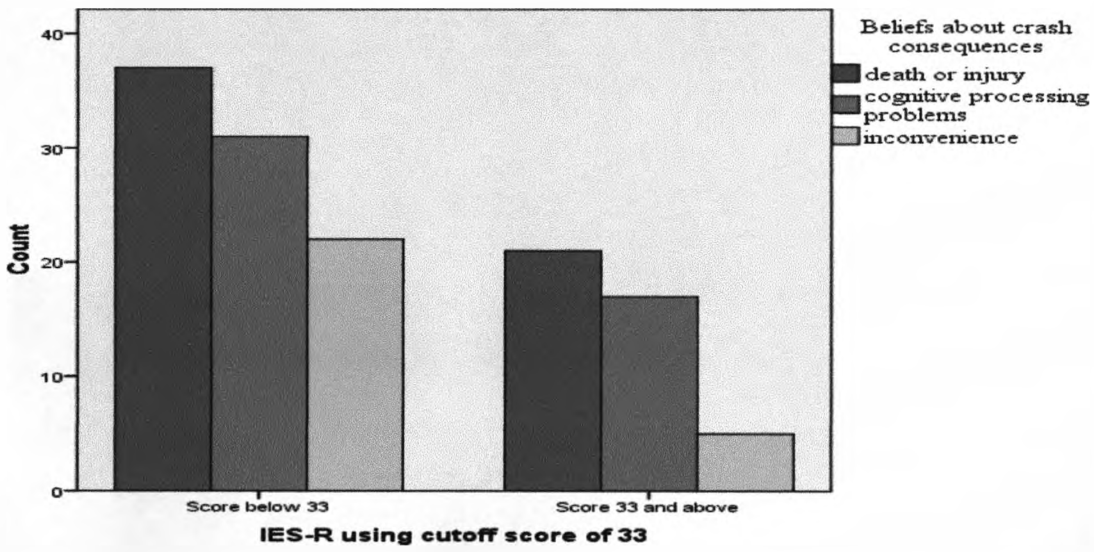
The majority (51%) of participants reported feeling normal/slightly unreal, a further 13% felt severely/completely unreal, whilst the remainder reported that they experienced definite feelings of unreality at the time of the crash (Figure 54). A significant association between the extent of unreality[W] and case-level PTSD[M] was established using Pearson's chi-squared test ($\chi 2$ 28.594, df 2, sig <0.001, 2 tailed).

This study found that the extent of unreality around the time of a RTC was linked to case level symptoms of both ASD^{W} and PTSD^{M} Moreover, not feeling unreal was associated with not having PTSD.

Subjective Perception of Crash Consequences

Participants reported their perception of what they believed would happen at the time of the crash. These responses were coded and categorised. Amongst the one month respondents the most frequent beliefs were about injury or death. Inconvenience or vehicular damage was the least reported category.

Figure 55: Relationship between crash beliefs and IES-R one month after RTC

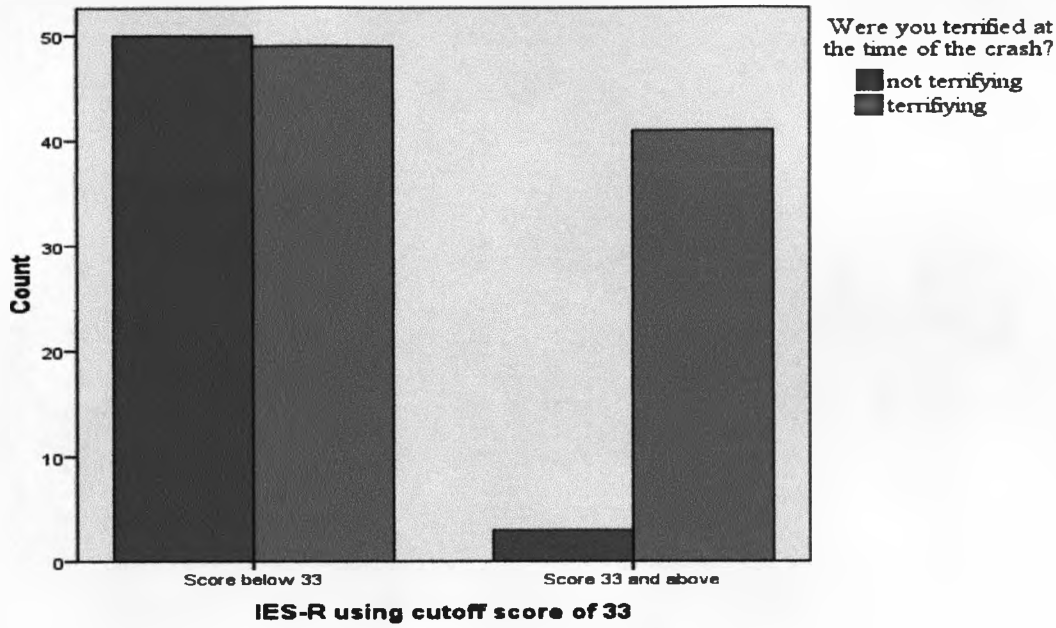


All three categories of beliefs were reported by participants with above and below PTSD caseness (Figure 55), although no trend between belief and PTSD caseness was evident. This was confirmed when the data was analysed using Pearson's Chi-squared test ($\chi2$ 2.962, df 2, sig 0.227, 2 tailed).

Terrified at the time

Many participants (63%) reported being terrified by their crash and almost half of these had above threshold IES-R symptoms. By comparison, only three people, who were not terrified, went on to develop above threshold symptoms of PTSD (Figure 56). This pattern suggested a relationship between these variables, which was significant, using Pearson's Chi-squared test ($\chi2$ 24.923, df 1, sig <0.001, 2 tailed).

Figure 56: Relationship between being terrified at time of crash and IES-R after one month

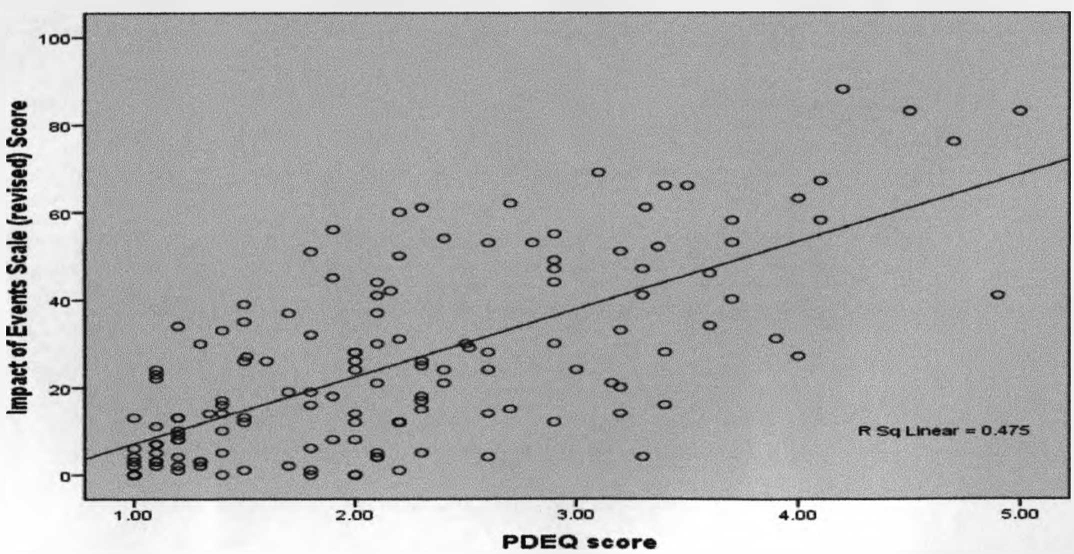


Being terrified by the crash was significantly associated with both ASD[W] and PTSD[M]. There was a significant relationship between both ASD[W] and PTSD[M], since participants, who were not terrified at the time of the crash, rarely developed PTSD, whereas some people who were terrified at the time of the RTC did.

Peri-Traumatic Dissociative Experiences

Although participants completed the PDEQ measure at one month, the questionnaire assessed participants' experiences around the time of their crash.

Figure 57: Relationship between PDEQ and IES-R scores a month after a RTC

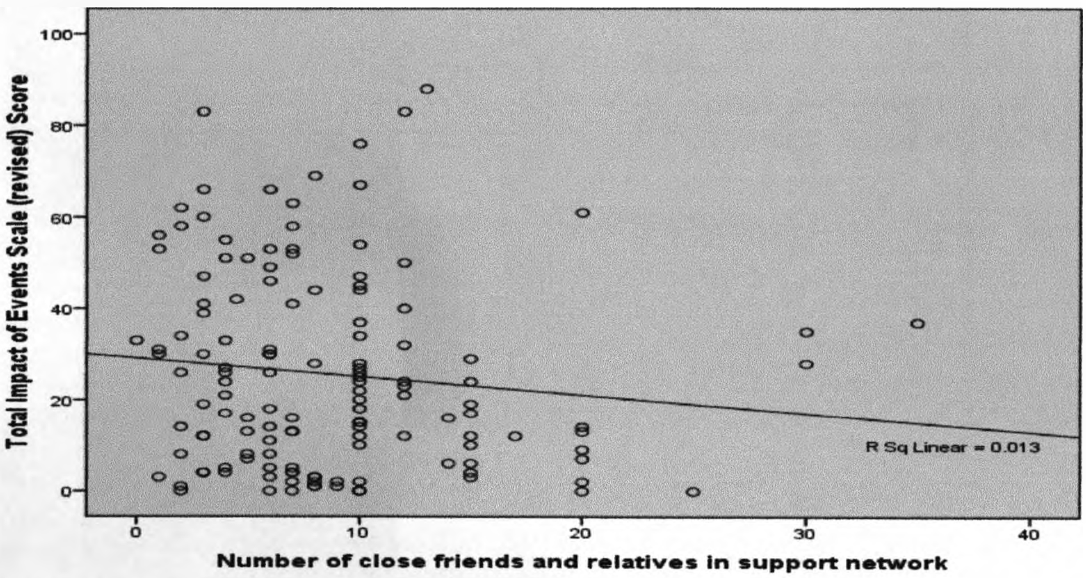


The relationship between PDEQ and IES-R scores was investigated using Kendall's tau_b, as the data was not normally distributed (Figure 57). A significant positive correlation was identified between the variables ($\tau = 0.477$, 2 tailed, $p < 0.001$, n=144).

Social Support Structure

Participants were asked to record the size (structure) of their support network, as part of the MOS measure. Network structure ranged from 0-35 close friends or family, with a mean of 8.8 ± SD 6.123, n=127. The correlation between network size and total IES-R score was analysed using Kendall's tau_b because the data was not normally distributed. No significant correlation was found between these variables ($\tau = -0.102$, $p = 0.093$, 2 tailed, n=137).

Figure 58: Relationship between Social support network and IES-R scores a month after a RTC



Social Support Function

The MOS examined the availability of four social support domains. The association between each domain and IES-R score was investigated using Kendall's tau_b, a non-parametric test, because the data was not normally distributed. None of the domains of social support[M] were significantly associated with the participants' IES-R scores.

Tangible support $\tau = -0.109$, 2 tailed, p=0.083, n= 130

Affection $\tau = -0.072$, 2 tailed, p=0.270, n= 130

Socialising $\tau = -0.084$, 2 tailed, p=0.196, n= 130

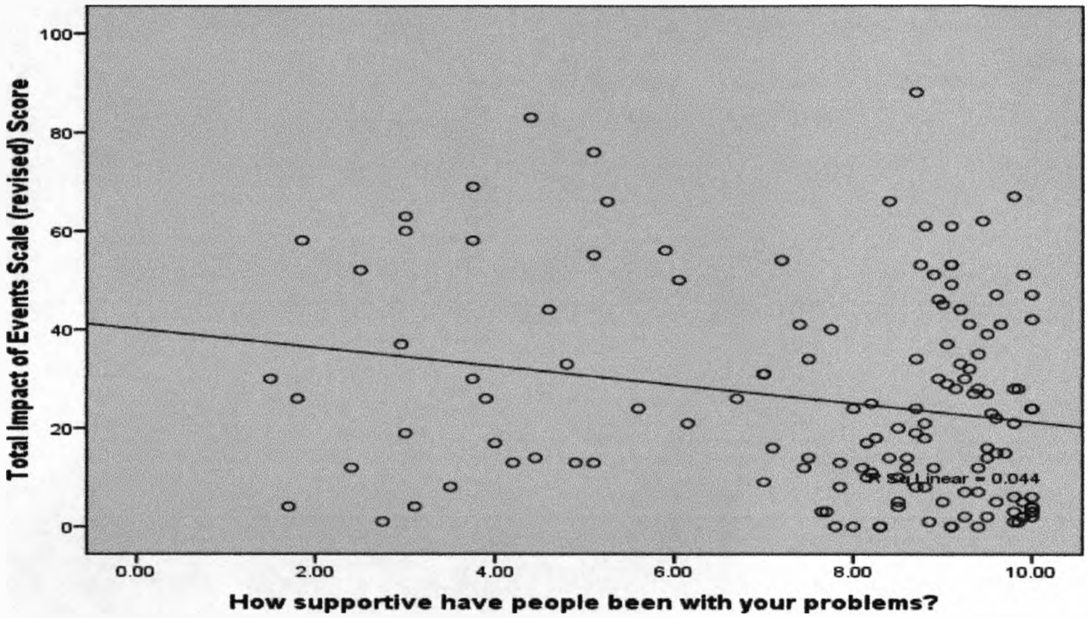
Emotional/Informational support $\tau = -0.114$, 2 tailed, p=0.065, n= 130

None of the assessed domains of social support were significantly linked to PTSD after a RTC.

Social Support with problems

Participants used a 10cm Visual analogue scale (VAS) to rate how supportive people had been with their problems after the RTC. Participants generally reported people to be supportive with their problems, with a mean response of 7.77 ± 2.34 (n=140) and a negatively-skewed distribution (Figure 59).

Figure 59: Relationship between support and IES-R a month after a RTC



The association between the participants' perception of social support and IES-R score was investigated using Kendall's tau_b, a non-parametric test, as the data was not normally distributed. A significant negative correlation was found between support ratings and IES-R scores (τ = -0.132, p = 0.023). Perceiving others as being supportive after a crash was associated with lower IES-R scores

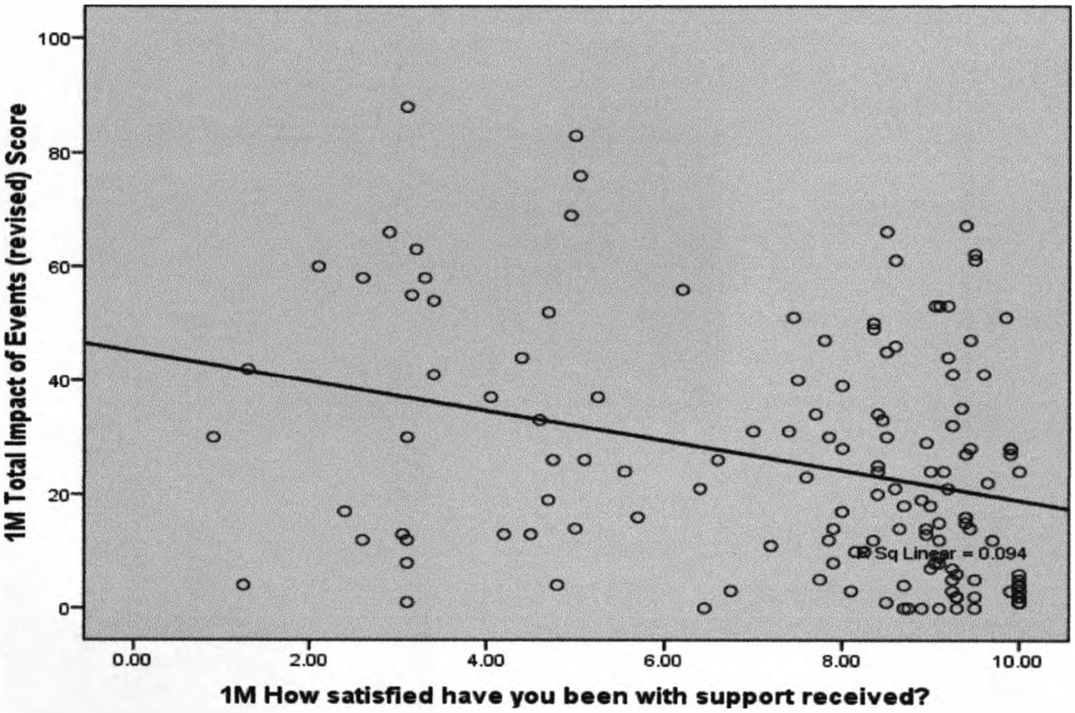
Conversely, a perception of poor support was associated with greater severity of PTSD. Importantly, the support indicated related to participants' perception and not to an objective measurement. From these results, the subjective belief about support correlated with PTSD symptoms. However, the direction of causality or influence of other variables on this relationship could not be determined.

Social Support Satisfaction

Participants rated their satisfaction with their support using a 10cm VAS. The participants were generally very satisfied with the support they received, with a mean value of 7.5± 2.5 (n=140) and a negatively skewed distribution (Figure 60).

The relationship between satisfaction rating and IES-R scores was analysed using Kendall's tau_b, a non-parametric test, as the variables were not normally distributed.

Figure 60: Relationship between satisfaction with support and IES-R score after one month

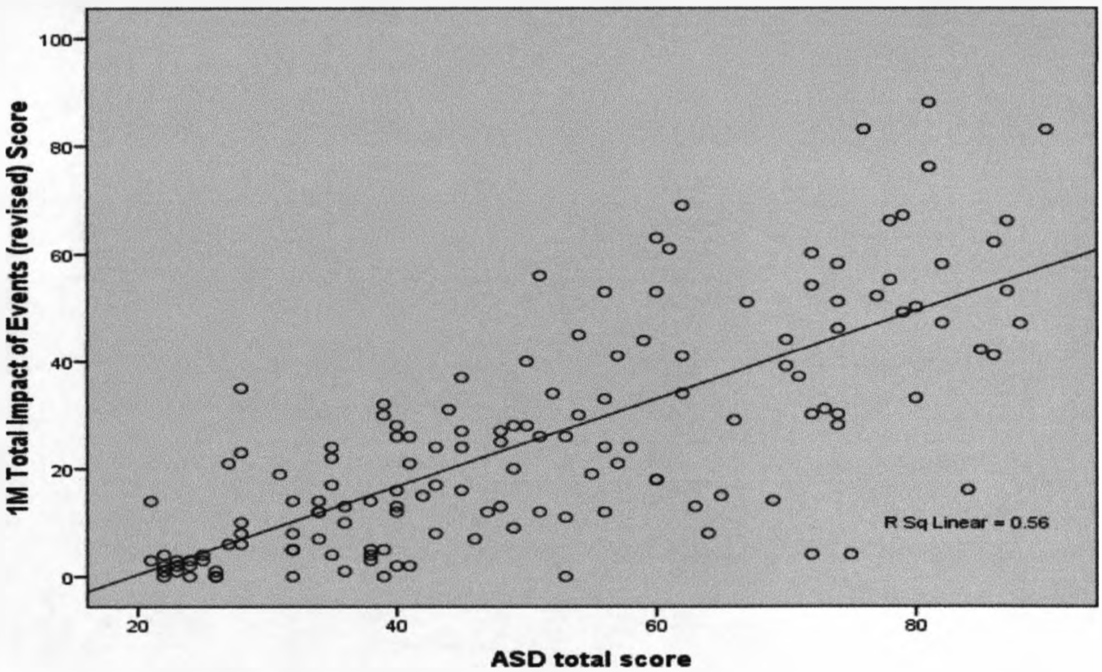


A significant negative correlation between social support satisfaction and IES-R was identified amongst the participants (τ= - 0.219, p<0.001), with a lack of satisfaction linked to greater PTSD symptoms. Conversely, being very satisfied was associated with low symptoms of PTSD (Figure 60). However, satisfaction is inherently subjective and the ratings could not be objectively compared between participants.

Acute stress disorder

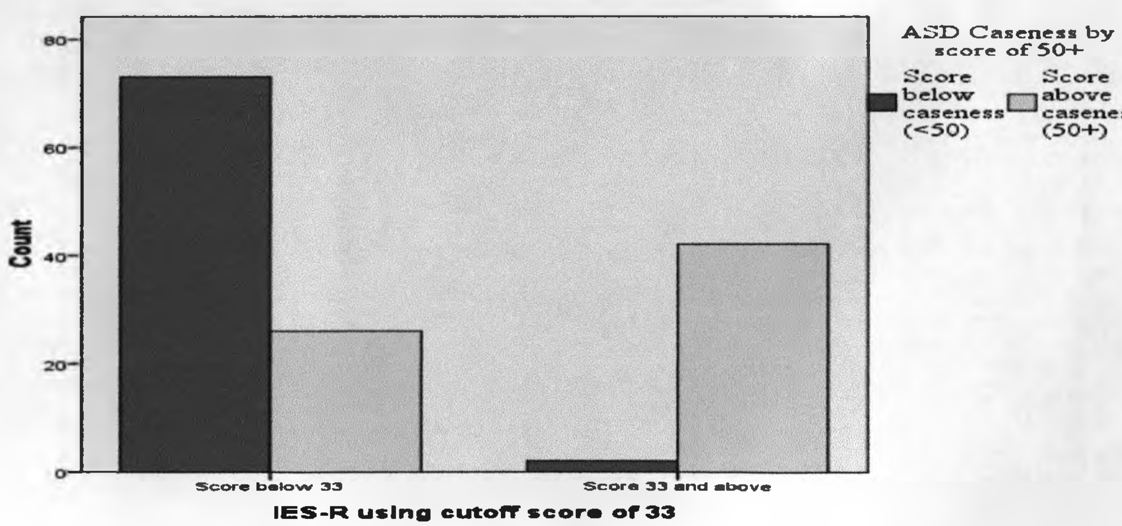
Initial trauma response was measured using the ASDS and at one month the IES-R was used to measure PTSD symptoms. The relationship between the scores for these measures was plotted and a positive trend was apparent between IES-R and ASDS (Figure 61). A significant relationship was established between the variables when analysed using Kendall's tau_b (τ = 0.57, p<0.001), hence the high levels of acute stress symptoms in the week after the crash correlated with high levels of PTSD symptoms after a month.

Figure 61: Correlation between ASDS after one week and IES-R scores a month post RTC



Amongst one month respondents, 48% endorsed above threshold scores for ASD. Only two participants with below threshold ASD subsequently reported PTSD^{M} (Figure 62). This compared with 42 participants reporting above case level symptoms of both ASD and PTSD. A significant relationship between PTSD and ASD was again established using Pearson's Chi-squared test ($\chi 2$ 58.474, df 1, sig <0.001), suggesting that case levels of one disorder are linked to the other. In this study, not having ASD at one week, was significantly associated with not having PTSD, which may be useful clinically to identify casualties, who do not require further monitoring.

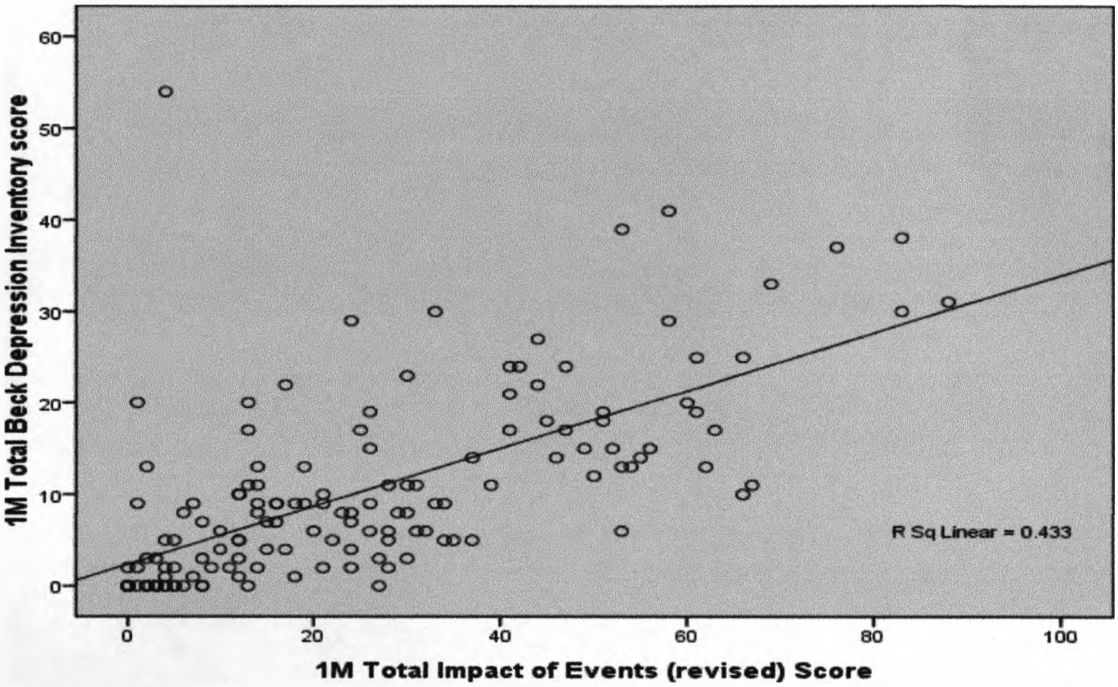
Figure 62: Relationship between ASDS caseness and IES-R caseness after one month



Depression

Participants completed BDI[M] and the relationship between the BDI and IES-R scores was explored using a non-parametric test, since both variables were positively skewed.

Figure 63: Relationship between BDI and IES-R scores one month after a RTC

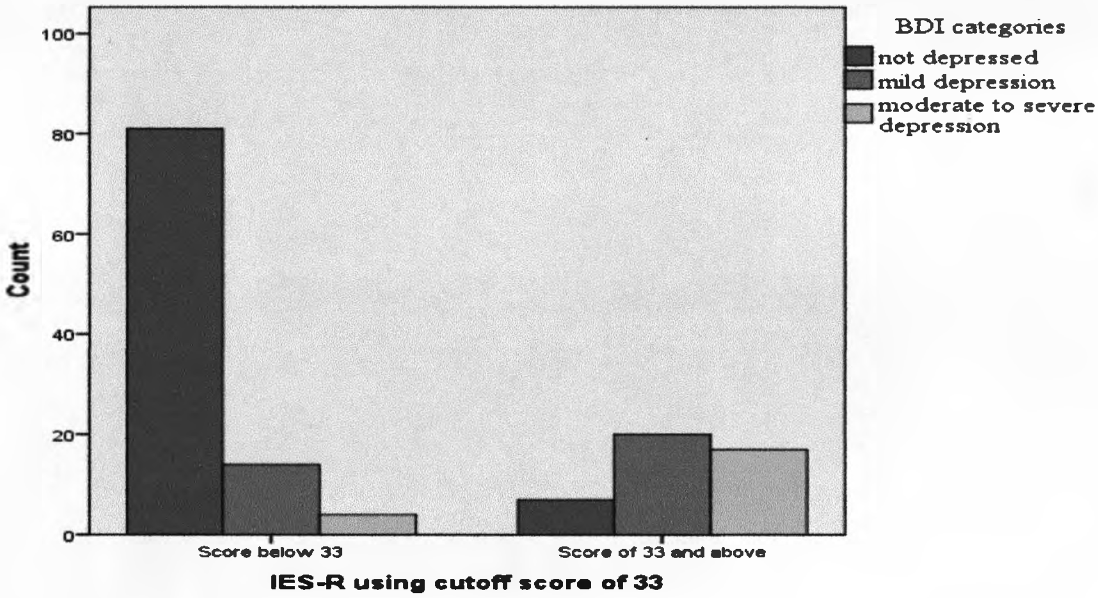


A significant correlation was identified between the scores from the two measures (Figure 63) using Kendall's tau_b test (τ=0.405, p<0.001, 2 tailed). A month after a RTC, scores for PTSD and depression were significantly correlated, suggesting strong co-morbidity between the disorders.

Further analysis was carried out looking at the case-level scores for both measures. The scores were categorised into three groups (not depressed <10, mild depression 10-18, moderate to severe depression 19+). Mild depressive symptoms were reported by 24% of respondents and a further 15% reported symptoms indicative of moderate to severe depression. Amongst those who were not depressed (n=88), only seven reported above caseness symptoms of PTSD (Figure 64), whereas amongst those with moderate to severe depression (n=21), only four had below caseness IES-R scores.

A significant relationship was identified between severity of depression and PTSD using Pearson's Chi-squared test ($\chi 2$ 58.892, df 2, sig <0.001) with case levels of the two disorders strongly associated.

Figure 64: Relationship between BDI categories and IES-R a month after a RTC

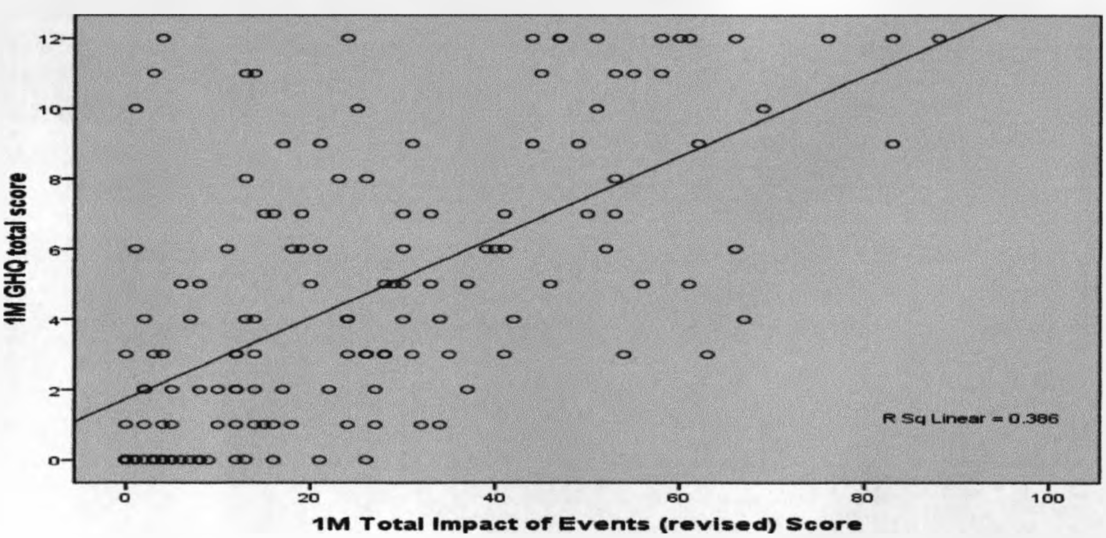


From Figure 64, it was evident that it was rare to have PTSD case-level symptoms amongst those with normal mood and, similarly, the majority of participants with moderate to severe depression had PTSD level symptoms. However, participants with mild depression were found in both PTSD categories.

General Health Questionnaire

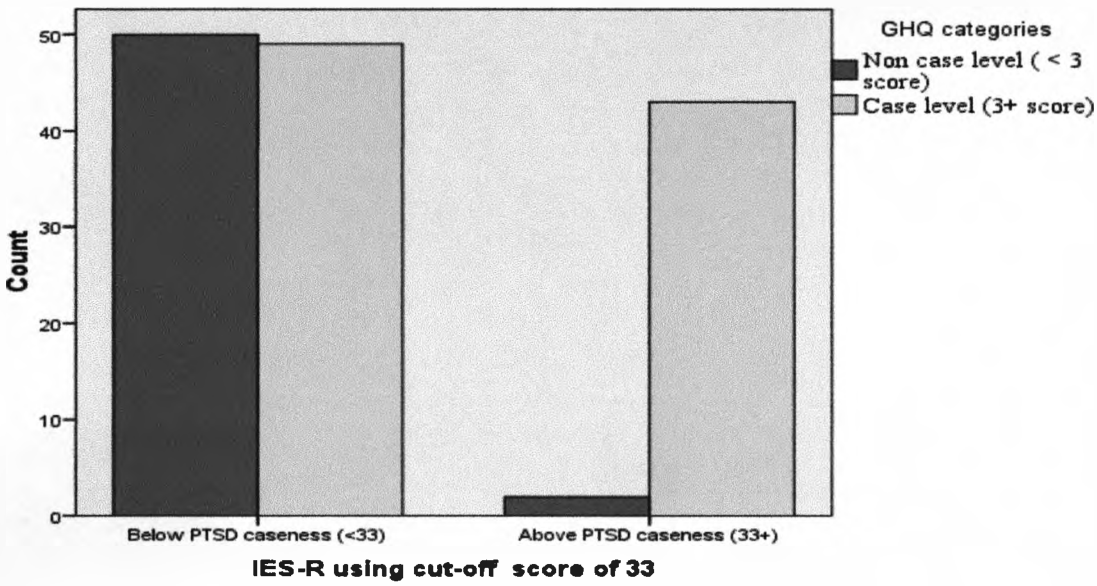
The GHQ12 measured general symptoms of psychiatric disorders and scores on this measure were compared with those from the IES-R (Figure 65) using a non-parametric test, since the data set was not normally distributed.

Figure 65: Relationship between GHQ total scores and IES-R total scores a month after a RTC



A significant positive correlation between GHQ and IES-R scores was identified using Kendall's tau_b test ($\tau = 0.477$, $p<0.001$, 2 tailed).

Figure 66: Relationship between GHQ caseness and IES-R caseness one month after RTC



However, the GHQ was intended to be used more as a categorical measurement tool. Therefore, the relationship between these variables was also analysed using GHQ as a categorical measure. Symptom levels above psychiatric caseness were reported by 63% of participants (Figure 66). PTSD symptoms were associated with general psychiatric disorder and PTSD caseness was rare amongst participants with a below caseness GHQ score, suggesting some potential to identify casualties with low risk of PTSD.

Function

The work and social function scale (WAS) was used to assess the impact of the crash on daily functioning. A large majority of respondents (72%) reported that their function was affected by the crash (n=144) and 42 (40%) participants had PTSD, whereas only 2 participants with PTSD (5%), did not have functional problems (Figure 67). A significant relationship was identified between functional impairment and PTSD using Pearson's Chi-squared test ($\chi 2$ 13.04, df 1, sig <0.001, 2 tailed).

Figure 67: Relationship between overall function and IES-R caseness after one month

The test results and Figure 67 suggest that reporting no impairment of function was linked to below caseness symptoms of PTSD, whilst impaired functioning was reported amongst participants with a range of PTSD symptoms. Reporting no functional impairment after a month, may be a useful characteristic to differentiate casualties with low PTSD risk from those requiring further monitoring.

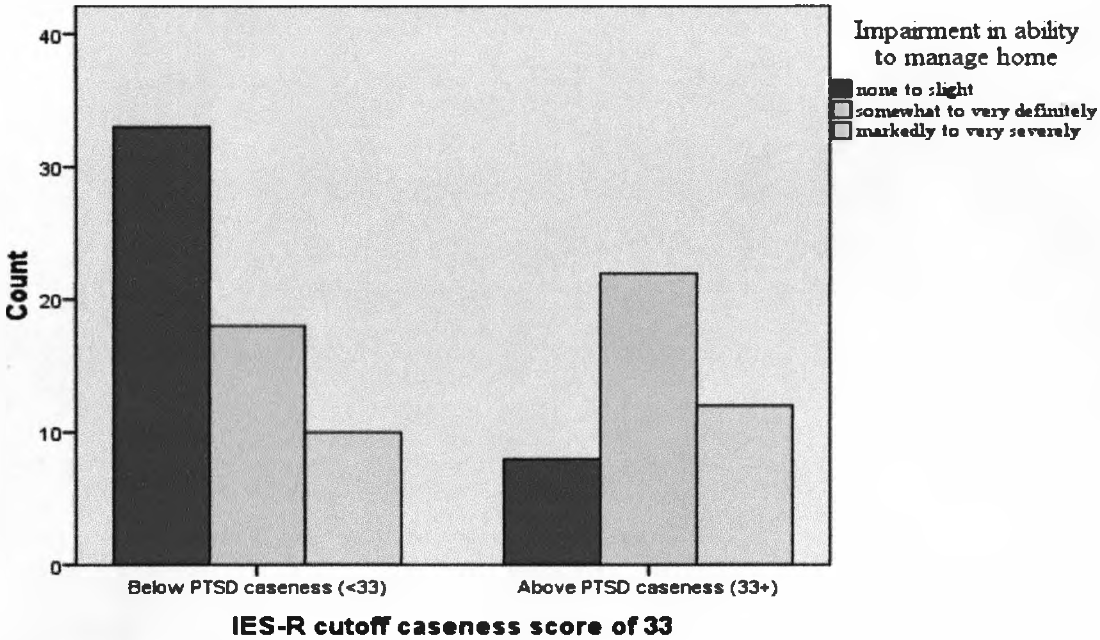
Participants, whose function was impaired, rated their dysfunction across several domains. To enable further analysis the nine categories were merged into three levels of impairment (non/slight, somewhat, definitely, very definitely, markedly/very severely). The relationship between each domain and PTSD was investigated using Pearson's Chi-squared test.

Impaired functioning in work although widely reported by the participants was not associated with PTSD ($\chi2$ 4.748, df 2, sig 0.093, 2 tailed).

Functioning at home was significantly associated with PTSD ($\chi2$12.755, df 2, sig 0.002, 2 tailed) with lower ratings of functional impairment reported amongst those with below threshold IES-R scores (Figure 68).

Socialising was significantly associated with PTSD ($\chi2$ 14.057, df 2, sig 0.001, 2 tailed) with less severe impairment, associated with below case level symptoms of PTSD (Figure 69).

Figure 68: Relationship between ability to manage home and IES-R after one month



In this study, ability to function alone was significantly related to PTSD[M] ($\chi 2$ 13.08, df 2, sig 0.001, 2 tailed). From Figure 70, it was apparent that low levels of impairment were associated with below threshold PTSD, whereas greater severity of impairment was linked to PTSD caseness. Difficulty functioning in relationships was significantly associated with PTSD ($\chi 2$ 29.028, df 2, sig <0.001, 2 tailed).

Figure 69: Relationship between ability to socialise and IES-R after a month

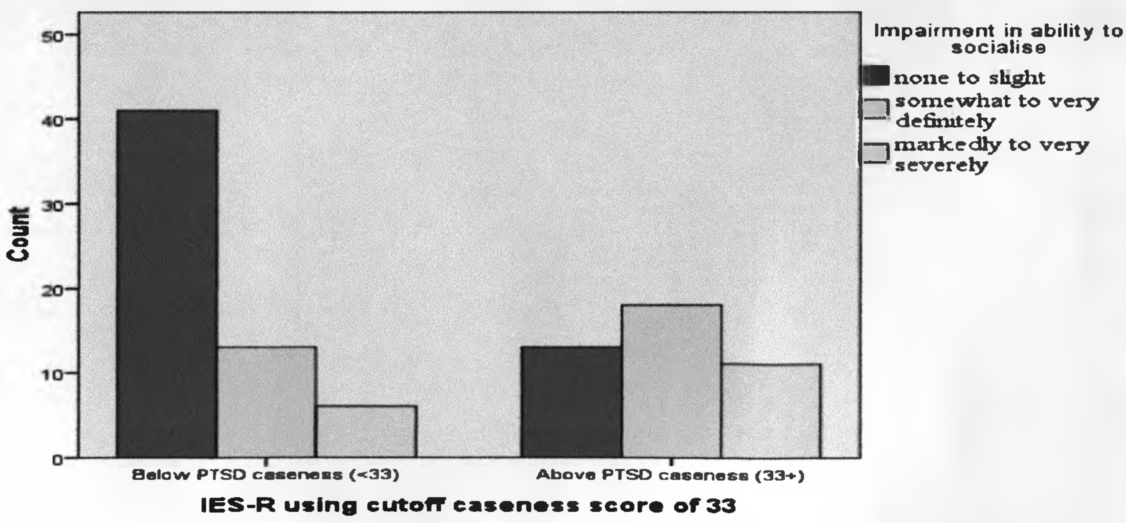
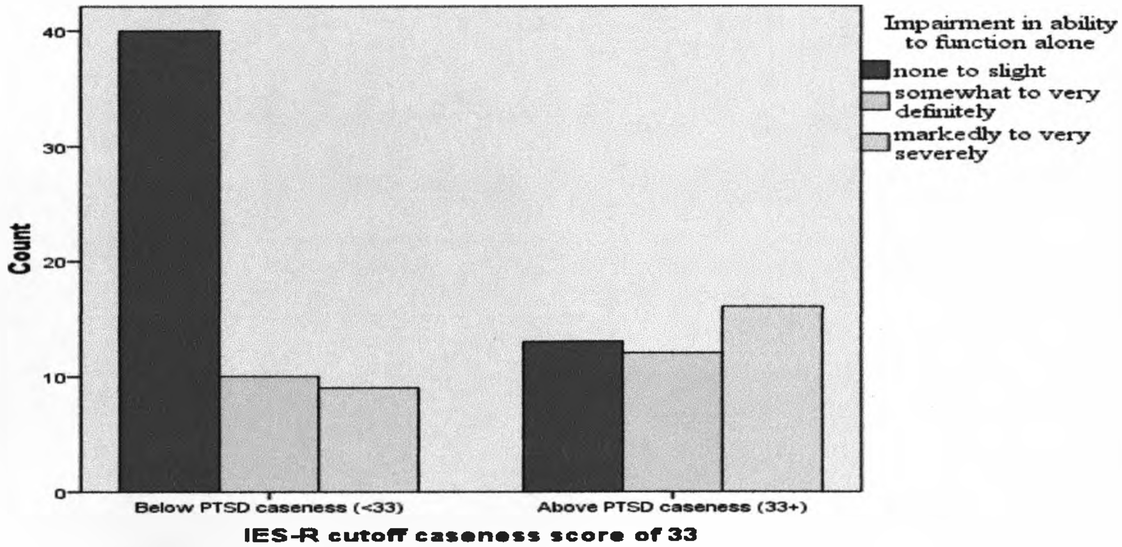
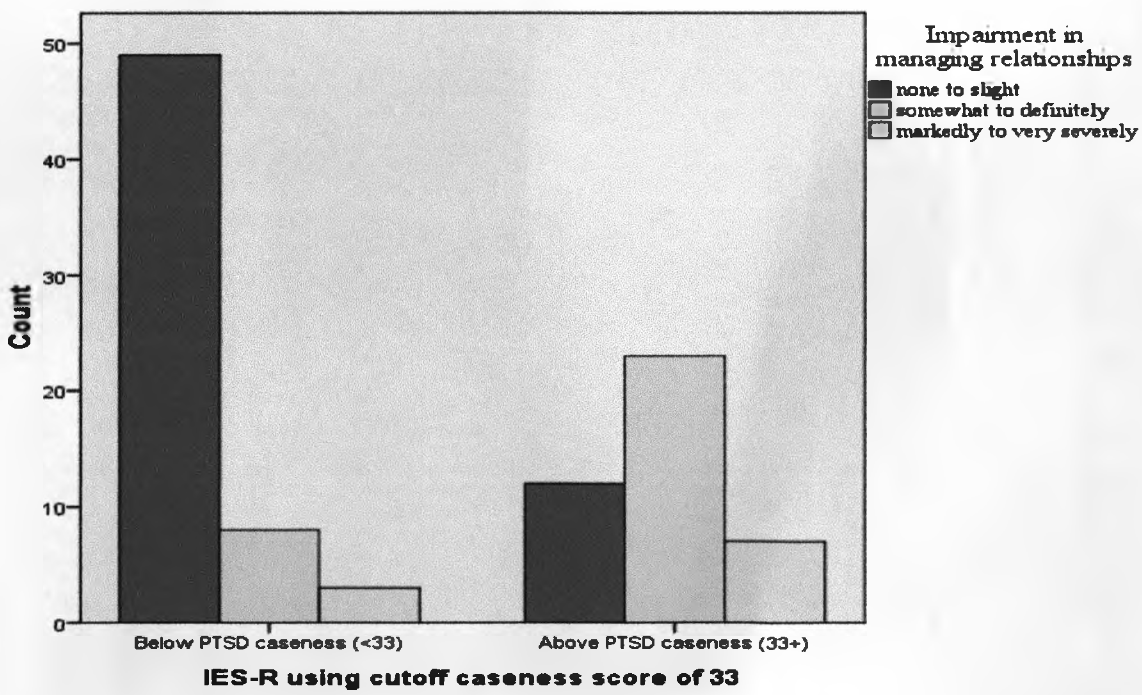


Figure 70: Relationship between ability to function alone and IES-R after one month



Minor impairment was associated with below caseness scores on the IES-R, whereas greater impairment was linked to above threshold PTSD scores.

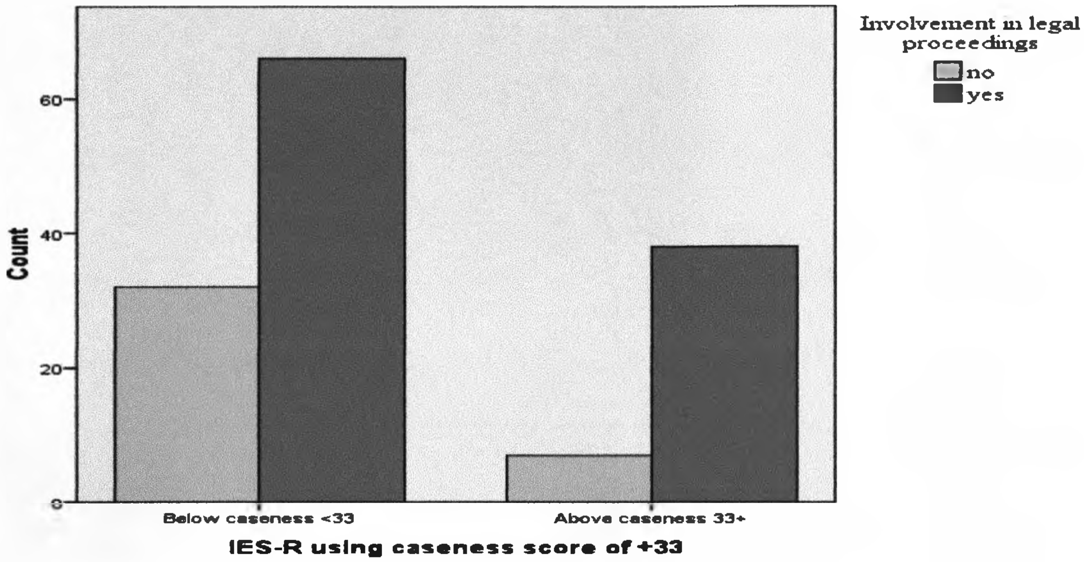
Figure 71: Relationship between managing relationships and IES-R after a month



Legal Proceedings

After one month, participants reported their involvement with legal proceedings after the crash. The majority of participants (72%) were involved in legal proceedings. A significant relationship between PTSD and involvement in legal proceedings was found using Pearson's Chi-squared test ($\chi 2$ 4.545, df 1, sig 0.033, 2 tailed).

Figure 72: Relationship between legal proceedings and IES-R after a month



Not being involved in a legal process, following a RTC was linked to below threshold symptoms of PTSD (Figure 72).

Summary of risk factors

Pre, peri and post-crash variables were investigated for their association with PTSD symptoms, measured by the IES-R (Table 7). Although a range of variables was investigated, being a smoker was the only pre-crash factor which when tested, was associated with PTSD^{M} caseness.

Apart from social support^{W}, all the significant the peri-crash variables were fear-related constructs (Table 8). Dissociation was reported using the PDEQ^{M} and feeling unreal^{W}, which in this study required participants to retrospectively rate the severity of these symptoms from around the time of the crash. Dissociation, being terrified and subjective injury severity were all related to PTSD caseness and with dissociation severity linked to PTSD symptom severity. Participants' retrospective reports of being terrified^{W} were related to PTSD caseness, with lack of terror linked to sub-threshold PTSD^{M}. Although the participants generally sustained minor injuries, the participants' subjective perception of injury severity was associated with PTSD caseness. None of the other variables tested were significantly related to PTSD^{M} (Table 8).

Table 7: Relationship between pre-crash variables and PTSD

Pre Trauma Factors	**Test results**	**Significance**	**Significant at 0.05 level**
Gender	$\chi2$ 3.684, df 1,	sig 0.055, 2 tailed	
Age	τ = - 0.91	p = 0.161	
Employment	$\chi2$ 1.409, df 1,	sig 0.235, 2 tailed	
Prior chronic health problems	$\chi2$ 0.594, df 1,	sig 0.441, 2 tailed	
Smoking	$\chi2$ 3.889, df 1,	sig 0.049, 2 tailed	Yes
Drinking Alcohol	$\chi2$ 1.445, df 1	sig 0.229, 2 tailed	
Previous Mental Health Problems	$\chi2$ 2.133, df 1,	sig 0.144, 2 tailed	
Family Mental Health Problems	$\chi2$ 1.703, df 1	sig 0.192, 2 tailed	
Previous Traumas	$\chi2$ 0.789, df1,	sig 0.374, 2 tailed	
Years since previous trauma	τ = 0.057,	p = 0.509	

Table 8: Relationship between peri-crash variables and PTSD

Peri-Trauma Factors	**Test results**	**Significance**	**Significant at 0.05 level**
Social Support in first week	$\chi2$ 3.227, df 1,	sig 0.072, 2 tailed	
Subjective severity of injuries	$\chi2$ 13.66, df 1,	sig 0.001, 2 tailed	Yes
Feeling strange / unreal	$\chi2$ 28.594, df 2,	sig <0.001, 2 tailed	Yes
Perception of crash consequences	$\chi2$ 2.962, df 2	sig 0.227, 2 tailed	
Terrified at time	$\chi2$ 24.923, df 1,	sig <0.001, 2 tailed	Yes
PDEQ score	r = 0.689,	p <0.001, 2 tailed, n=127	Yes

A range of post-crash variables and psychometric measures were investigated for their relationship with PTSD. Social support was measured by four different measures. The available network size and functional domains were not significantly related to IES-R scores, whereas support provided^{M} since the crash and satisfaction^{M} were negatively associated with IES-R scores. Ratings of social support and satisfaction may be useful, clinically, to highlight casualties at risk or with PTSD after a RTC.

Functional impairment due to the crash was measured globally and across five functional areas. A significant relationship between overall dysfunction and PTSD was established. When the separate functional areas were explored, all domains except work were significantly related to PTSD, with the reporting of minimal impairment linked to non-case PTSD. Whilst not being involved in legal proceedings, was linked to not having PTSD[M]. However, the direction of causality or influence of other variables on this relationship could not be determined from this study.

Table 9: Relationship between post-crash variables and PTSD

Post- Trauma Factors	Test results	Significance	Significant at 0.05 level
Social Support **Structure**	r = -0.102	p =0.093, 2 tailed	
Social Support **Tangible**	τ = -0.109,	2 tailed, p=0.083	
Social Support **Affection**	τ = -0.072,	2 tailed, p=0.270	
Social Support **Socialising**	τ = -0.084,	2 tailed, p=0.196	
Social Support **Emotion/Info**	τ = -0.114,	2 tailed, p=0.065	
Social Support with **current problems**	τ = -0.132	p= 0.023, 2 tailed	Yes
Social Support **satisfaction**	τ= - 0.219	p<0.001, 2 tailed	Yes
ASD score	$\chi 2$ 13.04, df 1, τ =0.570	sig <0.001, 2 tailed p<0.001, 2 tailed	Yes
BDI score	$\chi 2$ 58.892, df 2, τ=0.548,	sig <0.001, 2 tailed p<0.001, 2 tailed	Yes
GHQ score	$\chi 2$ 28,45, df 1, τ =0.477,	sig <0.001, 2 tailed p<0.001, 2 tailed	Yes
WAS overall functional impairment	$\chi 2$ 13.04, df 1,	sig <0.001, 2 tailed	Yes
WAS/Work	$\chi 2$ 4.748, df 2,	sig 0.093, 2 tailed	
WAS/ Home	$\chi 2$ 12.755, df 2	sig 0.002, 2 tailed	Yes
WAS/ Socialising	$\chi 2$ 14.057, df 2	sig 0.001, 2 tailed	Yes
WAS/ Alone	$\chi 2$ 13.08, df 2,	sig 0.001, 2 tailed	Yes
WAS/ Relationships	$\chi 2$ 29.028, df 2,	sig <0.001, 2 tailed	Yes
Legal proceedings	$\chi 2$4.545, df 1,	sig 0.033, 2 tailed	Yes

ASDS scores correlated with IES-R scores and case-levels of the two disorders were linked. Amongst participants without ASD, it was rare for them to develop case-level PTSD. These results suggest that ASD symptoms, discernible in the week after a crash, were useful to "screen out" casualties who were unlikely to develop PTSD and also to detect individuals with high levels of psychological distress. Such individuals may require additional psychological support and to be fast-tracked into early intervention, within the first month.

PTSD and depression were significantly correlated and 67% of participants, with low mood, also had PTSD. However, amongst participants with PTSD, depression was more commonplace, as 86% of participants with PTSD, also had depression. The GHQ, which measured generic symptoms of psychiatric disorders, was also found to correlate with the IES-R. General psychiatric disorder was detected in 63% of the population and 87% of participants with PTSD, scored above caseness on the GHQ. Conversely, only 47% of "cases" determined by the GHQ had case-level PTSD symptoms. From these results the GHQ was valid as a broad screening tool to detect general psychiatric symptoms, but further assessment would be required to detect specific disorders and to guide intervention. However, the GHQ may have value in "screening out" participants with low risk of PTSD, since below caseness on the GHQ was significantly related to below caseness PTSD.

Unlike ASD, smoking was the only pre-crash factor linked to PTSD, although several peri-crash factors were significantly related, particularly dissociation, fear and perceived injury severity. Most post-crash factors were related to PTSD, although social support^{W} in, support network size and functional problems were not significantly associated with PTSD. Support received and satisfaction, were negatively correlated with PTSD symptoms.

PlaTO

The proposed PlaTO model consists of three tiers. Targeting must be able to identify casualties at risk of chronic psychological problems after a RTC, to select them for monitoring and early intervention to minimise their dysfunction. This study has identified many pre, peri and post-crash factors linked to PTSD. Since none of the factors were singly able to discriminate between people with and without PTSD^{M}, it appeared that development of the disorder was influenced by the interaction of multiple factors.

To investigate the potential of the identified factors to predict people who would develop PTSD, a series of models were developed and tested through multiple regression.

Multiple regression risk factor analysis

Pre, peri and post-crash factors were linked to PTSD. Further modelling and analysis was undertaken to test potential predictive models of PTSD.

When developing these PTSD models, the theory and purpose for the model was considered. Identifying casualties, at risk of PTSD whilst they attended A&E, would ideally enable all casualties to be assessed and minimise post-discharge monitoring. However, the predictive ASD models developed, lacked the precision to discriminate sufficiently between casualties at high and low risk and led to the conclusion, that casualties must be directly assessed for ASD in the week after a crash. Therefore, it was postulated that risk assessment for PTSD could also take place during this assessment.

Therefore, predictive PTSD models were developed that could be assessed, whilst in A&E (pre and peri-crash factors) or within the week after the crash (pre, peri and post crash factors), to coincide with the proposed assessment of ASD. Models were developed incorporating the factors established as being significant from the reported univariate analysis (Table 7-Table 9). The PTSD Model 1 involved pre and peri-trauma variables detectable in A&E (smoking, feeling unreal, severity of injuries, being terrified). PTSD Model 2 involved pre and peri-trauma variables detectable after a week (smoking, feeling unreal, injury severity, being terrified, ASDS score and PDEQ score) and PTSD Model 3 was a combined model of relevant pre and peri-trauma variables from models 1 and 2, including social support factors. The models were tested through multiple regression analysis following the process described for ASD in Study B.

PTSD Model 1: Pre and Peri trauma factors detectable in A&E

Adjusted $R^2 = 0.362$, $F_{3, 134} = 26.880$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Feeling unreal	.383	p<0.001	.928
Being terrified	.341	p<0.001	.941
Smoking	.170	p=0.015	.984

(Subjective severity of injury was not a significant predictor in the pre and peri-trauma model).

Peri-trauma dissociation was the strongest predictor of PTSD, whilst being terrified during the crash and being a smoker were both significant within the model. This model accounted for 36% of the variance in IES-R scores.

The variables entered into this model, whilst accounting for a sizeable proportion of the variance, were not strong enough to predict the majority of the IES-R scores.

Therefore, this model was not viable for routine clinical use as a screening tool in A&E. However, it did support the questioning of casualties, by asking them if they felt unreal and terrified during the crash, as part of A&E assessment. It also, again, emphasised the association between being a smoker and risk of developing PTS disorders.

PTSD Model 2: Pre and Peri trauma factors detectable a week after RTC

Adjusted $R^2 = 0.619$, $F_{2, 136} = 113.043$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
ASDS score	.516	p<0.001	.567
PDEQ score	.348	p<0.001	.567

(Feeling unreal, being terrified or being a smoker were not significant predictors in this pre and peri-trauma model).

The ASDS measure of ASD^{W} was the strongest predictor of PTSD and dissociative experiences, as measured by the PDEQ^{M} and was also significant within this model. The pre and peri-trauma factors from Model 1 were not significant when the two psychometric scores were entered into this model.

Overall, Model 2 was a stronger predictor than the previous model and accounted for 62% of the variance in IES-R scores. Although this model accounted for a major portion of the variance, it lacked the precision to differentiate between high and low risk PTSD casualties in a clinical context.

However, the results from this model suggested that assessment using the ASDS was useful to inform a clinical assessment of crash survivors undertaken a week after a RTC. The PDEQ was completed by participants in this study a month after a RTC, but it could be implemented in the first week. Further testing of the validity of the PDEQ when used a week post crash, would be necessary to ensure it yielded similar results.

PTSD Model 3: Combined pre, peri and post-trauma factors

Adjusted $R^2 = 0.647$, $F_{2, 136} = 86.098$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
ASDS score	.571	p<0.001	.515
PDEQ score	.259	p<0.001	.542
Satisfaction with social support	-.116	p=0.028	.920

(Support provided was not a significant predictor in this combined factor model).

This combined PTSD model was the best predictor of PTSD, accounting for 65% of the variance in IES-R scores. As with Model 2, the psychometric measures were the best predictors of PTSD, although satisfaction with support was also influential in the model. Support received since the crash[M] was not significant within this model.

Although this model accounted for the greatest proportion of variance, the inclusion of a third factor did not increase the predictive value much beyond that of Model 2. Although Model 3 was the best predictor, it was not able to account for all the variance in IES-R scores, suggesting that other factors also influenced the development of PTSD.

Summary of risk factor models

The study aimed to inform the question "What predictive factors were associated with PTSD following a RTC?" The question was initially addressed, by examining participants' responses to questions on the Screening and the One Month Questionnaire, for a relationship with the IES-R[M] scores. Three predictive models for PTSD were developed, incorporating factors established as significantly related to PTSD in the univariate analysis. The design of the models was guided by their intended purpose, of predicting PTSD whilst RTC casualties attended A&E, or through an additional follow-up assessment after the crash.

Model 1only involved factors that could be assessed whilst casualties were in A&E. Although it was the weakest predictor of PTSD (36% of variance), the model highlighted three important areas to incorporate into a triage and assessment process of RTC casualties. Model 3 was the best predictor of PTSD and predicted a high portion of the variance, but the factors involved could only be assessed after a month, when PTSD could be directly diagnosed. Model 2 involved two psychometric tests; the ASDS and PDEQ.

In this study, the PDEQ was completed after a month. It would be possible to use the PDEQ at one week if the results were found to be comparable with those at one month.

In Model 2 the ASDS score was the strongest predictor, although PDEQ increased the predictive value of the model. The diagnosis of ASD is intended to function as a predictor of PTSD, which fits with the results from this study. However, the overall variance in the IES-R scores was accounted for more fully by the addition of the PDEQ, which measured peri-crash dissociation, a diagnostic feature of both PTSD and ASD.

PlaTO

When considering these results in the context of the proposed PlaTO model, it corroborated that assessment of PTSD risk (Model1), could not be reliably undertaken whilst casualties attended A&E. PTSD and ASD models developed, suggested that pre and peri-trauma factors in this study, were not sufficiently strong predictors of psychological trauma to warrant their routine use in clinical practice within an A&E department.

ASDS score was the best predictor of IES-R scores at a month and the predictive value was increased by the inclusion of PDEQ scores into Model 2 and 3. The ASDS cannot be used until a minimum of two days post-trauma and the PDEQ also required some time to have lapsed after the crash. These results suggest that the service needs to first assess RTC casualties a week after the crash, using the ASDS and PDEQ. This assessment would be able to identify casualties experiencing very high levels of acute distress, who may require immediate support and "fast-tracking" towards intervention, as well as casualties requiring monitoring and assessment for PTSD. PTSD Model 3 also highlighted the need to incorporate into the assessment process, the casualties' evaluation of satisfaction with their social support after the crash. Where satisfaction was low, assessment to determine the reasons for this would be required and strategies adopted to improve support satisfaction.

Such a service design has implications for the resources necessary requiring a system to monitor and assess casualties, after they have been discharged from A&E, since the results indicate that screening cannot be undertaken effectively whilst in the A&E department, based on the pre and peri-trauma factors tested in this study.

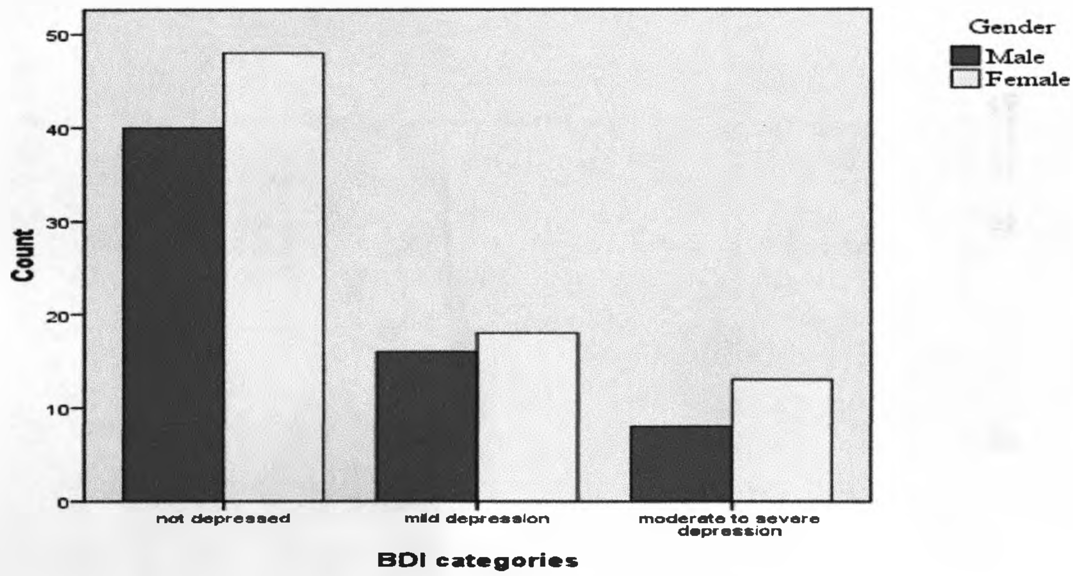
What predictive factors were associated with depression following a RTC?

Symptoms of low mood and depression were assessed using the Beck Depression Inventory (BDI) included in the One month Questionnaire.

Gender

In order to explore the relationship between gender and mood (Figure 73) the BDI scores were grouped into three categories. No significant association was found between gender and the three depression categories, when analysed using Pearson's Chi-squared test ($\chi 2$ 0.467, df 2, sig = 0.792, 2 tailed), suggesting gender was not linked to depression in this population.

Figure 73: Relationship between mood and gender



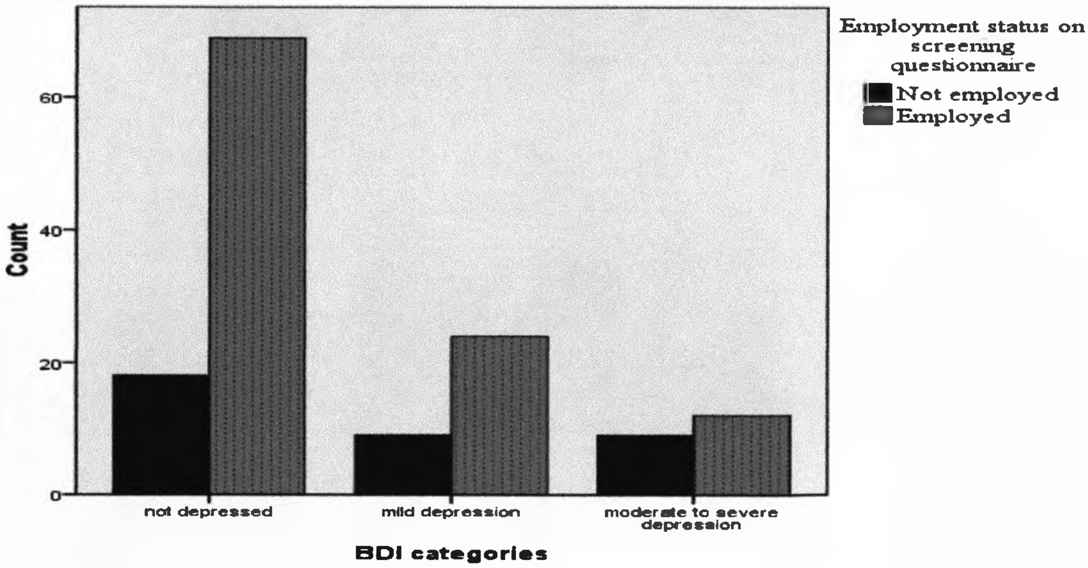
Age

The correlation between BDI scores and age was investigated using a non-parametric test as the data was not normally distributed. No significant correlation was established (τ= -0.23, p= 0.696, 2 tailed) between age and BDI scores.

Employment

The relationship between employment and mood was explored with BDI scores being grouped into three categories for analysis. The majority of respondents were employed (Figure 74) and no significant relationship between mood and employment was established through Pearson's Chi-squared test ($\chi 2$ 4.441, df 2, sig 0.109, 2 tailed).

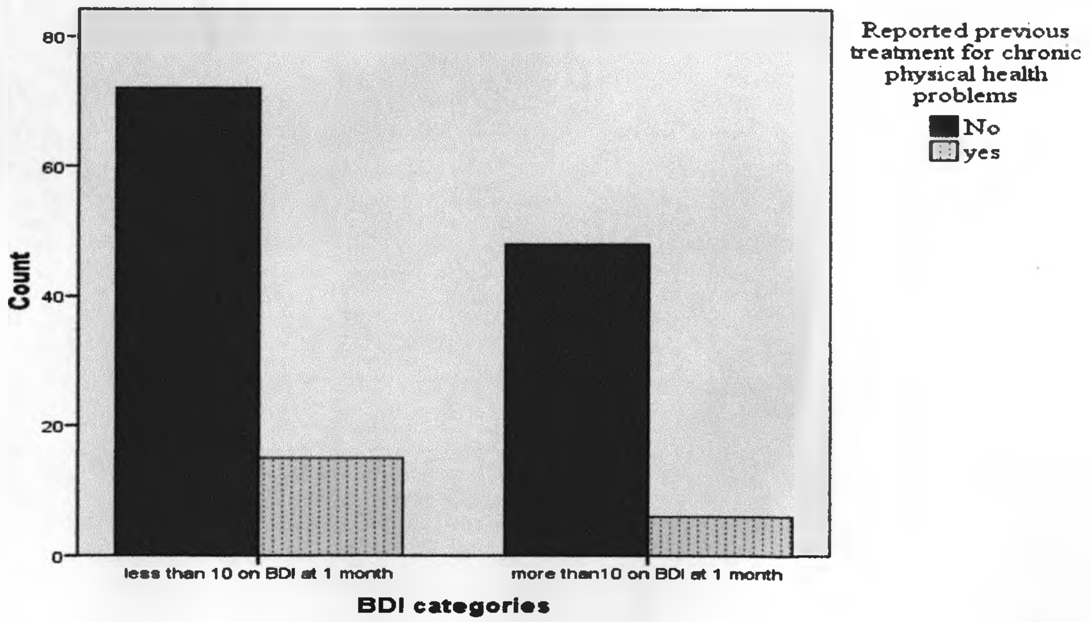
Figure 74: Relationship between employment status and mood



Treatment for Chronic Physical Health Problems

21 participants (15%) had such treatment and 6 reported above caseness on the BDI (29%), compared to 48 (40%), who did not report treatment (Figure 75). No significant association was established between previous physical health treatment and depression using Pearson's Chi-squared test. (2 0.988, df 1, sig 0.32, 2 tailed).

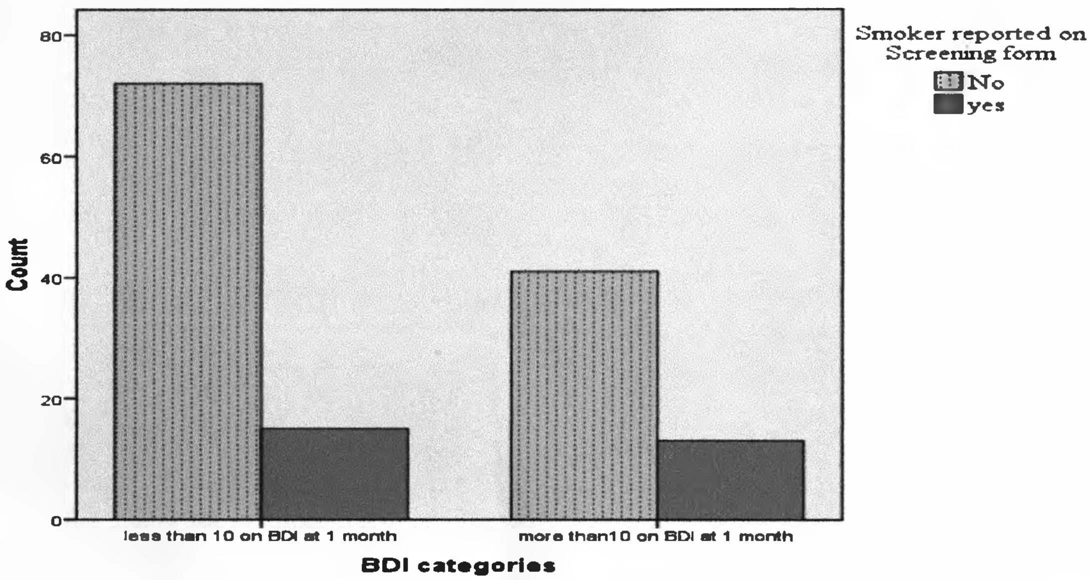
Figure 75: Relationship between previous treatment for physical health problems and mood



Smoking

Smokers reported both normal and low mood on the BDI (Figure 76). However, being a smoker was not significantly associated with mood when tested using Pearson's Chi-squared test ($\chi2$ 0.977, df 1, sig 0.323, 2 tailed). This finding differed from that reported for the trauma specific anxiety disorders (PTSD and ASD) suggesting that being a smoker was associated with anxiety, rather than low mood.

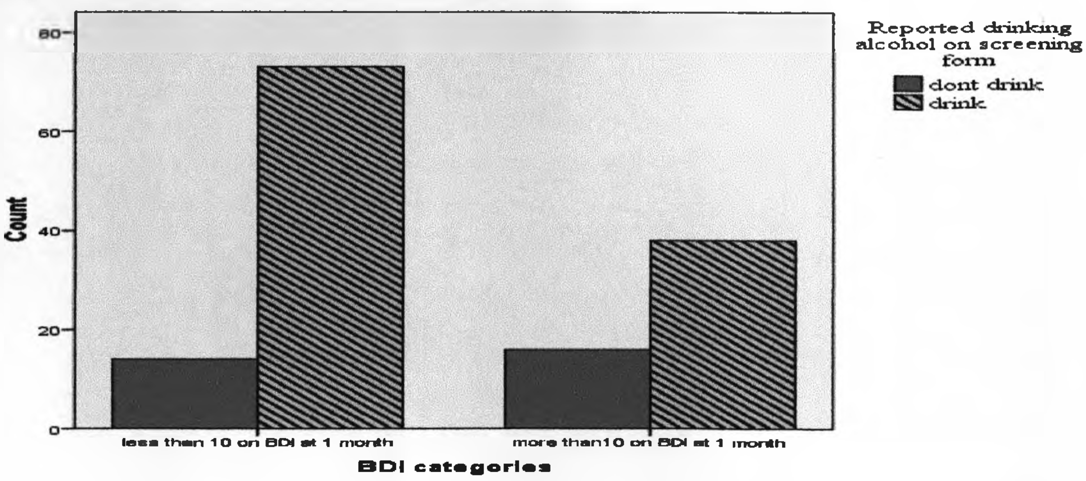
Figure 76: Relationship between smoking and mood



Drinking alcohol

Amongst the participants, there were 79 alcohol drinkers, 34% of whom had low mood (Figure 77).

Figure 77: Relationship between drinking alcohol and mood



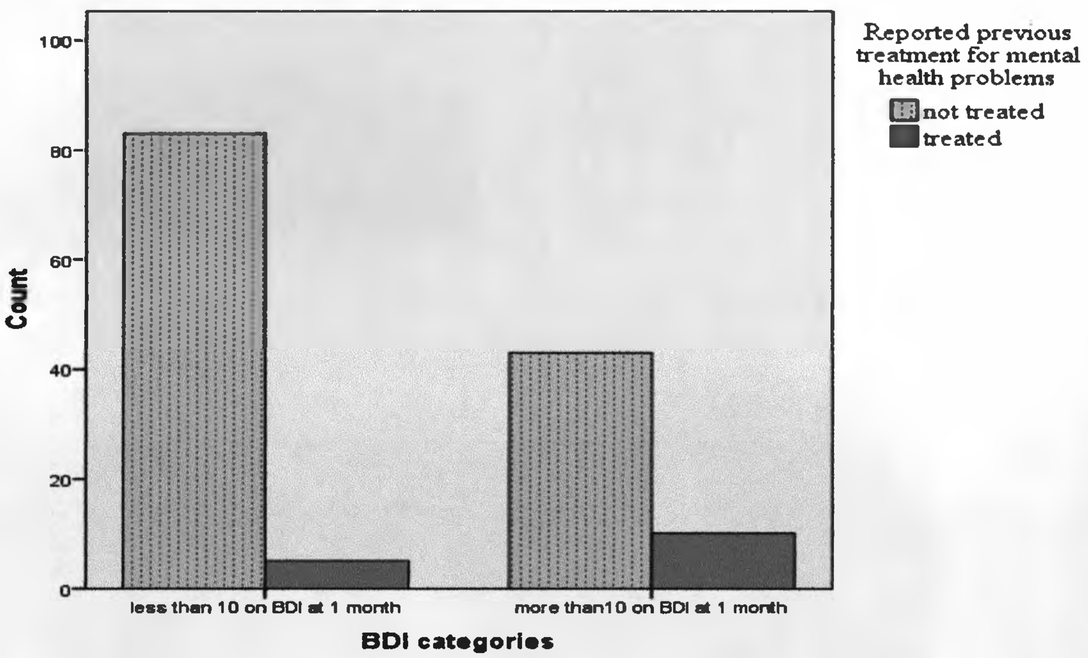
No significant relationship was identified between being an alcohol drinker and mood using Pearson's Chi-squared test ($\chi 2$ 0.3.646, df 1, sig 0.056, 2 tailed), which was consistent with the results obtained for ASD and PTSD.

Previous treatment for Mental Health Problems

Only 15 of the one month respondents had received treatment for mental health problems, but 10 of them (67%) had low mood (Figure 78).

Low mood and previous treatment for mental health problems were positively related when tested using Pearson's Chi-squared test ($\chi 2$ 6.05, df 1, sig 0.014, 2 tailed) indicating that the two were related.

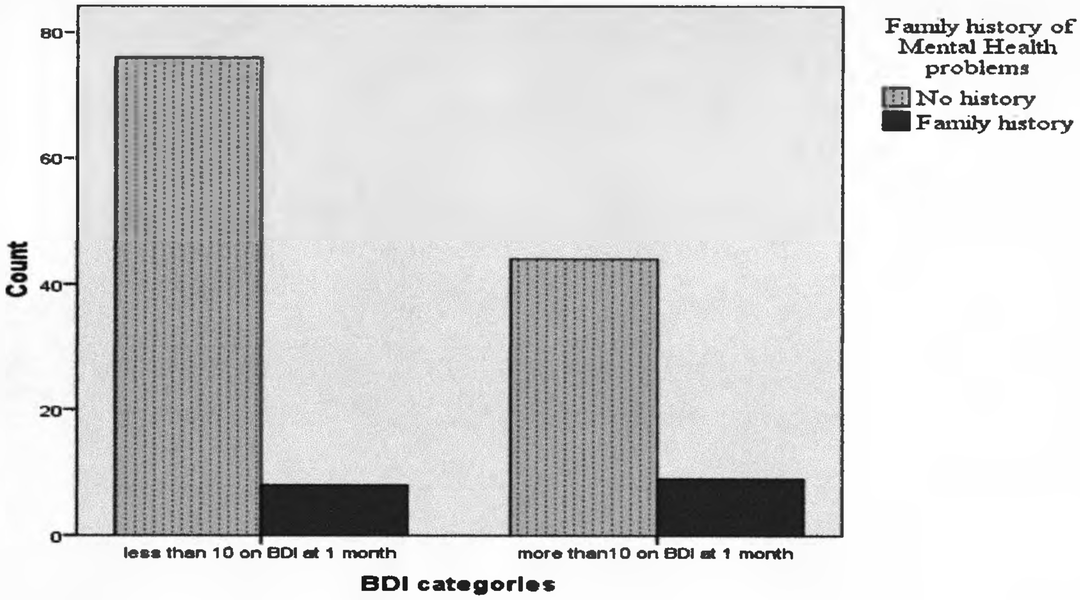
Figure 78: Relationship between previous mental health treatment and mood



Family Mental Health Treatment

A relationship between family history of mental health treatment and depression was explored. Amongst the one month respondents, 17 indicated such a history and over half of these had low mood (Figure 79), although no significant association emerged between the variables ($\chi 2$ 1.663, df 1, sig 0.197, 2 tailed).

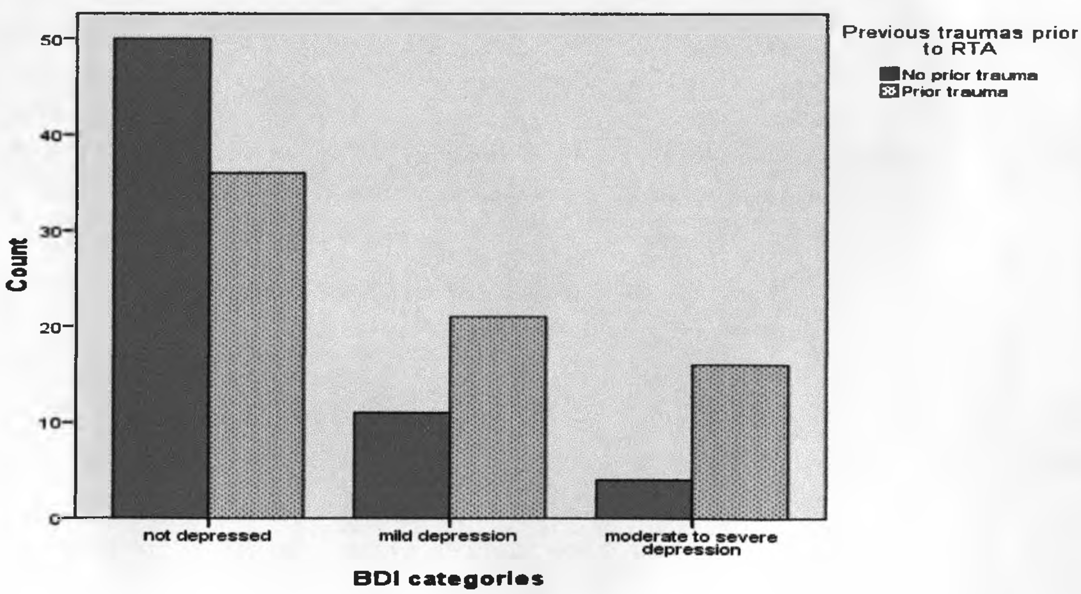
Figure 79: Relationship between family history of mental health problems and mood



Previous Traumas

Participants were asked to report previous trauma exposure and 73 (53%) reported involvement in a trauma prior to the RTC. From Figure 80, it was evident that amongst those with low mood and depression, more participants had experienced previous trauma and the opposite trend was found amongst those without depression and this relationship was significant when tested using Pearson's Chi-Squared test ($\chi 2$ 12.181, df 2, sig = 0.002, 2 tailed). However, it was feasible that participants could have been depressed at the time of the crash, which would have influenced the results obtained.

Figure 80: Relationship between experience of previous traumas and mood



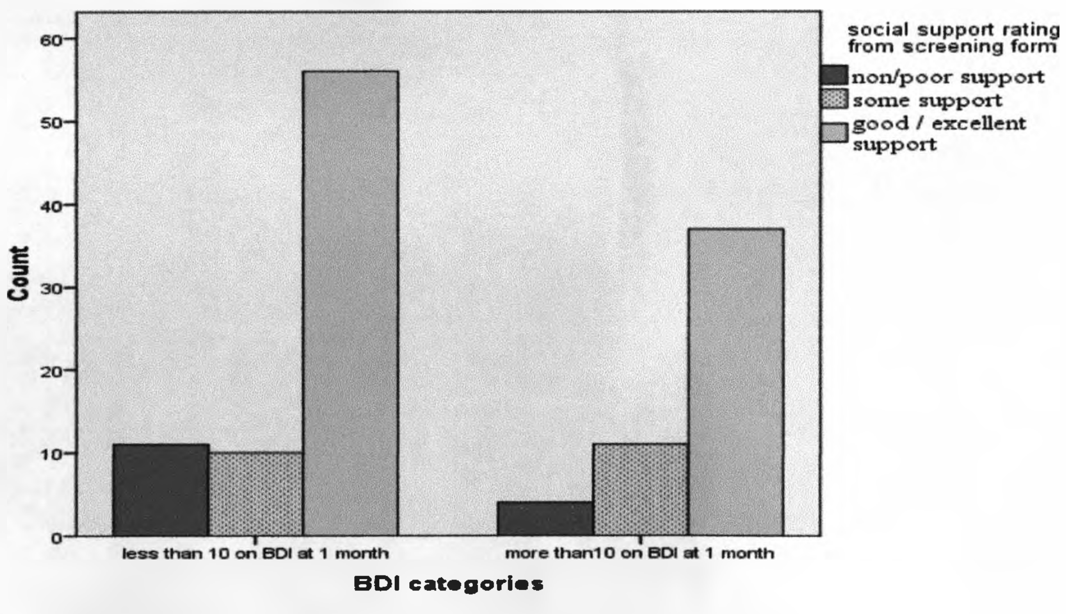
Years since previous traumas

One month respondents with previous trauma exposure reported a mean of 8 years since the event. The correlation between BDI score and years since the trauma was analysed using a non-parametric test, Kendall's tau_b, No significant correlation was established between BDI scores and time since trauma (τ= 0.035, p= 0.662, 2 tailed).

Social Support in first week

To investigate the relationship between peri-crash support^{W} and mood, the ratings reported were grouped into three categories. Most participants that reported good-excellent support (72%) had low mood (Figure 81). No significant association was established between social support^{W} and mood using Pearson's Chi-squared test. ($\chi 2$ 2.443, df 2, sig 0.295, 2 tailed). Thus social support^{W} was not related to participants' mood or PTSD after a month, but it was related to ASD.

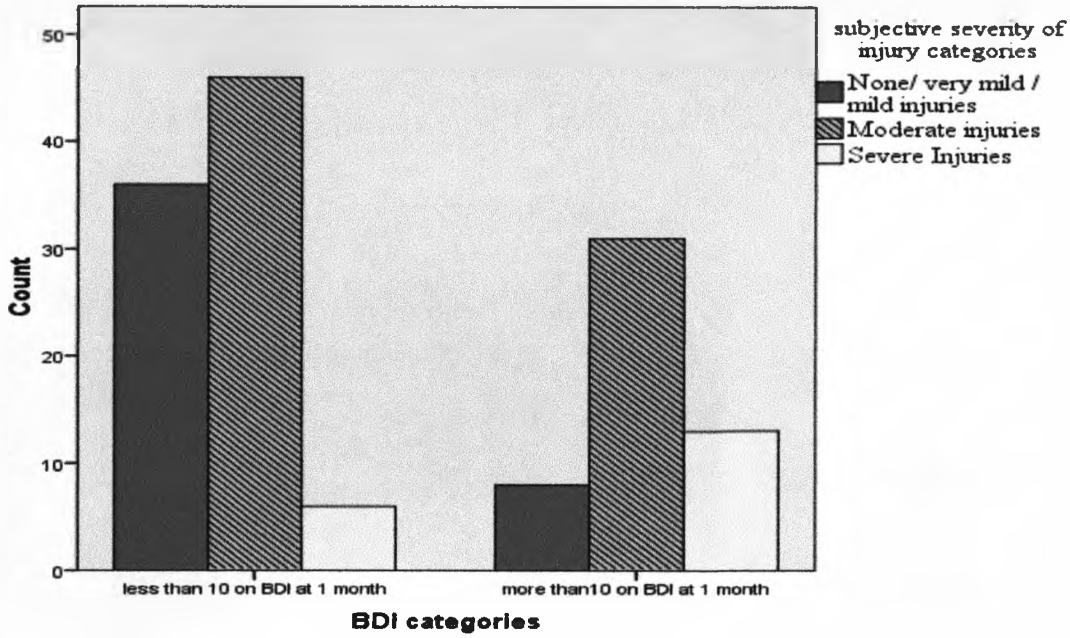
Figure 81: Relationship between peri-crash social support and depression one month after a RTC



Subjective Severity of Injuries

The injury ratings were categorised (Figure 82). The majority rated their injuries as moderately severe (55%). The relationship between subjective injury severity and mood was significant when tested using Pearson's Chi-squared test ($\chi 2$ 15.058, df 2, sig 0.001, 2 tailed). After a RTC, participants' perception of their injuries was significantly related to ASD, PTSD and mood compared to the relatively minor injuries sustained.

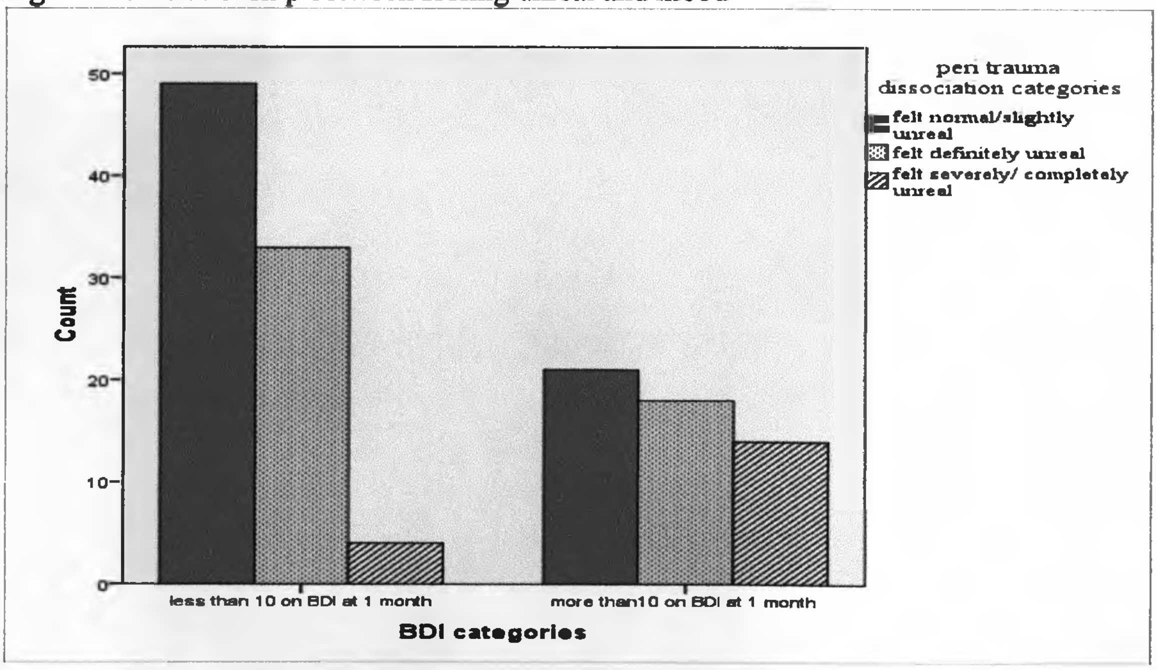
Figure 82: Relationship between subjective severity of injury and mood



Dissociation (feeling strange/unreal)

Ratings of feeling unreal were grouped into three categories for analysis. The majority of respondents who reported none or only slight dissociative feelings (70%), also reported below case-level BDI scores (Figure 83). Alternatively, 78% of those reporting severe dissociative experiences had a normal mood.

Figure 83: Relationship between feeling unreal and mood



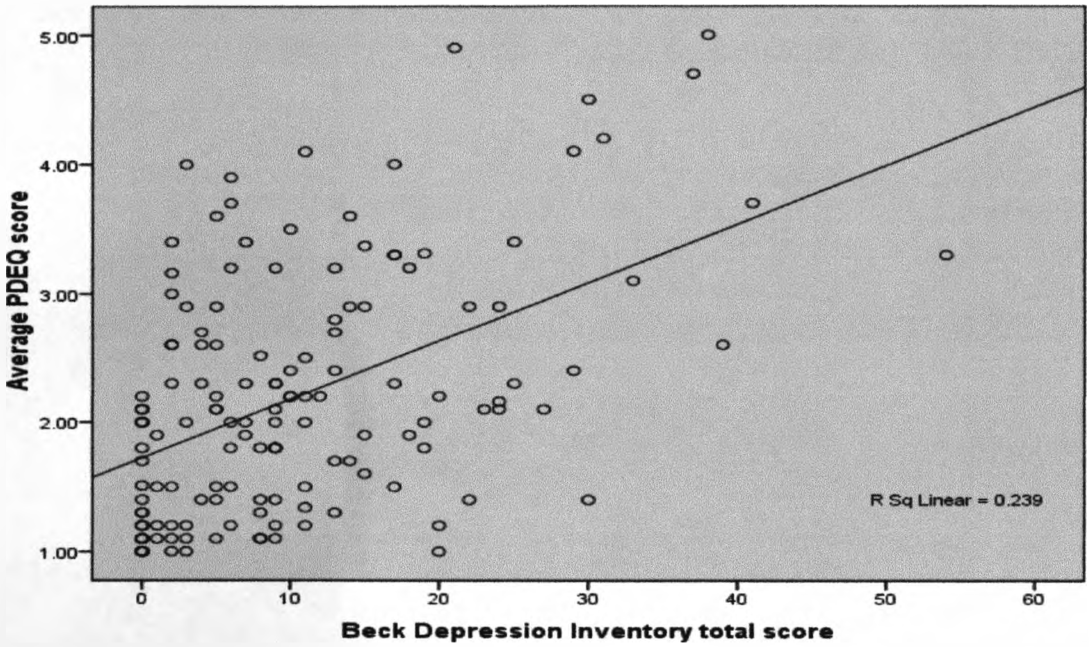
A significant association between mood and feeling unreal around the time of a RTC was established using Pearson's Chi-squared test ($\chi 2$ 14.129, df 2, sig 0.001, 2 tailed).

This result was congruent with the relationship established already reported for ASD and PTSD.

PDEQ

Peri-traumatic dissociative experiences were reported retrospectively at one month using the PDEQ (Figure 84). A significant relationship was established between the PDEQ and BDI scores ($\tau = 0.335$, $p < 0.001$, 2 tailed) when tested using Kendall's tau_b. The severity of dissociative phenomena was positively correlated with ASDS, IES-R and BDI scores, indicating that both mood and anxiety were influenced by peri-crash dissociation after a RTC.

Figure 84: Relationship between PDEQ and BDI scores one month after a RTC

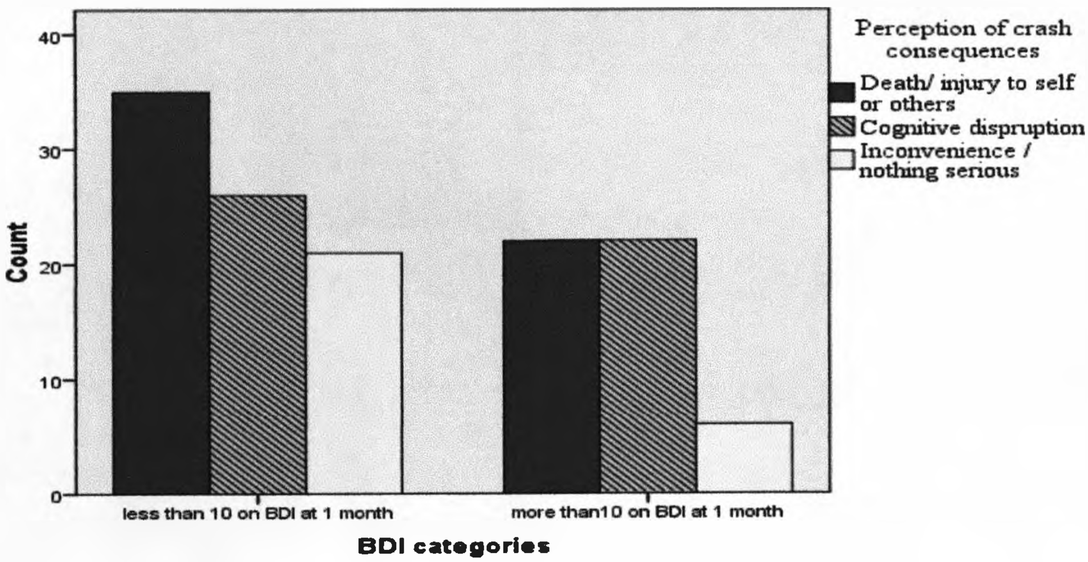


Subjective Perception of Crash Consequences

Participants' perception of their crash consequence was coded and grouped into three categories for further analysis (Figure 85).

No significant association was established between mood and perception of crash consequences using Pearson's Chi-squared test. ($\chi 2$ 4.116, df 2, sig 0.128, 2 tailed). It appeared that crash cognitions were only linked to initial trauma responses, since no relationship was identified between perceived consequences and PTSD or depression after a month.

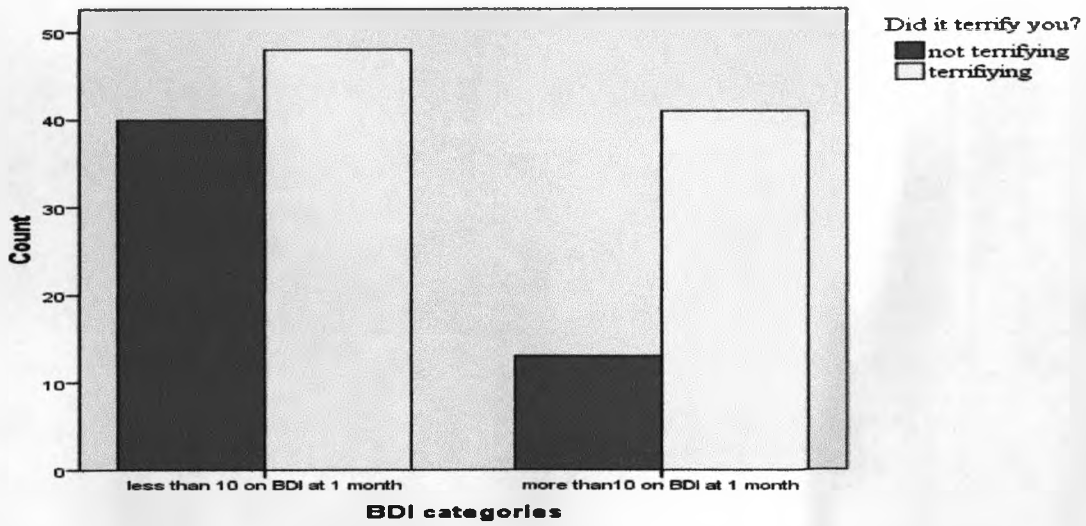
Figure 85: Relationship between perceptions of crash consequences and mood



Terrified at time

The majority of one month respondents reported being terrified (63%) and this group also reported higher percentages of low mood (Figure 86).

Figure 86: Relationship between being terrified and mood

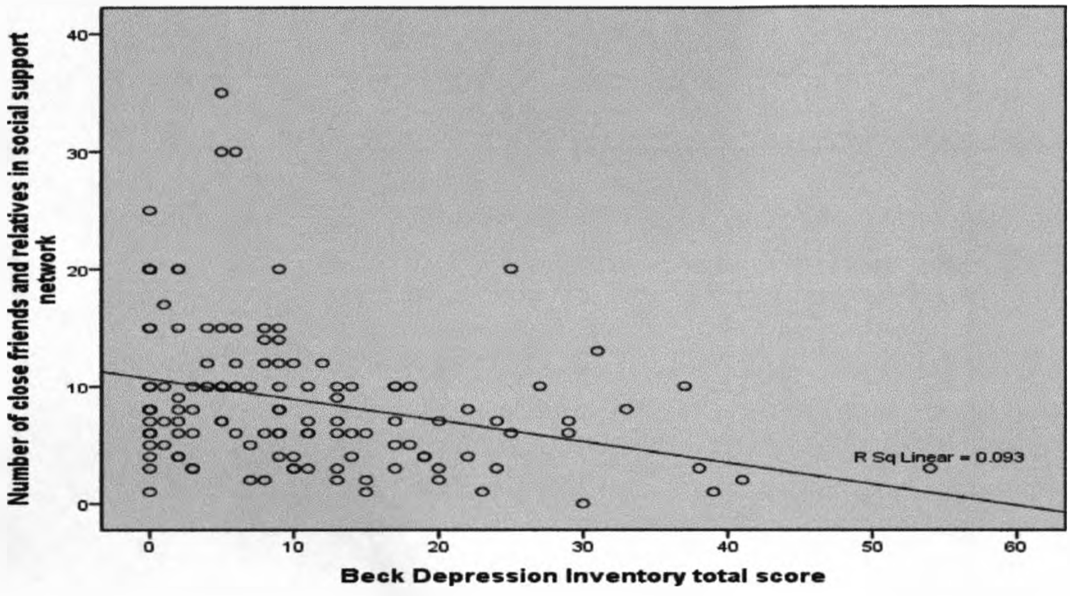


A significant relationship between low mood and terror was identified using Pearson's Chi-squared test ($\chi 2$ 6.539, df, 1, sig 0.011). Whereas terror was relatively common amongst all participants, not feeling terrified was linked with normal mood, similar to the results for both ASD and PTSD.

Social Support Structure

When the social support network size was compared with the BDI scores (Figure 87), there appeared to be a negative relationship, which was tested using Kendall's tau_b. A significant negative correlation was identified between BDI score and network size (τ= -0.234, p<0.001) indicating that smaller network size was significantly linked with lower mood.

Figure 87: Relationship between Social Support Network size and BDI scores



Social Support Function

The MOS provided information on the availability of four aspects of social support. The association between each domain and BDI score was investigated using Kendall's tau_b. All of the domains of MOS social support[M] were significantly associated with the participants' BDI scores.

Tangible support τ = -0.223, 2 tailed, p=0.001, n= 129

Affection τ = -0.207, 2 tailed, p=0.002, n= 129

Socialising τ = -0.228, 2 tailed, p=0.001, n= 129

Emotional/Informational support τ = -0.274, 2 tailed, p<0.001, n= 129

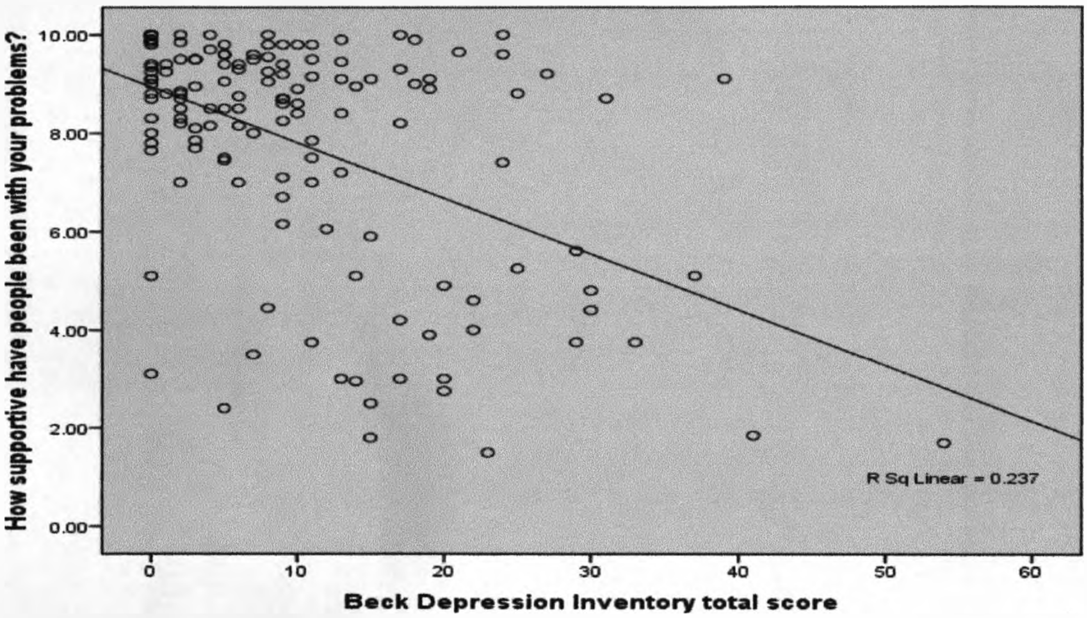
Symptoms of depression, but not PTSD were negatively linked to the availability of social support across all domains.

Social Support with problems

The ratings of how supportive people had been, were negatively skewed, suggesting generally high levels of support. When support provided was compared with BDI scores, a negative correlation emerged (Figure 88), which was tested using Kendall's tau_b. A significant negative relationship was identified (τ = -0.276, p<0.001) between support provided and BDI scores.

These results indicated that amongst RTC casualties, low levels of support were significantly associated with low mood, and PTSD.

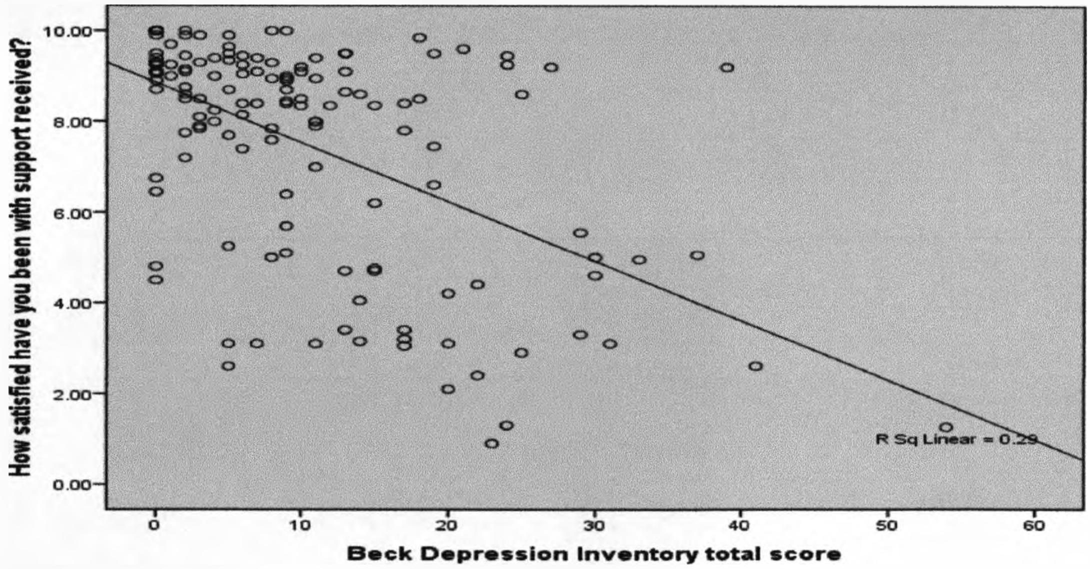
Figure 88: Relationship between social support provided and BDI scores



Social support satisfaction

Participants' satisfaction with their social support was negatively skewed, indicating generally high levels of satisfaction. The correlation between BDI scores and satisfaction with support (Figure 89) was tested using Kendall's tau_b, A significant negative correlation was established (τ= -0.363, p<0.001), suggesting that low satisfaction with support was associated with low mood and PTSD after a RTC.

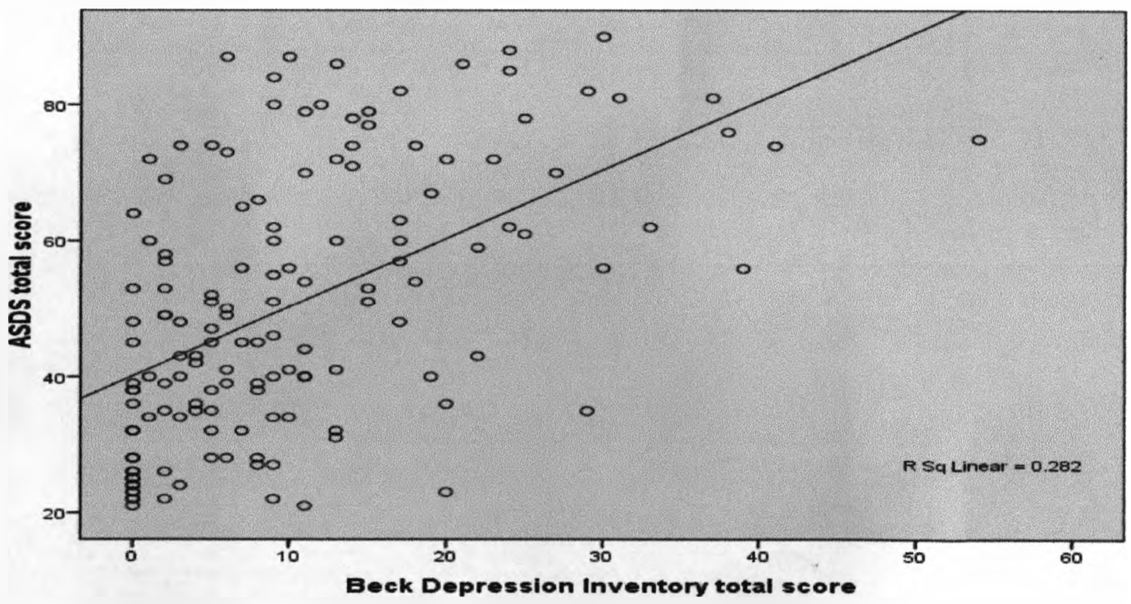
Figure 89: Relationship between satisfaction with support and BDI scores



ASD score

The relationship between acute stress disorder[W] and depression[M] was investigated by comparing ASDS and BDI scores (Figure 90) and then tested using Kendall's tau_b, since the data was not normally distributed. A significant positive correlation was established between the ASDS and the BDI scores ($\tau = 0.405$, $p<0.001$).

Figure 90: Relationship between ASD and Depression one month after a RTC



These results suggest that symptoms of ASD were linked to the subsequent development of both PTSD and depression amongst RTC casualties.

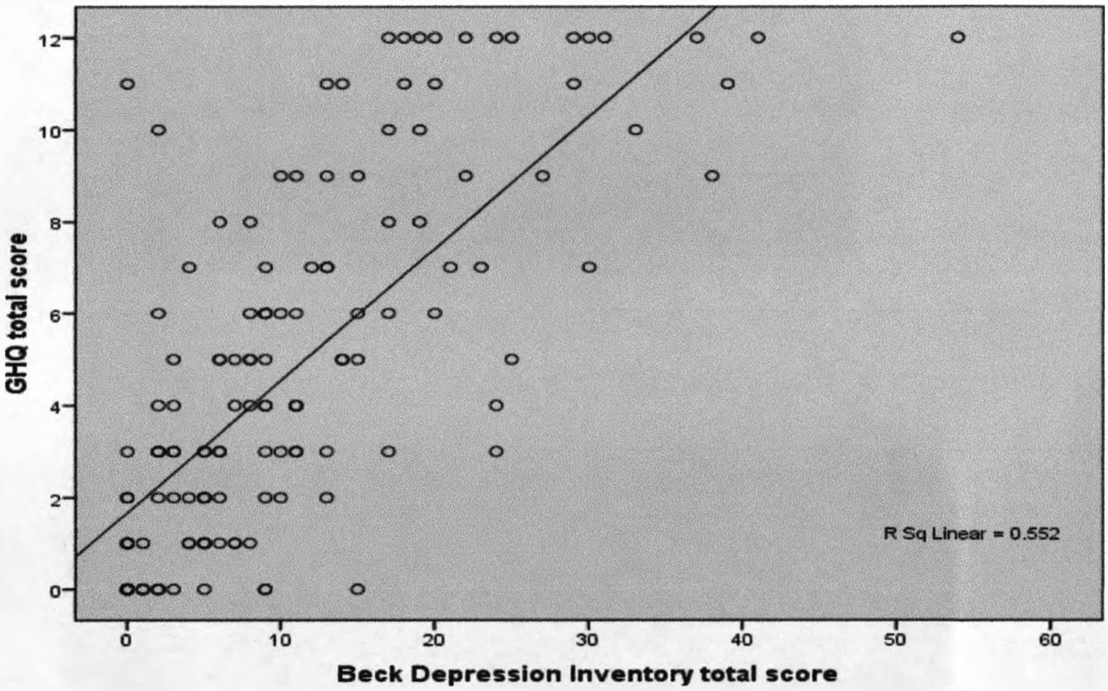
PTSD Score

The link between the IES-R and BDI scores was investigated (Figure 63) and reported in Study B. The two factors were significantly correlated ($\tau = 0.548$, $p<0.001$, 2 tailed), suggesting a relationship between these PTS disorders.

GHQ Score

A positive relationship emerged between GHQ and BDI scores (Figure 91), which was tested using Kendall's tau_b, since the data was not normally distributed. A significant positive correlation between BDI and GHQ scores was established ($\tau = 0.743$, $p<0.001$). The correlation between symptoms of general psychiatric disorder and mood reflected those already reported for ASD and PTSD.

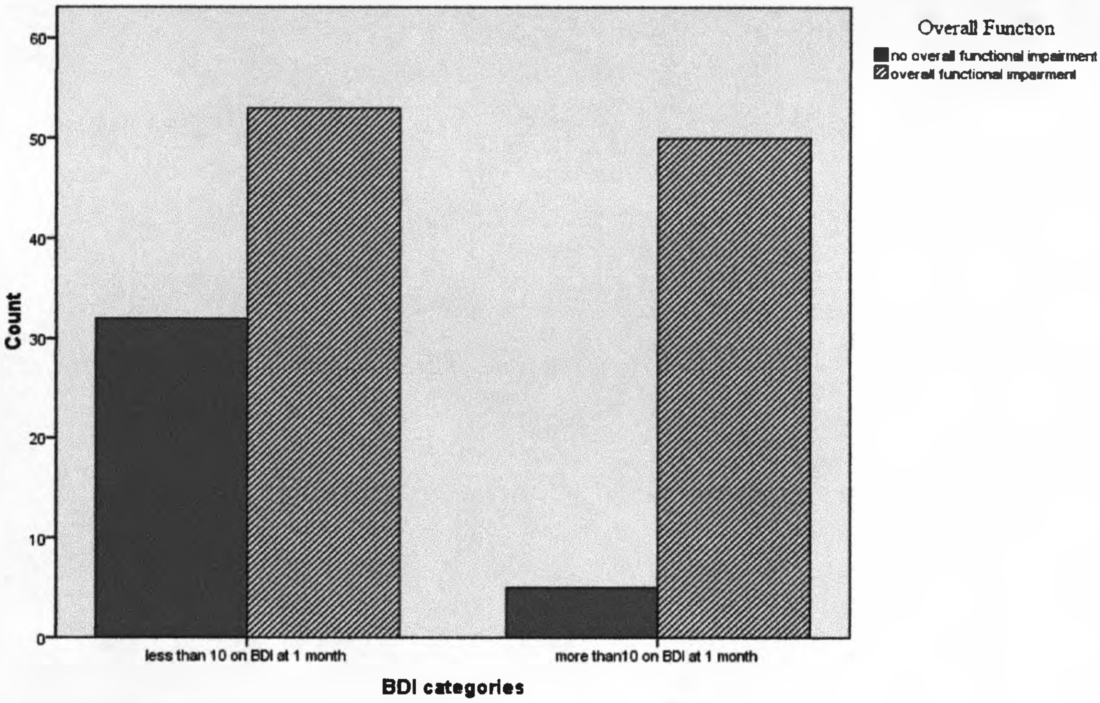
Figure 91: Relationship between GHQ scores and BDI scores



WAS functional impairment

Participants completing the WAS indicated whether their overall functioning had been impaired. Out of 103 participants reporting functional impairment (72%), 50 also reported BDI scores of ≥ 10, against 5 without any functional impairment (Figure 92). A significant relationship was identified between functional impairment and mood, when it was tested using Pearson's Chi-squared test ($\chi 2$ 14.005, df 1, sig < 0.001, 2 tailed) and suggested that no functional impairment was associated with normal mood.

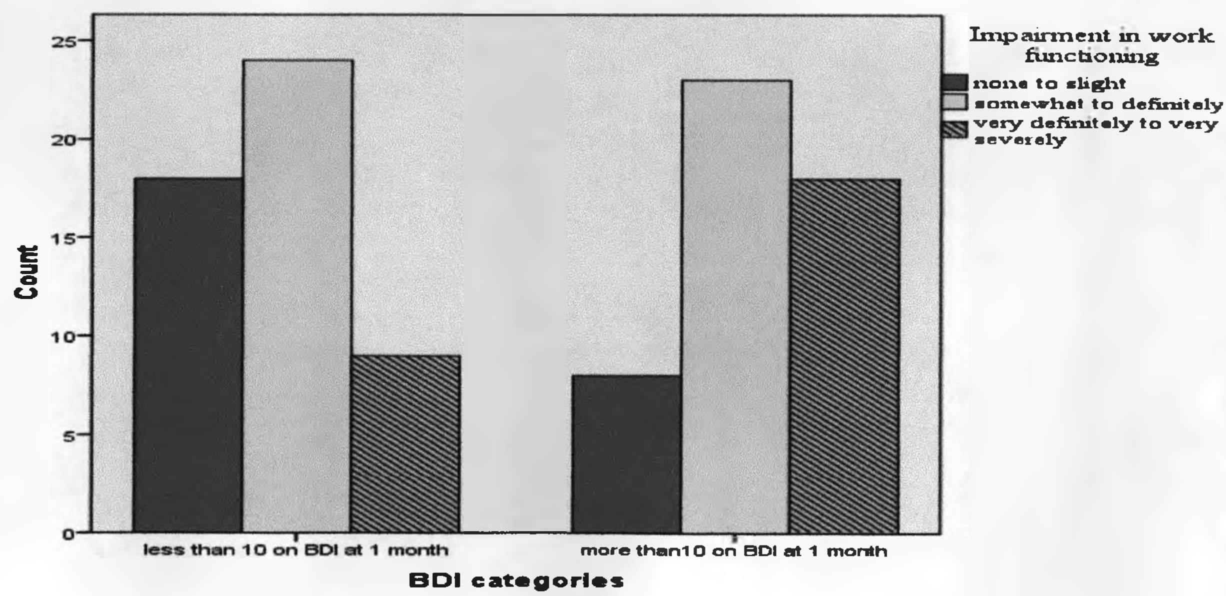
Figure 92: Relationship between function and mood



The relationship between mood and different aspects of function was also investigated amongst the 103 participants, who had reported functional problems.

Work: The association between participants' ability to function at work and depression was explored. The functional impairment ratings were grouped into three categories for analysis (Figure 93).

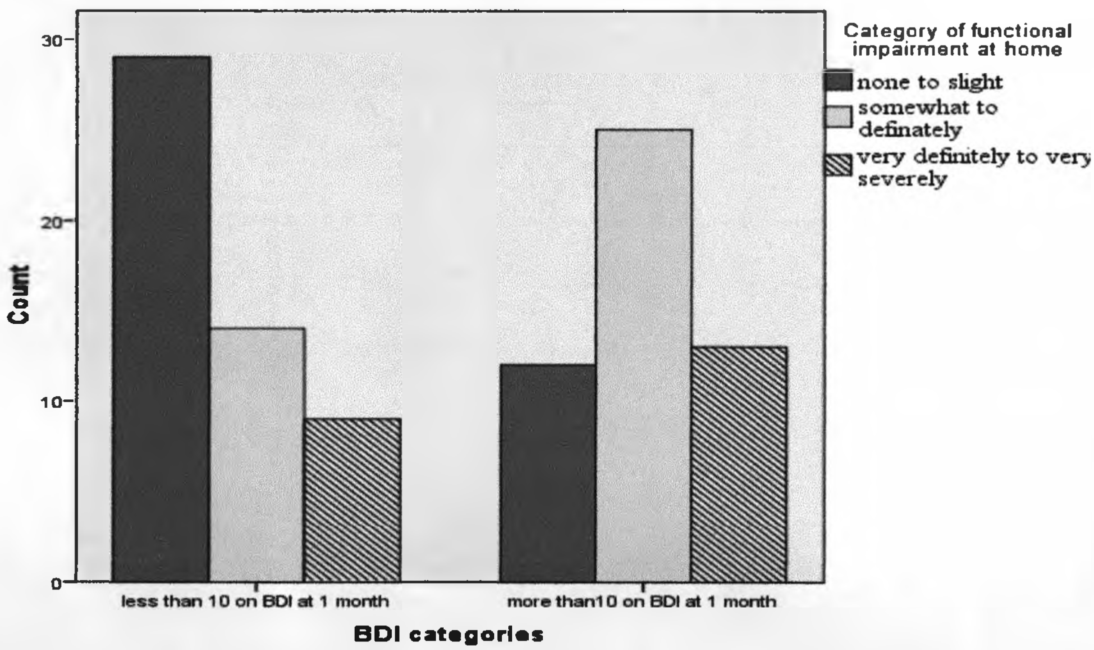
Figure 93: Relationship between function at work and mood



More participants reported none to slight impairment at work, amongst those with normal mood (18% of total participants), compared to those with low mood (8% of total participants). A significant association between level of work impairment and case-level depression was identified using Pearson's Chi-squared test ($\chi 2$ 6.83, df2, sig 0.033, 2 tailed). Difficulty functioning at work was linked to depression after a RTC.

Home: Dysfunction at home was associated with PTSD and hence its association with mood also merited exploration. Greater dysfunction was reported most frequently by depressed participants (Figure 94).

Figure 94: Relationship between function at home and depression a month after a RTC

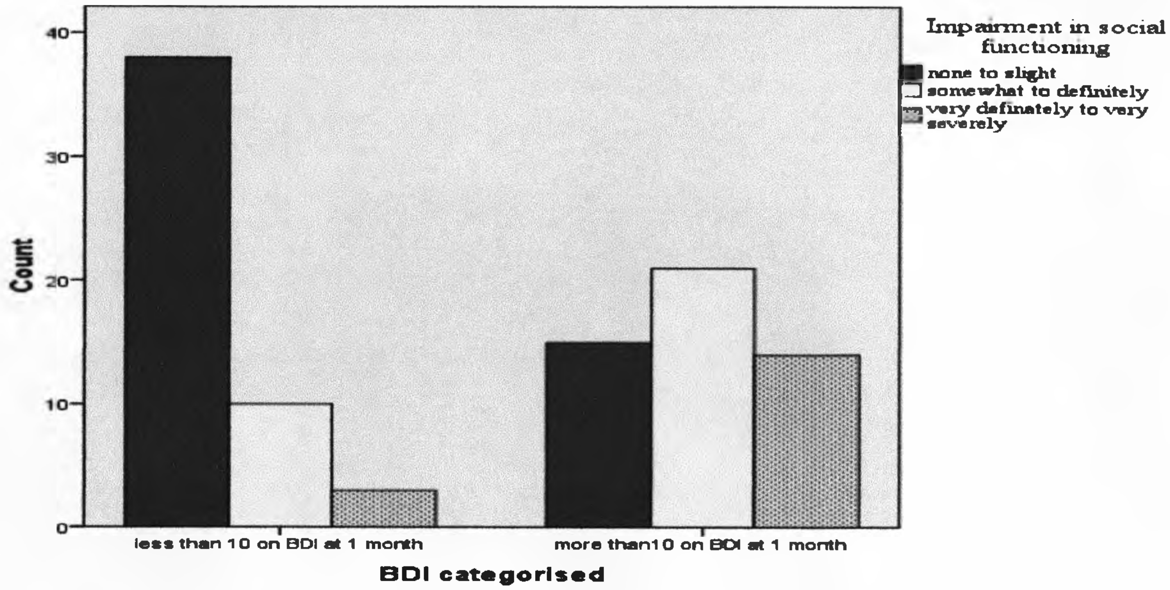


A significant relationship between mood and dysfunction was identified using Pearson's Chi-squared test and found to be significant ($\chi 2$ 10.844, df 2, sig 0.004, 2 tailed).

These results indicated that low mood was associated with greater difficulty managing at home after a RTC.

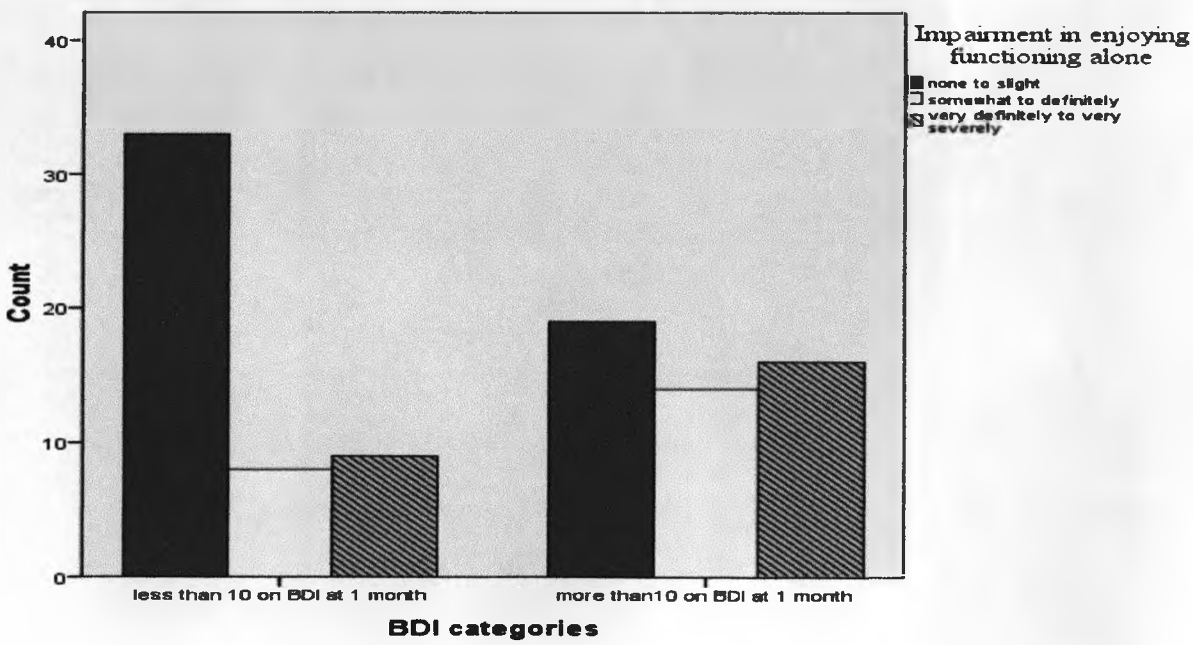
Social Functioning: Social functioning ratings were grouped into three categories for analysis (Figure 95). Minimal social dysfunction was more frequently reported amongst participants with normal mood (n=33). A significant relationship between social dysfunction and mood was identified using Pearson's Chi-squared test ($\chi 2$ 20.994, df 2, sig <0.001, 2 tailed). Similar to the relationship established between PTSD and social functioning, normal mood was linked to minimal social dysfunction.

Figure 95: Relationship between social functioning and depression a month after a RTC



Alone: Ratings of being able to enjoy doing things alone were grouped into three categories for analysis (Figure 96). A significant relationship between difficulty functioning alone and mood was established using Pearson's Chi-squared test. (χ27.356, df 2, sig = 0.025, 2 tailed).

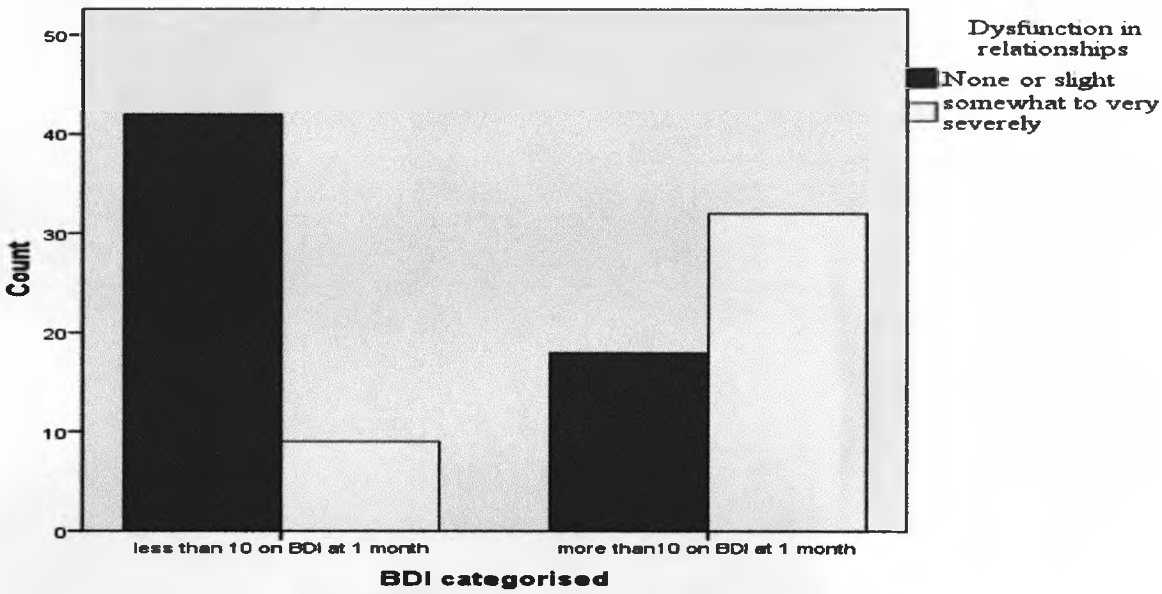
Figure 96: Relationship between functioning alone and depression a month after a RTC



Managing close relationships: Dysfunction managing close relationships was rated by participants and responses placed into two categories for further analysis. None/slight dysfunction was more frequently reported by those with normal mood (n=42), whereas greater levels of dysfunction were reported by depressed participants (n=32). A significant relationship between relationship difficulties and depression was identified using Pearson's Chi-squared test ($\chi2$ 22.495, df1, sig <0.001, 2 tailed).

These results indicated that like PTSD, difficulty managing close relationships after a RTC, was linked to low mood.

Figure 97: Relationship between functioning in relationships and depression a month after a RTC

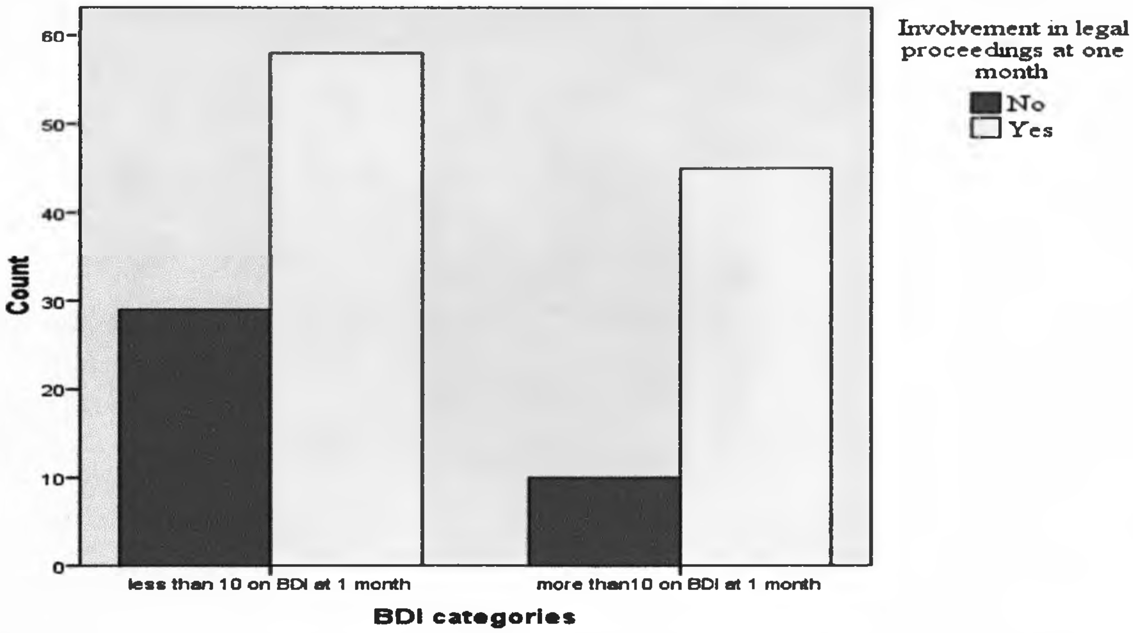


Legal Proceedings

The majority of participants were involved in legal proceedings (Figure 98). None-involvement was associated with a lower proportion of depression cases (26%), compared to those that were involved (44%).

When this association was tested using Pearson's Chi-squared test a significant relationship emerged ($\chi2$ 3.883, df1, sig 0.049, 2 tailed). Not being involved in legal proceedings was significantly associated with normal mood.

Figure 98: Relationship between involvement in legal proceedings and depression one month after a RTC



Summary

In this study, pre, peri and post-crash factors have been investigated for an association with mood, measured using the BDI to identify risk factors for depression that could be detected in the aftermath of a RTC. A range of pre-crash factors were investigated (Table 10). Depression was associated with prior mental health treatment and a previous trauma history. Further investigation is required to evaluate the ability of these factors to predict low mood after a RTC.

The peri-crash variables investigated (Table 11), concentrated on fear related symptoms, apart from the subjective perception of social support and severity of injuries. Retrospective rating of peri-crash dissociative experiences were reported using the PDEQ^{M} and peri-crash feelings of unreality^{W}. Dissociative experiences reported using both measures were strongly related to low mood.

Casualties who were not terrified were more likely to not be depressed after a month. Since depression is not a fear related disorder, further study is required to elucidate whether there was a direct connection between mood and terror, or whether the link was mediated through other variables. Participants' idiosyncratic beliefs about the crash were analysed within three categories. However, no relationship was established between the categories and depression.

Table 10: Relationship between pre-crash variables and symptoms of depression

Pre Trauma Factors	**Test results**	**Significance**	**Significant at the 0.05 level**
Gender	$\chi 2$ 0.467, df 2	Sig 0.792, 2 tailed	
Age	τ = - 0.23	p=0.696, 2 tailed	
Employment	$\chi 2$ 4.441, df 1	Sig 0.109, 2 tailed	
Prior chronic health problems	$\chi 2$ 0.988, df 1	Sig 0.32, 2 tailed	
Smoking	$\chi 2$ 0.997, df 1	Sig 0.323, 2 tailed	
Drinking Alcohol	$\chi 2$ 0.3646, df1	Sig 0.056, 2 tailed	
Previous Mental Health Problems	$\chi 2$ 6.05, df 1	Sig 0.014, 2 tailed	Yes
Family Mental Health Problems	$\chi 2$ 1.663, df1	Sig 0.197, 2 tailed	
Previous Traumas	$\chi 2$ 12.181, df 2	Sig 0.002, 2 tailed	Yes
Years since previous trauma	τ =0.035	P=0.662	

Social support[W], although linked to ASD, was not associated with depression or PTSD. Participants' beliefs about their injury severity were significantly associated with mood, with greater severity associated with lower mood. From these results, casualties rating their injuries as severe had lower mood. From this study, it appeared that several peri-crash factors were associated with low mood after a RTC. Dissociation, perceived severity of injuries and terror at the time of the crash were all linked to low mood and could provide useful methods for A&E staff to question casualties, to assess risk of subsequent depression.

Post-crash variables were investigated and the majority of the factors were significantly associated with mood (Table 12). Post-crash social support was assessed in terms of structure, function, delivery and satisfaction. Mood was linked to the size of participants' social support network and all four domains of social support, where less support was related to low mood. The amount of social support provided[M] and satisfaction[M] was negatively associated with low mood. It seems that low levels of overall and specific aspects of support and satisfaction were linked to low mood.

Table 11: Relationship between peri-crash variables and symptoms of depression

Peri-Trauma Factors	**Test results**	**Significance**	**Significant at 0.05 level**
Social Support in first week	$\chi2$ 2.443, df 2	Sig 0.295, 2 tailed	
Subjective severity of injuries*	$\chi2$ 15.058, df 2	Sig 0.001, 2 tailed	Yes
Feeling strange / unreal*	$\chi2$ 14.129, df 2	Sig 0.001, 2 tailed	Yes
Perception of crash consequences	$\chi2$ 4.116, df 2	Sig 0.128, 2 tailed	
Terrified at time*	$\chi2$ 6.539, df1	Sig 0.011	Yes
PDEQ score*	$\tau = 0.335$	$P < 0.001$	Yes

Table 12: Relationship between post-crash variables and mood

Post- Trauma Factors	**Test results**	**Significance**	**Significant at 0.05 level**
Social Support structure	$\tau = -0.234$	p<0.001	Yes
Social Support Tangible	$\tau= -0.223$	p= 0.001	Yes
Social Support Affection	$\tau= - 0.207$	p=0.002	Yes
Social Support Socialising	$\tau= - 0.228$	p=0.001	Yes
Social Support Emotional/information	$\tau= -0.274$	P<0.001	Yes
Social Support with current problems	$\tau = -0.276$	p<0.001	Yes
Social Support satisfaction	$\tau = -0.363$	p<0.001	Yes
ASD score	$\tau = 0.405$	p<0.001	Yes
IES-R score	$\tau = 0.548$	p<0.001	Yes
GHQ score	$\tau = 0.743$	p<0.001	Yes
WAS overall functional impairment	$\chi2$ 14.005, df1	Sig <0.001	Yes
WAS Specific areas of functional impairment	**Work** $\chi2$ 6.83, df2 **Home** $\chi2$ 10.844, df 2 **Social**$\chi2$ 20.994, df 2 **Alone** $\chi2$ 27.356, df2 **Relationships** $\chi2$ 22.445, df 1	Sig 0.033 Sig 0.004 Sig <0.001 Sig 0.025 Sig <0.001	Yes Yes Yes Yes Yes
Legal proceedings	$\chi2$ 3.883, df 1	Sig 0.049	Yes

All the psychometric measures investigated (ASDS, IES-R and GHQ) correlated with BDI scores. Since the ASDS can be administered earlier than the BDI, it may prove to be a useful to discern those at high risk of depression, if casualties were assessed a week after the crash.

Having explored a range of factors linked to depression after a RTC, it appeared peri and post-crash factors were more commonly linked to depression than pre-crash factors, although previous mental health treatment and prior trauma history were significantly associated with mood. Fear around the time of the crash, measured as terror or dissociative experiences, together with beliefs about injury severity, were also linked to mood after a month.

The strength of the relationship between these factors and mood needs further investigation, to establish their validity as screening factors for depression. Many social support factors were linked to mood, suggesting the potential to address depression by enhancing support. ASD symptoms were linked to mood, which may promote early identification of risk. As expected, mood was found to relate to PTSD and general symptoms of psychiatric disorder. Overall, impaired functioning in daily life and dysfunction across all domains was associated with low mood. The dysfunction reported in the population, highlighted the impact of low mood and, therefore, the potential merit of addressing such problems. Involvement in legal proceedings was also found to link to mood, but this link required further investigation to determine the direction of causality in this relationship.

Post trauma factors cannot be used as early screening tools, although investigating social support availability and satisfaction during early recovery may have merit, particularly if restorative intervention could enhance support during recovery. The value of screening for depression as well as PTSD has been established, since casualties appear to develop both disorders and have high levels of co-morbidity. Post-crash factors for depression require further scrutiny to establish their value as both predictors and indicators of the need for early intervention approaches.

Multiple regression risk factor analysis

Pre, peri and post-crash factors have been identified which were associated with PTSD. To establish a more robust impression of how risk factors can be used to predict disorder or inform the monitoring and intervention process, modelling and analysis was required.

Being able to identify factors associated with depression that could predict casualties at risk, whilst in A&E, informed the development of these models. In the absence of being able to accurately predict depression whilst in A&E, the feasibility of identifying high risk casualties in the week after the crash, was tested through modelling of peri and post crash factors. The models incorporated factors identified as significant from the univariate analysis of pre, peri and post-trauma models. The ability of the models to predict depression after a RTC was tested using multiple regression analysis.

Depression Model 1: Pre and Peri trauma factors detectable in A&E

Adjusted $R^2 = 0.345$, $F_{5,\,132} = 15.436$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Previous mental health treatment	.272	p<0.001	.916
Being terrified	.259	P=0.001	.909
Subjective severity of injury	.226	p=0.003	.833
Previous trauma history	.217	p=0.003	.900
Feeling unreal	.179	p=0.021	.817

All five variables were significantly associated with the model, which was able to account for 35% of the variance in BDI scores. Having previous treatment for a mental health problem was the strongest predictor in Model 1 and dissociative experiences around the time of the crash was the weakest predictor. This model relied on factors that could be assessed when casualties attended A&E after a crash. It was not a sufficiently strong predictor to determine which casualties were at risk of depression. However, it did highlight the importance of determining previous mental health history and peri-crash experiences for casualties after a RTC. Further models were investigated to explore the prediction of depression a week after a crash.

Depression Model 2: Pre and Peri and Post-trauma factors a week after a RTC

Adjusted $R^2 = 0.395$, $F_{1,\,136} = 52.992$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
ASDS Score	.372	p<0.001	.557
Previous mental health treatment	.312	P=0.001	.988
PDEQ Score	.205	p=0.024	.553

(Feeling unreal, injury severity and terror were not significant predictors in this model)

This model was a slightly better predictor of depression than Model 1 and was able to account for 40% of the variance in BDI scores. ASDS score was the strongest predictor of depression, although previous mental health treatment remained significant, together with the psychometric measures.

The PDEQ was completed by participants in this study at one month, but it can be completed after one week and it was, therefore, included in this model, but further testing would be required to ensure it was still a significant predictor when completed after a week.

Whilst Model 2 was a stronger predictor of depression, than the previous model, it accounted for less than half of the variance and so was not appropriate for routine clinical application, although it promoted the value of using ASDS and PDEQ measures, together with taking a psychiatric history from casualties a week after a crash.

Depression Model 3: Social support factors

Adjusted $R^2 = 0.341$, $F_{2,117} = 31.734$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Satisfaction with support	-.451	p<0.001	.755
MOS Tangible Support	-.222	p=0.011	.755

(Network structure, affection, socialising, emotional/informational support and support provided[M] were not significant predictors in this social support model)

This model was comparable with Model 1, since it predicted 34% of the variance in BDI scores and indicated the strength in the relationship between social support and depression. Although many elements of social support were associated with depression, only two factors remained in the model. Satisfaction with support was the strongest predictor of depression. In this study these factors were assessed a month after a RTC and although both measures have the potential to be utilised earlier, their predictive value would need to be confirmed if used a week after a crash.

Depression Model 4: Combined factors

Adjusted $R^2 = 0.536$, $F_{2, 119} = 36.517$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
ASDS score	.437	p<0.001	.914
Satisfaction with support	-.321	p<0.001	.712
Previous mental health treatment	.192	p=0.003	.913
MOS Tangible support	-.174	p=0.018	.719

(PDEQ was not a significant predictor in this combined model)

This model was developed from the strongest predictors in Models 1-3 and was overall the best predictor of depression^M and accounted for 54% of the variance in BDI scores. Satisfaction with support and the ASDS scores were the strongest predictors of depression. However, the model was not strong enough to be used as a routine screening tool for RTC casualties, since it only accounted for half the variance in scores. The model highlighted, that practical social support and satisfaction, were associated with risk of depression after a crash. It also highlighted the link between acute stress symptoms and previous mental health problems with subsequent depression. Since the model incorporated factors that can only be measured after casualties are discharged from A&E, it would be necessary to conduct a separate assessment in the week after a crash, as previously suggested, for ASD and PTSD, to establish the presence of some of these risk factors.

Summary

The study aimed to address the question "What predictive factors were associated with depression following a RTC?" This question was addressed through exploration of participants' responses on the screening and follow-up questionnaires for a relationship with the BDI^M scores. Four models of depression were developed, utilising pre, peri and post crash factors significantly associated with depression in the univariate analysis. The design of the models was informed by their intended purpose of predicting risk of depression in RTC casualties after a crash, whilst attending A&E or in a subsequent assessment. All the models were tested using multiple-regression and generally found to be moderate predictors of depression. No single model was sufficiently accurate for use as a screening tool, in the absence of a clinical assessment.

Model 1 relied on pre and peri-trauma factors, which could be assessed for, whilst in A&E, but had the weakest predictive value (35% of the variance). Model 4 was the strongest predictor of depression (54% of the variance) and relied on a combination of social support and early trauma responses.

PlaTO

The depression models reiterated that reliable assessment of casualties at risk of depression could not be achieved during attendance at A&E.

As established with PTSD, the strongest single predictor of depression was ASD. Its incorporation into the combined model with pre and post crash factors increased the overall predictive value. Only one factor in this model could be assessed immediately after a crash (previous mental health treatment), whereas ASDS must be completed two days after a crash. In this study the two social support factors in the combined model (satisfaction and MOS tangible support) were reported at one month. These could be included in an assessment at an earlier time-point, but the comparability of the results at a week must be verified.

These results indicate the PlaTO service model must include assessment of casualties, after discharge from A&E, using the ASDS, together with an assessment of their support satisfaction and discernment of practical support, since these factors were linked to depression. Such an assessment should enable both the recognition of casualties with high levels of distress, who may require immediate intervention and support as well as those, who require further monitoring and assessment for depression.

Whilst such a service would require additional resources to track and assess casualties, it would provide a more comprehensive assessment process to ensure casualties at risk of depression, were appropriately monitored and able to receive timely intervention.

Predictive factors Discussion

The purpose of this study was to investigate pre, peri and post-crash factors that were associated with PTS disorders after a RTC to enable casualties to be screened whilst attending A&E. Thus overcoming some of the issues involved in following-up attendees post-discharge and facilitating further monitoring (watchful waiting) and timely intervention in accordance with the NICE guidelines (NICE, 2005; NICE, 2007).

Pre-Crash Factors

Pre-crash factors were more important in the initial trauma response measured using the ASDS than depression and PTSD (Table 13). Although gender differences were reported in the trauma literature, with women having a higher prevalence of PTSD (Norris, Foster *et al.*, 2002; Olff, Langerland, Draijer and Gersons, 2007), only ASD was linked to gender in this study.

Reporting previous treatment for a chronic health problem was negatively associated with ASD and was also a significant predictor in the strongest ASD model. However, it was not subsequently related to either PTSD or depression. The direction of causality is unclear in this relationship, as is the issue of how experiencing a chronic physical health problem could reduce the risk of ASD. Further investigation of this issue is vital to understand the process, whereby illness is protective for psychological problems.

Being a smoker was significantly associated with both ASD and PTSD and was also a significant predictor in the strongest ASD model. The sample had a greater percentage of smokers than the local population (26% vs. 22%) (Great Britain. Office of National Statistics, 2006), which may have influenced these results. However, smoking has previously been linked with the development of anxiety disorders and trauma responses (Morrisette, Tull *et al.*, 2007), which was consistent with this study, in which being a smoker, was associated with PTSD and ASD, but not depression.

Participants were asked whether they had previously received treatment for mental health problems, as an indicator of past problems. Having a history of treatment was related to both ASD and depression and also formed a component within the strongest model of depression. PTSD and treatment were not associated, although Brewin et al (Brewin, Andrews *et al.*, 2000), reported an association in their meta-analysis of risk factors. This study also found an association between family mental health history and ASD, which was not established for PTSD. The lower than reported UK incidence of mental health problems (Glover, 2008) in the sample may have influenced these outcomes, since individuals may have been reluctant to report such information within the context of a survey. Interestingly neither ASD nor PTSD was associated with previous traumas, although depression was. In general, pre-crash factors were weak predictors of both PTSD and depression, but better predictors of ASD. However, the mechanism of the relationship between these factors and ASD was uncertain and needs further investigation.

Table 13: Relationship of pre, peri and post-crash factors with ASD, PTSD & Depression

Factor Type	Factor	ASDS (ASD)	IES-R (PTSD)	BDI (Depression)
Pre-crash factors	Gender	√		
	Age			
	Employment			
	Previous physical health treatment	√ ■		
	Smoking	√ ■	√	
	Drinking Alcohol			
	Previous Mental Health Treatment	√		√
	Family History M. Health Treatment	√		
	Previous traumas			√
	Years since previous traumas			
Peri-crash factors	Social Support[W]	√		
	Subjective injury severity	√	√	√
	Feeling Unreal	√ ■	√	√
	Perception of crash consequences	√ ■		
	Terrified at the time	√ ■	√	√
	PDEQ score		√ ■	√
Post-crash factors	Social support structure			√
	Social support Tangible			√ ■
	Social Support Affection			√
	Social Support Positive Socialising			√
	Social Support Emotional/Information			√
	Social support Current problems		√	√
	Social support Satisfaction		√ ■	√ ■
	ASDS score	N/A	√ ■	√ ■
	BDI Score		√	N/A
	IES-R Score		N/A	√
	GHQ Score		√	√
	WAS overall functional impairment		√	√
	WAS Work			√
	WAS Home		√	√
	WAS Socialising		√	√
	WAS Alone		√	√
	WAS Relationships		√	√
	Legal proceedings		√	√

√ Denotes factors significantly associated with the relevant disorder

■ Denotes factors significantly associated with the strongest predictive model

For RTC casualties attending A&E, this study indicated that pre-crash factors were weak indicators of PTS risk.

The limited influence of pre-trauma factors on the development of PTSD has previously been reported (Brewin, Andrews *et al.*, 2000; Ozer, Best *et al.*, 2003). Whilst pre-crash variables are rarely amenable to change, their limited contribution encouraged optimism that intervention can be brought to bear on peri and post-crash factors to minimise the consequences of crashes.

Peri-crash Factors

Peri-crash factors were linked to all three disorders. Social support[W] in the aftermath of the crash only related to the initial stress response, as did the participants' beliefs about the crash. This information was coded from free text responses, which may have impacted on the results obtained. The subjective perception of injury, feeling unreal and terror at the time of the crash were all associated with the three PTS disorders with participants reporting not being terrified, low injury severity and not feeling unreal being at low risk of PTS disorders.

The PDEQ was included in the peri-crash factors, as it measured the severity of dissociative experiences in the peri-crash period, but it cannot be completed whilst in A&E. The PDEQ was associated with both depression and PTSD and was linked with the strongest PTSD model. Dissociative experiences form part of a PTSD diagnosis, but are not associated with depression (American Psychiatric Association, 1994). The relationship between depression and PDEQ may have been mediated through PTSD, rather than via a direct relationship, although further investigation is necessary to explore this theory

The peri-crash factors were stronger predictors than pre-crash ones, consistent with the outcomes from study B and two studies of risk factors (Brewin, Andrews *et al.*, 2000; Ozer, Best *et al.*, 2003). Terror and feeling unreal were significant predictors in the strongest ASD model, congruent with the diagnostic criteria of fear and dissociation (American Psychiatric Association, 1994). None of the peri-crash factors were significantly associated with the depression model, again congruent with its diagnostic criteria (American Psychiatric Association, 1994).

Post-crash Factors

All the psychometric measures (GHQ, ASDS, BDI and PTSD) were associated with each other, suggesting that they shared common features and high levels of co-morbidity were found amongst participants.

Overall function was problematic for most participants and when this was investigated across specific domains, the impact of a RTC on daily life was evident, with depression affecting all functional areas, whereas work remained unaffected by PTSD, which may indicate different coping patterns. In this study, the wider impact of crashes emerged where the majority of casualties, had difficulty managing work, home and relationships.

Paucity of social support has previously been linked to psychological problems after a traumatic event, such as road traffic crashes (Kaniasty and Norris, 1992; Holeva, Tarrier *et al.*, 2001). Many aspects of social support were negatively associated with mood, whereas PTSD was only associated with "support provided" and "satisfaction". Consistent with other studies, the subjective appraisal of satisfaction was important (Kaniasty and Norris, 1992) and this featured in both depression and PTSD models. The apparent importance of social support to RTC casualties' psychological status, suggests that its provision may promote psychological benefits after a crash, an area often overlooked within therapy (Litz, Gray *et al.*, 2002; Roberts, Kitchiner *et al.*, 2009). Thus, the embellishment of social support may offer pathways to buffer against the psychological impact of a crash (Joseph, 1999), although the type and timing of support may be critical.

The majority of participants were involved in litigation. However, people not involved were less likely to have PTSD or depression, although this relationship may be bi-directional. Further exploration of the link between PTS disorders and litigation would be necessary to unravel the causal path in this relationship.

Many of the post-crash factors were significantly linked to PTSD and mood. Mood was more strongly associated with social support than PTSD, especially tangible support, which was linked to the strongest depression model. Overall satisfaction with social support, together with ASDS scores, emerged as important predictors of PTSD and depression. Since post-crash support may be amenable to change, it may prove possible to minimise the psychological consequences of crashes through the enhancement of social support in the aftermath of a crash.

PlaTO

The analysis of risk factors associated with ASD, PTSD and depression influenced the design of the proposed service model, since none of the models tested could be used as stand-alone assessments for casualties whilst attending A&E.

These results were consistent with previous studies (Brewin, Andrews *et al.*, 2000; Ozer, Best *et al.*, 2003), which identified that pre-trauma variables were weak predictors of PTSD.

The purpose of this study was to determine whether it was clinically viable to identify casualties at risk of psychological problems, whilst they attended A&E. Although factors were identified that accounted for a sizeable proportion of the variance in ASDS scores, the models tested were not sufficiently strong for routine clinical screening. However, the importance of including questions within the assessment of RTC casualties that address smoking, previous health problems, personal and family mental health history, perceptions of the crash and their injuries, feeling terrified and unreal was highlighted. However, such a change in assessment away from a purely physical examination may be difficult for A&E staff, due to the prevailing culture that focuses on action rather than interaction (Crowley, 2000). The results of the study led to the conclusion that current ASD models were not satisfactory predictors according to Wilson's screening criteria (UK National Screening Committee, 2008). Hence assessment of ASD after a week was essential to fulfil the NICE recommendations (NICE, 2005). However, the greater resource implications required to undertake this were appreciated.

As ASD must be assessed after discharge, it offered opportunities to evaluate factors predictive of PTSD and depression concurrently. Since social support was related to the development of PTSD and depression, an evaluation of available support and satisfaction would inform not only a risk assessment, but provide opportunities to rectify support deficits. Furthermore, providing a follow-up assessment may also be perceived by casualties as supportive in its own right and may inadvertently provide a stress-buffering effect, thereby reducing the risk of subsequent disorder.

It was also essential to acquire an understanding from casualties about the healthcare they received, after discharge from A&E to inform PlaTO since few casualties (9%), received directed follow-up from the hospital. However, it was not known whether they independently accessed healthcare services and whether they received treatment after discharge.

What were the consequences of a RTC?

This question was informed through two specific research questions (Figure 27). Study B had already established that there was a sizeable prevalence PTS disorders following a crash. To inform the proposed service development, it was necessary to establish what functional impact arose from a crash and what services casualties typically received after discharge.

What functional impairment was reported by RTC casualties a month after a crash?

To investigate the impact of a RTC on daily functioning, participants completed the WAS contained within the One month Questionnaire. Firstly participants reported whether they had problems after a month and 72% indicated that they did (Table 14)Table 5. Participants with problems then rated their dysfunction across five domains.

Table 14:Participants with functional impairment equivalent to a "caseness" score

Questionnaire	n "cases"/ *(out of N respondents)*	%
WAS^{M} (reporting dysfunction)	104/141	72%
WAS^{M} ($\geq$4 in any functional area reported)	76/104	73%
WAS^{M} ($\geq$4 in any functional area reported)[5]	76/141	54%

From the results it was evident that impairment occurred in all domains (Table 15). Managing to function at work was the most difficult for participants. Only 6 people reported no problems managing work and 16 people indicated maximum dysfunction. Many participants (59%) reported a score of $\geq$ 4 in this area, suggesting that after a RTC, difficulty functioning at work was likely, even after a month.

Table 15: Work and Social Adjustment Impairment one month after a RTC

Question	**Mean** on 0-8 scale	**Standard Deviation**
Ability to manage work	4.2	2.4
Ability to manage home	3.5	2.1
Ability to enjoy being alone	3.2	2.8
Ability to socialise	2.7	2.5
Ability to manage relationships	2.5	2.4

[5] The values reported relate to those for the whole participant group that answered this questions since 104 out of 141 participants reported having functional impairment

Enjoying doing things alone was less affected with 27 people (26%) reporting no problems. However, 47 (45%) rated their dysfunction at home as ≥ 4 (Table 15). Forming and managing relationships was the least affected area with 33% unaffected in this domain, although 34% did report problems with their relationships (scores of $\geq$4). Over half of all respondents in the complete sample (n=144) had some functional difficulty after a month (Table 14). Functional impairment was more common (96%) amongst participants that endorsed case-level scores on all psychological measures suggestive of links between psychological and functional problems.

Summary of functional impairment

In this study impairment in activities of daily living was widely reported (72%). This equated to 2182 casualties annually from Hospital A. 73% (n=76) of participants who reported functional difficulties endorsed a score of ≥ 4 in at least one functional area. This equated to 53% of all the participants, with functional problems for at least one aspect of their life, more than a month after a crash.

All the domains were found to be problematic for some participants, although the greatest dysfunction was reported with work. This was of particular concern given the RTC population was predominantly of working age. Relationships were the least affected area which could help to buffer against stress (Cohen and McKay, 1984) during early recovery. The WAS does not specify the origin of the dysfunction and in this population it may have arisen through both physical and psychological problems. This study highlighted the considerable impact that even minor RTCs had on function, especially work and suggested a need to investigate the impact of a RTC on function more extensively, from an individual perspective, particularly in view of the working age of most RTC casualties and the complex relationship evident between psychological problems, physical injury and daily dysfunction.

What healthcare services did RTC casualties receive after discharge from A&E department?

All participants completed a log of healthcare appointments, medication and treatment received in the month after their crash (n=144). It was evident that casualties did attend healthcare appointments within the first month. Participants had the most contact with doctors and physiotherapists with general practitioners being the most attended healthcare service, used by 80 participants (Table 16).

The least reported contacts were with professionals trained in psychological interventions (counselling, psychology and occupational therapy). However, it was possible that psychological support and advice was derived indirectly from contact with healthcare professionals as a total of 283 healthcare attendances were reported by the participants, often with multiple attendances (mean 1.95 attendances/ participant) within the month. 80 participants were prescribed medication (55%), virtually all analgesics, with three participants prescribed antidepressants.

Patterns of healthcare usage were also examined for participants who scored above ASD caseness (Table 17) at one week (n=68). GPs were the most frequently accessed with 37 people (54%) attending, often with more than one appointment (average 1.73 GP appointments). Consultants and physiotherapy were also attended frequently by participants, usually involving multiple appointments. The professions with psychological training were again the least consulted, together with community nurses.

Although 68 participants had ASD only 2 received counselling following their crash6. A total of 153 attendances with healthcare providers were reported after a month by participants with ASD, resulting in a mean of 2.25 attendances per participant over the month. This value was higher than the 1.95 attendances reported for the total participants suggesting that casualties with ASD, tended to attend more healthcare appointments. Apart from 2 participants, casualties with ASD did not report more psychological input from the existing healthcare system. Participants with ASD were prescribed medication (42%) in the month after the crash and analgesia was the most common medication (93%). 2 participants reported antidepressant medication.

Summary of healthcare received

On average casualties were seen by healthcare professions just under twice in a month although for casualties with ASD the mean was more than twice. Analgesic medication was the most likely intervention although people with ASD were less often prescribed medication (42% versus 55%). Few participants received antidepressants, two with ASD and one without. Physiotherapy was the main therapeutic intervention attended by those with ASD, whilst healthcare professionals with psychological training were rarely attended and moreover, 65 participants, with case level ASD, received no overt psychological assessment or intervention. However, this study occurred prior to the publication of the NICE guidelines, so routine practice may have subsequently altered.

Table 16: Healthcare usage of RTC casualties in the month after a crash

Healthcare services	Number of attendances in first month after RTC									Total number attendances	Number of casualties N=144
	0	1	2	3	4	5	6	7	8		
Consultant	114	26	2	2						36	30
GP	64	47	15	13	4		1			138	80
Out Patient	121	20	2	1						27	23
Practice Nurse	134	4	5						1	14	9
Physiotherapist	121	6	7	4	4	2				50	23
Occupational Therapist	142	1	1							3	2
Counsellor	141	2	1[6]							2	2
Community nurse	142	1	1							3	2
Other	137	6			1					10	7

[6] This participant was already attending counselling prior to the crash about other problems and has not been included in the total attendance figures

Table 17: Healthcare usage of RTC casualties with case level ASD in the month after a crash

Healthcare services	Number of attendances in first month after RTC									Total number of attendances	Number of casualties N=68
	0	1	2	3	4	5	6	7	8		
Consultant	50	16	1	1						23	18
GP	28	22	6	8			1			64	37
Out Patient	55	12		1						15	13
Practice Nurse	62	3	3							9	6
Physiotherapist	57	3	2	3	2	1				29	11
Occupational Therapist	66	1	1							3	2
Counsellor	65	2	1[6]							3	3
Community Nurse	66	1	1							1	2
Other	65	2			1					6	3

Discussion of RTC consequences

Functional impairment was commonly reported, despite the majority of participants sustaining minor injuries. These results highlight the importance of assessing and recognising the potential impact a crash may have regardless of the injury severity. This information may prove useful to impart to other crash casualties in order to normalise their recovery process. Not all functional areas were similarly affected and whilst after a month relationships were the least affected area, over a longer period of time a different pattern may emerge. Functional impairment was more common amongst participants with psychological problems, which suggests some aspects of dysfunction could be alleviated by addressing these disorders directly. This notion requires further investigation on an individual level and wider scale.

Although directed follow-up after A&E was rare, casualties accessed a range of healthcare professionals. Doctors and physiotherapists had the most contact. Consequently medication and physiotherapy were the most common interventions. Given the high prevalence of WAD reported amongst the RTC population in Study A, the interventions fits with the stepped care pathway recommended by the Quebec Task Force (Spitzer, Skovron *et al.*, 1995). Participants with ASD consulted healthcare service more than twice in a month, although there was no evidence that 65/68 out of the casualties with ASD obtained any psychological assessment or support. However, support may have been derived from healthcare professionals.

The results obtained suggested that, although formal follow-up for RTC casualties after discharge was limited, over half saw their GP in the first month. The majority of participants with ASD^{W} had no overt evidence of receiving psychological assessment, support or intervention after discharge. Further investigation was required to determine, at an individual level, whether routine healthcare appointments with a GP or physiotherapist included psychological support or intervention. There was a possibility that healthcare professionals may have assessed and supported the psychological needs of RTC casualties, irrespective of psychological training.

Were there gender differences in the prevalence of PTS disorder, predictive risk factors and consequences of a RTC?

This question was informed through three specific research questions (Figure 27) with the aim of being able to personalise services for RTC casualties, through a stronger understanding of any emergent gender differences.

Were there gender differences in the prevalence of PTS disorders?

Acute stress disorder symptoms were investigated using the ASDS[W]. Women scored higher on the ASDS (mean 55+/-21) compared to men (mean 49+/-18). The significantly higher women's mean was also compounded by the higher frequency of female participants. This difference was significant when analysed (Table 18), using an independent t-test, (t-test –2.4, df 198, sig 0.019 2-tailed).

Table 18: Gender differentiated scores for Acute Stress Disorder

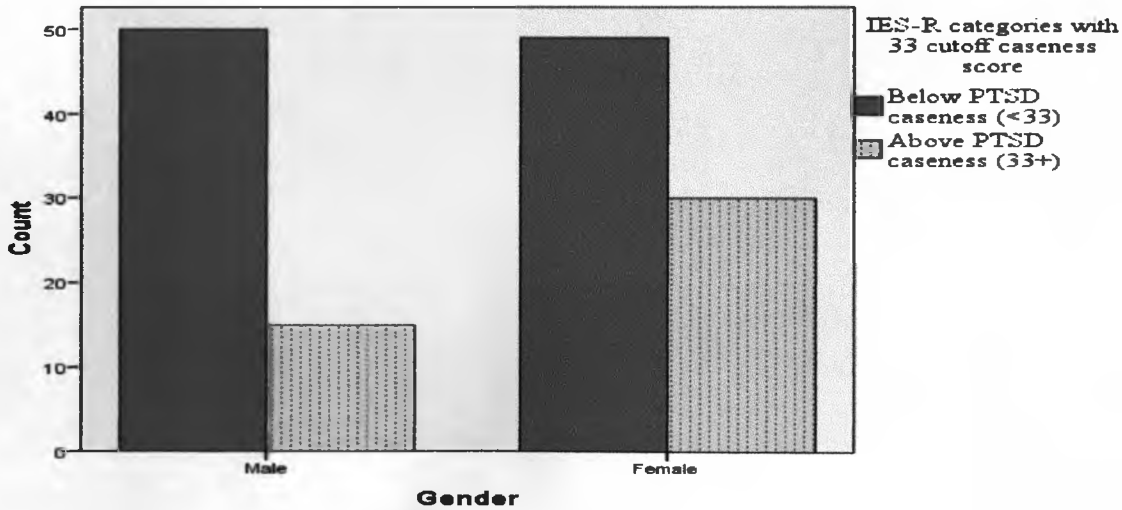
	n/N Above "cut-off" point	% Above "cut-off" point
All participants Score of ≥50 cut off indicative of ASD	100/200	50%
Males Score of ≥50 cut off indicative of ASD	39/91	43%
Females Score of ≥50 cut off indicative of ASD	62/109	57%
All Participants Score of ≥56 cut off indicative of future PTSD	80/200	40%
Males Score of ≥56 cut off indicative of future PTSD	30/91	33%
Females Score of ≥56 cut off indicative of future PTSD	54/109	50%

Although both genders reported considerable prevalence of ASD, women had higher mean ASDS scores, higher prevalence of ASD and were more likely to develop PTSD than men. However, a sizeable number of men also experienced case-level symptoms.

The significantly higher rate of ASD in women, was consistent with a previous study, that found gender differences in ASD after a crash (Bryant and Harvey, 2003), although the overall rates of ASD were considerably lower in their study. The Australian study used a more severely injured population, which may have influenced the prevalence of psychological disorder. They found that ASD diagnosis was better at predicting PTSD in women, since it relied heavily on the endorsement of dissociative symptoms, which were more common amongst females. Their results suggested that caution must be exercised when using ASD symptoms to predict PTSD in men, because the criteria may overlook male distress.

PTSD symptoms were assessed using the IES-R^{M}. Different mean scores were reported by women (28 ± 22) and men (23 ± 20). Further analysis using an independent sample t-test found that the difference between the male and female scores was not significant (t-test 1.4, df 141, sig 0.16 2-tailed).

Figure 99: Association between gender and PTSD caseness



When case level scores were examined (Figure 99), more women had PTSD (38%) than men (23%), although again this was not significant, using Pearson's Chi-squared test ($\chi2$ 3.684, df 1, sig 0.055). Therefore no significant gender differences in PTSD prevalence were established.

Symptoms of depression were measured using the BDI^{M} and a total score obtained. Females had a slightly higher mean score on the BDI measure (females 11 ± 10: males 10 ± 10), but independent sample t test analysis found the difference was not significant (t-test 0.691, df 141, sig 0.491 2 tailed). Although more women reported severe depression (Figure 100), this trend was not significant when tested by Pearson's Chi-Squared test ($\chi 2$ 0.467, df1, sig 0.792, 2 tailed). Therefore no significant gender differences in depression prevalence were established.

Figure 100: Depression caseness by gender

Gender	BDI Score ≤10 Not depressed	BDI Score 10-20 Mild Depression	BDI Score ≥21 Moderate-Severe depression
Male	62.5%	25%	12.5%
Female	60.8%	22.8%	16.5%

Were there gender differences in predictive risk factors for PTS disorders?

This question was informed by the investigation of gender-differentiated risk factors for ASD, PTSD and depression and the development of disorder specific models, which were tested using multiple regression analysis.

ASD Risk Factors

The screening questionnaire collected information from participants about potential risk factors for subsequent psychological problems. The literature indicated that risk of psychological distress differed between men and women, (Norris, Foster *et al.*, 2002; Bryant and Harvey, 2003; Olff, Langerland *et al.*, 2007). The association between pre or peri-trauma factors with ASD^{W} were initially analysed, individually, to inform the disorder specific models. Age was analysed as a continuous variable. All the remaining variables were analysed as categorical data. The results of the univariate relationships with ASD are presented below.

The male participants reported the same significant pre and peri-crash factors as those reported for the generic sample, except that social support^{W} was not significant for men (Table 19). Further statistical modelling of these significant variables was conducted, to determine the relative contribution of these factors to ASD caseness.

Table 19 Male Pre and Peri-trauma risk factors associated with ASDS scores

Factor	Factor Type	Relationship to ASD	Statistics	Significance
Age	Pre-trauma	Age was not correlated with ASDS scores	τ= - 0.160	p=0.63
Employment	Pre-trauma	Employment status was not associated with ASD caseness	χ2 2.649, df1	p=0.104
Previous physical health treatment*	Pre-trauma	Previous treatment for physical health problem was negatively associated with ASD caseness	χ2 4.659, df1	p=0.031
Smoking*	Pre-trauma	Smoking was associated with ASD caseness	χ2 5.976, df1	p= 0.015
Alcohol	Pre-trauma	Alcohol was not associated with ASD caseness	χ2 1.61, df1	p= 0.204
Previous mental health treatment*	Pre-trauma	Previous mental health treatment was associated with ASD caseness	χ2 3.985, df1	p= 0.046
Family mental health treatment	Pre-trauma	Family history mental health treatment was not associated with ASD caseness	χ2 0.359, df1	p=0.549
Previous traumas	Pre-trauma	Previous traumas were not associated with ASD caseness	χ2 1.94	p= 0.164
Social Support[W]	Peri-trauma	Social support in the first week was not related to ASD caseness	χ2 9.689, df3	p= 0.072
Subjective severity of injuries*	Peri-trauma	Subjective perception of injury severity was associated with ASD caseness	χ2 6.294, df1	p= 0.012
Feeling strange/unreal*	Peri-trauma	Feeling strange/ unreal was associated with ASD caseness	χ2 7.379, df1	p=0.007
Subjective perception of crash consequences * (death)	Peri-trauma	A belief about dying was associated with ASD caseness	χ2 5.017, df1	p=0.025
Terrified at time*	Peri-trauma	Feeling terrified at the time was associated with ASD caseness	χ2 13.373, df1	p<0.001

*Significant at 0.05 level

Table 20: Pre and Peri-trauma risk factors associated with ASDS scores for women

Factor	Factor Type	Relationship to ASD	Statistics	Significance
Age	Pre-trauma	Age was not correlated with ASDS scores	τ= - 0.26	p=0.738
Employment	Pre-trauma	Employment status was not associated with ASD caseness	$\chi2$ 0.2, df1	p=0.887
Previous physical health treatment	Pre-trauma	Previous treatment for physical health problem was not associated with ASD caseness	$\chi2$ 3.209, df1	p=0.820
Smoking	Pre-trauma	Smoking was associated with ASD caseness	$\chi2$ 3.789, df1	p= 0.052
Alcohol	Pre-trauma	Alcohol was not associated with ASD caseness	$\chi2$ 0.261, df1	p= 0.610
Previous mental health treatment	Pre-trauma	Previous mental health treatment was not associated with ASD caseness	$\chi2$ 1,315, df1	p= 0.251
Family mental health treatment	Pre-trauma	Family history mental health treatment was not associated with ASD caseness	$\chi2$ 0.486, df1	p=0.486
Previous traumas	Pre-trauma	Previous traumas were not associated with ASD caseness	$\chi2$ 0.177	p= 0.674
Social Support^{W}*	Peri-trauma	Social support in the first week was associated with ASD caseness	$\chi2$ 11.044, df3	p=0.011
Subjective severity of injuries	Peri-trauma	Subjective perception of injury severity was associated with ASD caseness	$\chi2$2.621, df1	p= 0.105
Feeling strange/unreal*	Peri-trauma	Feeling strange/ unreal was associated with ASD caseness	$\chi2$ 15.580, df1	P<0.001
Subjective perception of crash consequences (death)	Peri-trauma	A belief about dying was not associated with ASD caseness	$\chi2$ 1.049, df1	p=0.306
Terrified at time*	Peri-trauma	Feeling terrified at the time was associated with ASD caseness	$\chi2$ 17.578, df1	p<0.001

*Significant at 0.05 level

The female participants differed from the generic sample, as no significant pre-crash factors emerged (Table 20). Amongst women, social support^{W} was significantly associated with ASD and the peri-crash factors were more strongly associated with ASD, than the pre-crash ones, consistent with the earlier findings from Study B.

Models of ASD

Models were developed using the gender-differentiated factors found to be significantly related to ASD (Table 21). There were 91 males who completed the screening questionnaire, To ensure reliable regression modelling, a maximum of six variables were incorporated into the initial model building process (Field, 2005). Therefore, the pre and peri-trauma factors were modelled separately, through multiple regression analysis using SPSS 16. Since only three variables were found to be associated with ASD for women they were all entered into a single model.

Table 21: Gender differentiated Pre and Peri-trauma factors associated with ASDS[W]

	Male	**Female**
Previous physical health treatment	✔	
Smoking	✔	
Previous mental health treatment	✔	
Social support[W]		✔
Subjective injury severity	✔	
Feeling strange/unreal (dissociated)	✔	✔
Subjective cognition (death)	✔	
Terrified at the time	✔	✔

Male Model of ASD 1: Pre-trauma factors

Three pre-trauma factors were significantly related to ASD caseness for men; previous treatment for physical health problems, smoking and previous treatment for mental health problems.

Adjusted $R^2 = 0.122$, $F_{2,88}=7.260$, $p=0.001$

The significant variables are shown below

Predictor Variable	**Standardised Beta**	**P**	**Tolerance**
Smoker	.264	0.01	.983
Previous treatment for mental health problems	.236	0.02	.983

(Previous treatment for chronic physical health problems was not a significant predictor in this pre-trauma model)

The male pre-trauma model for ASD found that 12% of the variance in the $ASDS^W$ scores was accounted for by this model, suggesting these factors were weak predictors of $ASDS^W$, although being a smoker was the best predictor. This model was not viable as a clinical tool to assess future risk of ASD, because it only accounted for a small proportion of the variance in ASD scores.

Male Model of ASD 2: Peri-trauma factors

Four peri-crash factors were associated with ASD caseness and these were entered into the model.

Adjusted $R^2 = 0.412$, $F_{3,74}=18.978$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	P	Tolerance
Did it terrify you?	.406	p<0.001	.926
Feeling unreal	.301	p= 0.002	.847
Subjective severity of injuries	.206	p=0.034	.846

(Subjective perception of crash consequences was not a significant predictor of $ASDS^W$ scores in this model.)

The male peri-trauma model accounted for 41% of the variance in $ASDS^W$ scores. This was a much stronger model of ASD, than Model 1 and identified three peri-trauma factors that were associated with ASD. However, this model was not robust enough for clinical use, because it did not predict the majority of variance associated with ASD.

Male Model of ASD 3: Combined Pre and Peri-trauma factors

Combining the two earlier models, to include a total of five variables, the combined model was analysed.

Adjusted $R^2 = 0.488$, $F_{4,84}= 21.986$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	P	Tolerance
Did it terrify you?	.411	p<0.001	.904
Feeling unreal	.277	p= 0.002	.789
Smoker	.227	p=0.004	.984
Subjective severity of injuries	.194	p=0.026	.791

(Previous history of mental health treatment was not a significant predictor of $ASDS^W$ scores in this model.)

The combined model, when analysed by multiple regression, accounted for 49% of the variance in $ASDS^W$ scores. This male model performed better than Models 1 and 2 and indicated that these four questions from the screening tool were moderate predictors, accounting for almost half the variance in ASD. However, the model was not strong enough to account for the majority of variance in ASDS scores. Therefore, this combined male model could not be used in isolation to predict male ASD risk.

Female Model of ASD: Peri-trauma factors

Only three factors were associated with ASD caseness hence all three variables were entered into the model.

Adjusted $R^2 = 0.327$, $F_{2,96} = 24.780$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	P	Tolerance
Did it terrify you?	.310	p<0.001	.953
Feeling unreal	.432	p<0.001	.953

(Social $support^W$ was not a significant predictor of $ASDS^W$ scores in this model.)

The female model of ASD only involved peri-trauma factors and was not as strong as the male Model 3 for ASD and was not sufficiently robust to predict ASD in female RTC casualties.

ASD Summary

Gender differences were found in factors associated with ASD. Social support was not related to male ASD, but was linked to female ASD, whilst in women only peri-trauma factors were found to link with ASD. In men, ASD was linked to both pre and peri-trauma factors. Gender specific models were tested to determine their value as predictors of ASD amongst RTC casualties.

Amongst the three male models tested, model 3 was the best predictor of ASD and was stronger than the female model. Both male and female models included feeling terrified and unreal, as the best predictors of ASD, suggesting that these factors were universal and consistent with earlier findings in Study B. For men, being a smoker and the subjective severity of injuries were additional factors predictive of ASD.

The male ASD combined model 3 was a slightly better predictor (49% variance) than the best generic model for ASD (42% variance), established in Study B. In contrast the female model (33% variance) did not perform as well.

The study identified gender differences in risk factors and differentiated models were developed for ASD.

PTSD risk factors

Pre, peri and post-trauma risk factors were examined separately in terms of their relationship with PTSD and gender. Firstly, univariate analysis was carried out for both genders and then significant factors were tested through multiple-regression. No significant pre-trauma factors emerged (Table 22) but, most peri-trauma factors were significant. Social support[W] was the only peri-trauma factor that was not related to PTSD. All of the diagnostic psychometric tools correlated with IES-R scores. Overall function also related to PTSD for men. Analysis of the relationship between PTSD and pre, peri and post crash factors, reported by women, revealed a different pattern of risk factors (Table 23).

Being a smoker was related to PTSD for women, although this was the only pre-trauma factor linked to PTSD. Amongst women, different aspects of social support were significantly linked to PTSD, whereas no such relationships were identified amongst men.

To further analyse the relative contribution of all these gender differentiated risk factors to PTSD, additional analysis was undertaken using multiple regression.

Table 22: Male pre, peri and post crash variables and PTSD

Factor	Factor Type	Relationship to PTSD	Statistical test	P value
Age	Pre-trauma	Age was not associated with IES-R scores	τ= -0.139 n=65	P=0.109
Employment	Pre-trauma	Employment was not associated with PTSD caseness	$\chi 2$= 1.896, df1	P=0.169
Previous physical health treatment	Pre-trauma	Previous physical health treatment was not associated with PTSD caseness	$\chi 2$= 0.710, df1	P= 0.399
Smoking	Pre-trauma	Smoking was not associated with PTSD caseness	$\chi 2$= 1.097, df1	P= 0.295
Alcohol	Pre-trauma	Alcohol use was not associated with PTSD caseness	$\chi 2$= 0.052, df1	P=0.819
Previous mental health treatment	Pre-trauma	Previous mental health treatment was not associated with PTSD caseness	$\chi 2$= 0.024, df1	P=0.876
Family mental health treatment	Pre-trauma	Family history of mental health problems were not associated with PTSD caseness	$\chi 2$= 1.170, df1	P=0.280
Previous traumas	Pre-trauma	Previous trauma exposure was not related to PTSD caseness	$\chi 2$= 0.019, df1	P=0.891
Social Support^{W} by two categories	Peri-trauma	Social support^{W} was not related to PTSD caseness	$\chi 2$= 0.979, df1	P=0.322
Subjective severity of injuries*	Peri-trauma	Subjective severity of injuries was related to PTSD caseness	$\chi 2$= 5.0307, df1	P=0.021
Feeling strange/ unreal*	Peri-trauma	Feeling strange/ unreal was associated with PTSD caseness	$\chi 2$= 14.329, df1	P<0.001
Subjective perception of crash consequences (death) *	Peri-trauma	Perception of death as consequence was associated with PTSD caseness	$\chi 2$= 3.865, df1	P=0.049
Terrified at the time*	Peri-trauma	Being terrified at the time was associated with PTSD caseness	$\chi 2$= 14.157, df1	P<0.001
PDEQ score*	Peri-trauma	PDEQ correlated with IES-R scores	τ=0.444,	P<0.001

Social support **Structure**	Post-trauma	Social network size was not correlated with IES-R scores	τ= -0.44	P=0.635
Social support **Tangible**	Post-trauma	Tangible support was not correlated with IES-R scores	τ=0.032,	P=0.745
Social support **Affection**	Post-trauma	Affection was not correlated with IES-R scores	τ= 0.036	P=0.721
Social support **Socialising**	Post-trauma	Socialising was not correlated with IES-R scores	τ=0.017	P=0.864
Social support **Emotional &** informational	Post-trauma	Emotional &Informational support was not correlated with IES-R scores	τ=-0.032	P=0.733
Social support^{M} Current **prob**lems	Post-trauma	Social support^{M} with current problems was not correlated with IES-R scores	τ= -0.054	P=0.541
Social support **satisfaction**	Post-trauma	Social support satisfaction was not correlated with IES-R scores	τ= -0.162	P=0.064
ASD score*	Post-trauma	ASD was correlated with IES-R scores	τ= 0.513	P<0.001
BDI score*	Post-trauma	BDI was correlated with IES-R scores	τ=0.511	P<0.001
GHQ score*	Post-trauma	GHQ was correlated with IES-R scores	τ= 0.360	P<0.001
WAS overall function*	Post-trauma	Overall function was associated with PTSD caseness	χ2= 5.158, df1	P=0.023
Involvement in legal proceedings	Post-trauma	Involvement in legal proceedings was not associated with PTSD caseness	χ2= 3.385, df1	P=0.066

*Significant at the 0.05 level

Table 23: Female pre, peri and post crash variables and PTSD

Factor	Factor Type	Relationship to PTSD	Statistical test	P value
Age	Pre-trauma	Age was not correlated with IES-R scores	τ=-0.022 N=79	P= 0.773
Employment	Pre-trauma	Employment status was not associated with PTSD caseness	$\chi2$=0.111, df1	P= 0.738
Previous physical health treatment	Pre-trauma	Previous treatment for physical health was not associated with PTSD caseness	$\chi2$=0.158, df1	P= 0.691
Smoking*	Pre-trauma	Smoking was associated with PTSD caseness	$\chi2$=4.767, df 1	P=0.029
Alcohol	Pre-trauma	Alcohol use was not associated with PTSD caseness	$\chi2$=0.633, df1	P=0.426
Previous mental health treatment	Pre-trauma	Previous mental health treatment was not associated with PTSD caseness	$\chi2$=1.654, df1	P= 0.198
Family mental health treatment	Pre-trauma	Family history of mental health treatment was not associated with PTSD caseness	$\chi2$=0.684, df1	P=0.408
Previous traumas	Pre-trauma	Previous trauma exposure was not associated with PTSD caseness	$\chi2$=1.454, df1	P=0.228
Social Support^{W} by two categories*	Peri-trauma	Social support^{W} was associated with PTSD caseness	$\chi2$=9.276, df1	P=0.002
Subjective severity of injuries*	Peri-trauma	Subjective severity of injuries was associated with PTSD caseness	$\chi2$=7.180, df1	P=0.007
Feeling strange/ unreal*	Peri-trauma	Feeling strange/unreal was not associated with PTSD caseness	$\chi2$= 12.629, df1	P<0.001
Subjective perception of crash consequences (death)	Peri-trauma	Perception of death as consequence was not associated with PTSD caseness	$\chi2$=0.005, df1	P=0.945
Terrified at the time*	Peri-trauma	Being terrified was associated with PTSD caseness	$\chi2$= 8.898, df1	P=0.003

PDEQ*	Peri-trauma	PDEQ was correlated with IES-R scores	τ=0.513 N=79	P<0.001
Social support **Structure**	Post-trauma	Social network size was not correlated with IES-R scores	τ=-0.134	P=0.099
Social support **Tangible***	Post-trauma	Tangible support was correlated with IES-R scores	τ=-0.197	P=0.019
Social support **Affection**	Post-trauma	Affection was not correlated with IES-R scores	τ= -0.142	P=0.107
Social support **Socialising**	Post-trauma	Socialising was not correlated with IES-R scores	τ=-0.148	P=0.085
Social support **Emotional** & informational *	Post-trauma	Emotional and informational support was correlated with IES-R scores	τ=-0.187	P=0.025
Social support Current **problems***	Post-trauma	Social support [M] with current problems was correlated with IES-R scores	τ=-0.208	P=0.008
Social support **satisfaction***	Post-trauma	Social support satisfaction was correlated with IES-R scores	τ=-0.295	P<0.001
ASD score*	Post-trauma	ASD was correlated with IES-R scores	τ=0.618	P<0.001
BDI score*	Post-trauma	BDI was correlated with IES-R scores	τ=0.584	P<0.001
GHQ score*	Post-trauma	GHQ was correlated with IES-R scores	τ= 0.571	P<0.001
WAS Overall function*	Post-trauma	Overall function was associated with PTSD caseness	$\chi2$=7.396, df1	P=0.007
Involvement in legal proceedings	Post-trauma	Involvement in legal proceedings was not associated with PTSD caseness	$\chi2$=2.110, df1	P=0.146

*Significant at the 0.05 level

Male models of PTSD

No pre-trauma factors were significantly associated with PTSD so models were developed around peri and post crash variables only.

Male model of PTSD 1: Peri-trauma factors

The four factors significantly related to PTSD caseness were included in this model. PDEQ, unlike the other four factors, was inappropriate for A&E. Therefore, the PDEQ was excluded from this model.

Adjusted $R^2 = 0.251$, $F_{2,52}=10.048$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Feeling unreality	.365	0.005	.748
Did it terrify you?	.282	0.028	.837

(Subjective severity of injury and perception of death as consequence of crash were not significant predictors in this model)

This male peri-trauma model of PTSD accounted for 25% of the variance in IES-R scores and involved only two of the four variables entered. The model found, that feeling unreal was the best peri-trauma predictor of PTSD, in men. Being terrified was also a predictor of subsequent PTSD. However, the model was not strong enough to use as a clinical tool.

Male Model of PTSD 2: Peri-trauma Factors and PDEQ

Two factors from Model 1 were tested, along with the inclusion of the PDEQ, in a combined model. Such a model could reflect an assessment occurring the week after a RTC. The combined model could not be used to assess risk, when initially attending A&E, unlike the previous model, since several days must lapse between the crash and completion of the PDEQ.

The adjusted $R^2 = 0.579$, $F_{1,61}= 39.074$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
PDEQ score	.540	<0.001	.902
Feeling unreality	.270	0.009	.902

(Being terrified was not a significant predictor in this model)

This model was a stronger predictor of PTSD in men, accounting for 58% of the variance in IES-R scores. Since the model consisted of two dissociative type factors, it also indicated that dissociative experiences in men were better predictors of PTSD, than terror. The model provided reasonable predictive value but would have to be assessed in a follow-up appointment.

Female Models

Unlike for men, PTSD related pre, peri and post crash variables were identified. A Model was developed around peri-trauma factors, since only smoking was relevant from the pre-trauma variables tested. Social support variables were also found to be relevant, so another model was developed, to investigate the relationship between such support and PTSD.

Female Model of PTSD 1: Peri-trauma factors

Three peri-trauma factors that could be assessed within an emergency department were significantly associated with PTSD. Social support[W] refers to support in the first week, so does not fit the aim of this model and was therefore not included as part of Model 1.

The adjusted $R^2 = 0.416$, $F_{3,67} = 17.610$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Feeling unreal	.373	<0.001	.920
Feeling terrified	.386	<0.001	.976
Subjective injury severity	.254	0.009	.936

All variables remained in the model, accounting for 42% of the variance in IES-R scores. The model suggested that peri-trauma dissociation was an important contributor to PTSD for women, although the model was not robust enough to be able to accurately predict future PTSD amongst this population.

Female Model of PTSD 2: Social Support factors

Several dimensions of social support were found to be related to PTSD in women, but not men. A social support model was evaluated, from both peri and post trauma factors. Five factors were entered into the model, but only one remained after stepwise entry.

The adjusted $R^2 = 0.189$, $F_{1,64} = 16.164$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Satisfaction with support	-.449	<0.001	1.00

(Social support^W, tangible support, emotional/informational support, help with current problems were not significant predictors in this model).

From the testing of this model, it appears that satisfaction with support was the best predictor of PTSD^M amongst this group of female RTC casualties. Satisfaction accounted for 19% of the variance in IES-R scores, which for a single variable, suggested sizeable importance within the context of PTSD development.

Female Model of PTSD 3: Combined pre, peri and post-crash factors

Post crash social support factors, peri-trauma factors and smoking (pre-trauma) were combined and entered into a single model.

The adjusted $R^2 = 0.445$, $F_{4,69} = 15.64$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Feeling terrified	.282	0.03	.927
Feeling unreal	.349	<0.001	.891
Satisfaction with support	-.305	0.01	.949
Subjective severity of injuries	.205	0.029	.898

(Smoking was not a predictor in this model)

In this combined model peri-trauma factors and satisfaction with support were the best predictors of PTSD^M. The model accounted for 46% of the variance and, from this perspective, was the strongest of the female PTSD models evaluated.

PTSD Summary

Two peri-trauma related models were tested using multiple-regression. Amongst the male models of PTSD tested, Model 2 was the best predictor, accounting for 58% of the variance in IES-R scores. However, the factors in this model could not be determined when a man initially presented to A&E, due to the inclusion of the PDEQ.

A wider range of factors were associated with PTSD in women than men. Again peri-trauma models were the strongest. Unlike the male model, the subjective severity of injury was also found to be a significant predictor of PTSD in women. Several univariate social support factors were tested in one model. However, only satisfaction remained in the model. The best predictive model tested involved four peri-trauma questions. The inclusion of the social support^{W} factor into the combined model meant that, although this accounted for nearly half the variance, the model could not be used in A&E, since support had to be measured after discharge. The study identified specific gender differences in risk factors and gender models developed for PTSD. The study also suggested clinical questions to consider within a clinical assessment.

None of the predictive models tested were able to account for sufficient variance to enable them to be used for screening. The most robust models tested for men and women could not be assessed in the immediate aftermath of a crash, again suggesting that post-discharge assessment may yield stronger clinical predictions of PTSD, than possible at the time of the crash.

Depression risk factors

For men, no pre-trauma variables were associated with mood, whilst several peri-trauma factors were significantly related to mood (Table 24). From this analysis, only peri and post-trauma factors were significantly associated with low mood. In general, more factors were related to low mood for women than men with some pre, peri and post crash variables associated with mood (Table 25).

Table 24: Male pre, peri and post crash variables and mood

Factor	Factor Type	Relationship to Mood	Statistical test	P value
Age	Pre-trauma	Age was not correlated with BDI scores	τ=-0.043 N=79	P= 0.629
Employment	Pre-trauma	Employment status was not associated with mood	$\chi2$=1.290, df1	P= 0.256
Previous physical health treatment	Pre-trauma	Previous treatment for physical health was not associated with low mood	$\chi2$=2.922, df1	P= 0.87
Smoking	Pre-trauma	Smoking was not associated with low mood	$\chi2$=1.684, df 1	P=0.194
Alcohol	Pre-trauma	Alcohol use was not associated with low mood	$\chi2$=0.720, df1	P=0.396
Previous mental health treatment	Pre-trauma	Previous mental health treatment was not associated with low mood	$\chi2$=0.335, df1	P= 0.056
Family mental health treatment	Pre-trauma	Family history of mental health treatment was not associated with low mood	$\chi2$=0.281, df1	P=0.596
Previous traumas	Pre-trauma	Previous trauma exposure was not associated with low mood	$\chi2$=1.724df1	P=0.189
Social Support[W] by two categories*	Peri-trauma	Social support[W] was associated with low mood	$\chi2$=5.973, df1	P=0.015
Subjective severity of injuries	Peri-trauma	Subjective severity of injuries was associated with low mood	$\chi2$=3.130, df1	P=0.077
Feeling strange/ unreal*	Peri-trauma	Feeling strange/unreal was associated with low mood	$\chi2$= 11.264, df1	P=0.001
Subjective perception of crash consequences	Peri-trauma	Perception of death as consequence was not associated with low mood	$\chi2$=0.002, df1	P=0.965
Terrified at the time	Peri-trauma	Being terrified was not associated with low mood	$\chi2$= 2.55, df1	P=0.110
PDEQ*	Peri-trauma	PDEQ was correlated with BDI scores	τ=0.355	P<0.001
Social support **Structure**	Post-trauma	Social network size was not correlated with BDI scores	τ= -0.152	P=0.111
Social support **Tangible**	Post-trauma	Tangible support was correlated with BDI scores	τ= -0.069	P=0.492
Social support **Affection**	Post-trauma	Affection was not correlated with BDI scores	τ= -0.114	P=0.269
Social support **Socialising**	Post-trauma	Socialising was not correlated with BDI scores	τ= -0.162	P=0.115
Social support **Emotional & informational***	Post-trauma	Emotional and informational support was correlated with BDI scores	τ= -0.265	P=0.006
Social support Current	Post-trauma	Social support[M] with current problems was correlated with	τ= -0.255	P=0.005

problems*		BDI scores		
Social support **satisfaction***	Post-trauma	Social support satisfaction was correlated with BDI scores	τ= -0.307	P=0.001
ASD score*	Post-trauma	ASD was correlated with BDI scores	τ= 0.366	P<0.001
IES-R score*	Post-trauma	IES-R was correlated with BDI scores	τ= 0.511	P<0.001
GHQ score*	Post-trauma	GHQ was correlated with BDI scores	τ= 0.596	P<0.001
WAS Overall function*	Post-trauma	Overall function was associated with low mood	$\chi 2$=6.066, df1	P=0.014
Involvement in legal proceedings	Post-trauma	Involvement in legal proceedings was not associated with low mood	$\chi 2$=1.422, df1	P=0.233

*Significant at the 0.05 level

Table 25: Female pre, peri and post -crash variables and mood

Factor	**Factor Type**	**Relationship to Mood**	**Statistical test**	**P value**
Age	Pre-trauma	Age was not correlated with BDI scores	τ= 0.002 N=79	P= 0.976
Employment	Pre-trauma	Employment status was not associated with mood	$\chi 2$=1.481, df1	P= 0.256
Previous physical health treatment	Pre-trauma	Previous treatment for physical health was not associated with low mood	$\chi 2$=2.922, df1	P= 0.224
Smoking	Pre-trauma	Smoking was not associated with low mood	$\chi 2$=0.022, df 1	P=0.882
Alcohol	Pre-trauma	Alcohol use was not associated with low mood	$\chi 2$=2.803, df1	P=0.094
Previous mental health treatment*	Pre-trauma	Previous mental health treatment was associated with low mood	$\chi 2$=6.35, df1	P= 0.012
Family mental health treatment*	Pre-trauma	Family history of mental health treatment was associated with low mood	$\chi 2$=4.491, df1	P=0.034
Previous traumas*	Pre-trauma	Previous trauma exposure was associated with low mood	$\chi 2$= 10.829, df1	P=0.001
Social Support[W] by two categories*	Peri-trauma	Social support[W] was associated with low mood	$\chi 2$=5.725, df1	P=0.017
Subjective severity of injuries*	Peri-trauma	Subjective severity of injuries was associated with low mood	$\chi 2$=6.644, df1	P=0.01
Feeling strange/ unreal*	Peri-trauma	Feeling strange/unreal was associated with low mood	$\chi 2$= 4.588, df1	P=0.032

Subjective perception of crash consequences	Peri-trauma	Perception of death as consequence was not associated with low mood	$\chi 2$=0.613, df1	P=0.434
Terrified at the time*	Peri-trauma	Being terrified was not associated with low mood	$\chi 2$= 4.158, df1	P=0.041
PDEQ*	Peri-trauma	PDEQ was correlated with BDI scores	τ=0.325 N=79	P<0.001
Social support **Structure***	Post-trauma	Social network size was not correlated with BDI scores	τ= -0.193	P=0.019
Social support **Tangible***	Post-trauma	Tangible support was correlated with BDI scores	τ= -0.327	P<0.001
Social support **Affection***	Post-trauma	Affection was correlated with BDI scores	τ= -0.277	P=0.002
Social support **Socialising***	Post-trauma	Socialising was not correlated with BDI scores	τ= -0.267	P=0.002
Social support **Emotional & informational***	Post-trauma	Emotional and informational support was correlated with BDI scores	τ= -0.292	P=0.001
Social support Current **problems***	Post-trauma	Social support[M] with current problems was correlated with BDI scores	τ= -0.289	P<0.001
Social support **satisfaction***	Post-trauma	Social support satisfaction was correlated with BDI scores	τ= -0.408	P<0.001
ASD score*	Post-trauma	ASD was correlated with BDI scores	τ= 0.402	P<0.001
IES-R score*	Post-trauma	IES-R was correlated with BDI scores	τ= 0.584	P<0.001
GHQ score*	Post-trauma	GHQ was correlated with BDI scores	τ= 0.628	P<0.001
WAS Overall function*	Post-trauma	Overall function was associated with low mood	$\chi 2$=8.011, df1	P=0.005
Involvement in legal proceedings	Post-trauma	Involvement in legal proceedings was not associated with low mood	$\chi 2$=3.206, df1	P=0.201

*Significant at 0.05 level

From this analysis all three categories of factors were associated with low mood for women. A wider range of social support factors were linked with mood than established for men and pre-trauma factors were relevant for women but none were identified for men (Table 26). Further analysis of these risk factors through multiple regression was required to elucidate the relative merit of the gender specific factors in predicting depression after a RTC.

Table 26: Gender differentiated pre, peri and post-trauma factors significantly associated with BDI^M scores

	Male	Female
Previous mental health treatment		✔
Family history of mental health treatment		✔
Previous traumas		✔
Social support^W	✔	✔
Subjective injury severity		✔
Feeling strange/unreal (dissociated)	✔	✔
Subjective cognition (death)		
Terrified at the time		✔
PDEQ	✔	✔
Social Support network structure		✔
Tangible support		✔
Affection		✔
Positive Socialising		✔
Emotional/Informational support	✔	✔
Social support with current problems^M	✔	✔
Satisfaction with social support^M	✔	✔
Overall functioning	✔	✔
Involvement in legal proceedings	✔	✔
ASDS Score	✔	✔
IES-R Score	✔	✔
GHQ score	✔	✔

Male models of Depression

No pre-trauma factors were significantly associated with low mood, so models were developed around peri and post crash variables only. The method of model building and analysis followed Study Bi.

Male model of Depression 1: Peri-trauma factors

Two factors significantly related to low mood were entered into this model. PDEQ was not included as it could not be completed whilst in A&E.

Adjusted $R^2 = 0.061$, $F_{1,54}= 4.580$, $p= 0.037$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Feeling Unreal	.280	0.037	1.0

(Social support[W] *was not a significant predictor when entered stepwise in this model)*

This model only accounted for 6% of the variance in BDI scores and when the data was entered stepwise, resulted in only one variable remaining within the model. Testing of this peri-trauma model identified that it was not appropriate for use as a predictive tool in a clinical setting and further modelling of male risk factors was required.

Male Model of Depression 2: Peri-trauma Factors and PDEQ

The two factors forming Model 1 were amalgamated with the PDEQ into a combined model, although this combined model could not be used to assess risk when initially presenting to A&E.

The adjusted $R^2 = 0.155$, $F_{1,54}= 11.066$, $p= 0.002$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
PDEQ score	.412	0.002	1.0

(Social support[W] *and feeling unreal were not significant predictors when entered stepwise into this model)*

This model accounted for 16% of the variance in BDI scores and, when the factors were entered stepwise, only one variable remained in the model.

In men, it appeared that peri-trauma factors were weak predictors of depression after a RTC. The peri-trauma factors measured did not provide a clinically useful model to predict low mood, so other models were explored.

Male Model of Depression 3: Social Support factors

This social support model included four factors. One factor was measured in the week after the crash and the others after a month. Therefore, this model could not be used to predict risk when attending A & E, but its potential value was to investigate an association between social support with depression, to inform care after a crash.

The adjusted $R^2 = 0.352$, $F_{1,46} = 26.531$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Satisfaction with Social Support	-.606	<0.001	1.0

(Social support^W, emotional/informational and support with current problems when entered stepwise were not significant predictors in this model)

Although this model accounted for 35% of the variance in BDI scores, only one factor remained significant in the model, when the variables were entered stepwise. The social support model was a weak predictor of low mood and therefore was not clinically viable, although satisfaction with social support was the best predictor of BDI scores out of the variables entered into the model.

Male Model of Depression 4: Combined factors

The previous models accounted for a minor proportion of the variance in BDI scores and were not appropriate for prediction of mood, amongst RTC casualties. In the combined model, peri and post-crash factors were included in a single model, to develop a model that could be used to assess male RTC casualties after discharge from A&E, since the models that aimed to predict risk, whilst attending A&E, had proved non-viable. ASD scores, PDEQ scores and satisfaction with social support were entered stepwise into the model. When tested through regression analysis:

The adjusted $R^2 = 0.443$, $F_{2,58} = 24.892$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
ASDS score	.448	<0.001	0.924
Satisfaction with Social Support	-.402	<0.001	0.924

(PDEQ was not a significant predictor in this model)

This was the most robust model tested for men with 44% of the variance in BDI scores accounted for by the scores on the ASDS and satisfaction with social support. Dissociative experiences were not found to be significant predictors of mood in this model. This combined model lacks adequate predictive strength to work in clinical practice, although it did highlight the relationship between initial acute stress reactions, social support satisfaction and mood for men after a RTC.

Female Model of Depression 1: Pre-Trauma Factors

Three pre-crash factors were significantly associated with BDI scores and these were entered into the model.

The adjusted $R^2 = 0.151$, $F_{1,73} = 14.172$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Previous treatment mental health problems	.403	<0.001	1.0

(family history of mental health problems and previous trauma were not significant predictors when entered stepwise into this model)

This model was able to predict 15% of the variance in BDI scores for women. This pre-trauma female model was not viable as a clinical model to predict depression at a month.

Female Model of Depression 2: Peri-Trauma Factors

Three factors were entered stepwise into the regression analysis. Social support[W] was not included in this model, since it aimed to include only variables that could be determined on attendance at A&E.

The adjusted $R^2 = 0.190$, $F_{2,74} = 9.931$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Feeling Unreal	.360	0.001	0.973
Feeling terrified	.234	0.028	0.973

(Subjective severity of injury was not a significant predictor in this model)

Peri-trauma factors measurable in A&E accounted for 19% of the variance in BDI scores for women.

Fear and dissociative experiences were able to predict a portion of low mood in this group of women, although the model's predictive strength prevented its use as a clinical tool.

Female Model of Depression 3: Social Support Factors

Social support measures taken at one week and one month were combined into a single model of social support. Whilst this could not be assessed in A&E the model aimed to test the contribution of social support to mood at one month.

The adjusted $R^2 = 0.372$, $F_{2,60} = 19.356$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
Satisfied with support	-.375	0.003	0.703
Tangible Support	-.337	0.007	0.703

(Social Support^{W}, support network, support with problems, affection, emotional/informational support and socialising were not significant predictors)

For women satisfaction with support^{M} and the availability of practical or tangible support^{M} was associated with mood. The social support model accounted for 37% of the variance in BDI scores, which suggests that some aspects of social support were important in female RTC casualties. However, the measures of social support that remained in this model were both assessed at one month.

Female Model of Depression 4: Pre, peri and post crash Factors

Relevant factors, which had emerged from the previous models, were amalgamated, together with ASDS and PDEQ scores, into a single combined model to predict low mood after a RTC in women.

The adjusted $R^2 = 0.507$, $F_{3,66} = 24.688$, $p<0.001$

The significant variables are shown below

Predictor Variable	Standardised Beta	p	Tolerance
ASDS score	.398	<0.001	0.900
Tangible Support	-.320	0.002	0.722
Satisfied with support	-.275	0.010	0.661

(Feeling unreal and PDEQ were not significant predictors in this model)

This was the strongest model tested for female depression. The combined model accounted for 51% of the variance in BDI scores. ASD symptoms, tangible support and satisfaction with social support formed the model and were able to predict over half the variance in female RTC casualties. Whilst this model was informative clinically, it was not possible to use it when women attend A&E, as it relied upon responses occurring after discharge.

Depression Summary

Gender differentiated risk factors were explored in relation to mood and a series of predictive models were developed and tested through regression analysis. For both genders, the combined models tested (Model 4 male & Model 4 female) were the most robust, accounting for the greatest variance in BDI scores.

Social support around the time of the crash was related to mood, for both men and women. However, more aspects of social support were significant for women than men. In both combined models, ASDS scores and satisfaction with support were significant. For women, the value of practical support emerged in relation to mood. Female Model 4 was a better predictor of mood [M] accounting for 51% of the variance compared to 44% for the Male Model 4. Although both these models were promising, none demonstrated a high enough predictive ability for routine clinical use and nor could any be used to predict depression at the time of attendance at A&E, as they relied on post-discharge changes.

However, the models emphasised that it may be worthwhile focusing specific attention on satisfaction with social support, during a follow-up assessment of RTC casualties. The female model also highlighted the importance of practical support to women, which did not emerge for men. Specific gender differences in risk factors were identified and gender models developed for depression that highlighted the importance of satisfaction with social support to men's and women's mood. Further investigation is necessary, to build upon these models, to develop gender specific screening tools for RTC casualties. In the absence of models with strong predictive merit, this study indicated that it was prudent to directly assess casualties for mood problems using psychometric assessment and subjective appraisal of social support, after discharge from A&E, rather than use weaker predictive models.

Discussion of gender differences

On all diagnostic measures taken post crash women reported higher mean symptom scores, although only ASDS was significantly different (Table 27)

Table 27: Comparison of scores on psychological measures by gender

Measure	Male Mean ±SD	Female Mean ±SD	Independent sample t-test	Significant at 0.05 level
ASDS	29±18	55±21	t-test -2.4, df 198, sig 0.019 2-tailed	**Yes**
IES-R	23±20	28±22	t-test 1.411, df 142, sig 0.16 2 tailed	
BDI	10±11	11±10	t-test 0.691, df 141, sig 0.491 2 tailed	

The prevalence of ASD was also significantly higher for women than men. Gender differences in ASD are documented in literature, but this area is less intensively investigated than PTSD, where the increased risk for women has been frequently observed (Kessler and McLeod, ; Breslau, Davis, Andreski, Peterson and Schultz, 1997; Fullerton, Ursano *et al.*, 2001; Bryant and Harvey, 2003). However, in this study, whilst women had higher rates of PTSD and depression, the differences were not significant.

Whilst the prevalence of PTSD and depression were similar for men and women, this did not infer that the causal and risk pathways for the emergence of these disorders, were identical. This was evident when pre, peri and post-crash risk factors associated with PTS disorders were analysed by gender. The factors associated with each disorder, despite having some areas of commonality, also had gender specific features. For men and women, feeling terrified and unreal around the crash, was associated with ASD symptoms (based on the strongest models), which were consistent with the diagnostic criteria (American Psychiatric Association, 1994). For men, being a smoker and having a higher perception of injury severity were also related to the disorder. Although smoking can be viewed as a coping strategy and nicotine dependence is elevated amongst individuals with mental health problems, including PTSD (Shalev, Bleich and Ursano, ; Leonard, Adler, Benhammou, Berger, Breese *et al.*, 2001), within this study the risk was associated with being a smoker before the crash. Since there may be underlying biological mechanisms for nicotine addiction, it has also been previously recognised as a risk factor for the development of PTSD (Morrisette, Tull *et al.*, 2007).

Although the majority of injuries sustained by the participants were considered minor in terms of life-threat, the whole group tended to rate their injury severity more highly. However, believing the injury to be severe was associated with the development of ASD. This could have arisen from a true difference in the injuries sustained by men, since men are typically involved in more severe crashes (Department for Transport, 2008). However, from review of the LOS data and treatment records this was unlikely to be the case (Study A). Therefore, the risk may represent a subjective appraisal that can be distorted by mood, pain or anxiety and, therefore, may be amenable to change through intervention. Further investigation would be necessary to explore the differences between casualties' perceptions of their injuries and more objective measurements of severity, such as the Abbreviated Injury Scale (Greenspan, McLellan *et al.*, 1985).

When exploring the gender differences for PTSD, whilst feeling unreal featured in both male and female models, dissociation was the strongest feature for men, which again links to the diagnostic criteria (American Psychiatric Association, 1994), whereas, terror, social support satisfaction and injury severity were linked to PTSD in women. Terror, fitted with the diagnostic criteria for PTSD and the influence of injury severity in women may arise through similar processes to those discussed for men and ASD hence requiring further elucidation. Poor social support has been associated with poor recovery from a range of mental and physical health problems, including PTSD (Tarrier and Humphreys, 2003) and here women appeared to be particularly affected by low satisfaction with support.

Depression was associated with support satisfaction for both men and women and, additionally, poor tangible support, was also related to mood problems amongst women. Consideration, therefore, needs to be given to strategies to increase individuals' satisfaction with support after a RTC and for women to ensure that they have access to appropriate practical assistance in their early recovery. The most significant risk factor for depression was ASD at one week for both genders. This reinforced the importance of identifying individuals experiencing acute distress at one week, with the aim of intervening to reduce the risk of subsequent depression or PTSD.

The primary purpose for developing gender differentiated models for PTS disorders was to determine, whether they would offer better predictive validity than the undifferentiated ones already tested.

However, it appeared that the gender models were not quantitatively better than the generic models and from a parsimonious stance, the use of gender specific models was not justifiable, particularly, since they still did not permit the screening for PTS disorders whilst casualties attended A&E.

A secondary purpose was to inform the process of clinical assessment and development of more personalised services. This study has emphasised some of the differences between men and women, in response to an everyday trauma and, particularly, the impact that lack of practical support for women may have. The study has also identified that, congruent with ASD, fear and dissociation in the early aftermath of a crash, were strongly associated with subsequent development of PTSD. From the study results, it would be advisable for clinicians seeing RTC casualties in the week after a crash, to enquire about dissociation (unreality), terror, perception of injury severity and satisfaction with social support, since these concerns were associated with the development of PTS disorders in this sample, irrespective of the gender differences. Given the significant relationship between social support and depression identified, the use of the MOS to assess the availability of different types of support, may also be worthwhile, to include in a follow-up assessment particularly for women. The results demonstrated some gender differences and commonalities in risk factors for PTS disorders. Although a gender difference in ASD emerged, no differences in the prevalence of PTSD and depression were identified.

However, limitations arise in the interpretation of the results from this study, on account of the gender differences in this sample, compared to the annual population and the response rate. Furthermore, when gender differences were explored, the size of the two samples falls under the number recommended by O'Donnell et al (O'Donnell, Creamer *et al.*, 2003). To explore these identified gender differences in more detail necessitates a larger sample size, if the results are to be generalised to the target population of RTC casualties. Individual investigation was also essential to investigate in more detail how social support and PTS disorders interact, in order to explore the possibilities for improving recovery through the enhancement of social support.

PlaTO Implications

This study has demonstrated the importance of social support satisfaction for both men and women, in the month after a crash.

It has also highlighted different support elements that are gender specific. Therefore, development of the PlaTO design must incorporate social support from a gendered perspective, within its operational remit. A gendered investigation of risk factors did not promote a qualitatively better risk assessment than the more parsimonious generic models reported in Study B.

Study B Discussion

The overall purpose of Study B was to establish a more detailed understanding of the psychological and functional impact of a RTC, to evaluate whether a Targeting process within the proposed PlaTO model, was necessary or feasible. To achieve this purpose a series of four inter-linked studies were undertaken (Figure 27). The study was informed by the analysis of data collected from two questionnaires, completed by participants one week and one month after a RTC.

Prevalence of PTS disorders

Exploration of electronic hospital records from three Northwest hospitals and a consecutive series of individual casualty records, demonstrated that psychological distress or arousal after a RTC was rarely documented. Since the diagnostic criteria for ASD and PTSD specified that a response of fear, helplessness or horror, should occur following the traumatic event (American Psychiatric Association, 1994), it was postulated that PTS disorders were rare after a RTC. However, when ASD was assessed amongst the participants, 40% were “at risk” of developing PTSD. The prevalence of ASD amongst RTC casualties has predominantly focused on individuals with severe injuries who have been hospitalised (Harvey and Bryant, 1999; Creamer, O'Donnell *et al.*, 2004; Hamanaka, Asukai *et al.*, 2006) and these populations appeared to report lower prevalence than A&E RTC samples (Harvey and Bryant, 1999; Harvey and Bryant, 1999; Holeva, Tarrier *et al.*, 2001) where the prevalence ranged from 20-34%, when sub-syndromal ASD was included. This study included a population with predominantly minor injuries (92%). However, the number of participants that experienced symptoms of acute distress was considerable and, for Hospital A, equated to1558 casualties per annum (based on 2003 data). The scale of this problem contrasted starkly with the assessment information in the casualties’ A&E records.

The prevalence of PTSD was assessed after a month. Above case-level symptoms were identified for 31% of participants and was comparable with previous studies of RTC casualties (O'Donnell, Creamer *et al.*, 2008) equating to 966 casualties per annum who could develop PTSD. Low mood was reported by 41% of participants, making it far more widespread than PTSD and 19% had moderate-severe depression. High levels of comorbidity between PTSD and depression have previously been reported (Blanchard, Buckley *et al.*, 1998; O'Donnell, Creamer *et al.*, 2004) and similar patterns were identified in Study B. Whilst comorbidity between depression and PTSD appeared to be the norm, consistent with previous studies (Brady, Killeen *et al.*, 2000), evidence also exists that, depression alone, develops after a trauma (O'Donnell, Creamer *et al.*, 2004).

In this study 15% of participants developed depression in the absence of PTSD. Further investigation is required to establish whether this sub-group of trauma survivors respond better to recommended interventions for depression or PTSD. Whilst gender differences in trauma responses have been well documented (Norris, Foster *et al.*, 2002) in this study, only ASD was reported more frequently by women. However, Dawkins reported that the gender distribution for PTSD was more equal than for other anxiety disorders (Dawkins, 1995). Since more men attended A&E in the hospitals studied, the similar prevalence across genders potentially increased the overall proportion of the RTC population at risk of PTS disorders. Study B, in identifying the high prevalence of PTS disorders within this RTC sample, demonstrated the scale of casualties placed at risk of longer term distress and dysfunction after a crash.

Risk Factors

With a view to screening individuals attending A&E for subsequent risk of PTS disorders, a detailed analysis of risk factors was undertaken. The screening questionnaire contained a series of questions developed from previously reported risk factors, with the aim of developing a screening tool for A&E. Overall peri and post-crash risk factors were better predictors than pre-crash ones. Although multiple predictive models were tested for each disorder, none of them had sufficient predictive validity to enable casualties to be screened, whilst attending A&E. The strongest model for ASD predicted 42% of the variance and involved both pre and peri-crash factors. Feeling unreal and being terrified around the time of the crash were the strongest predictive factors, consistent with the diagnostic features for ASD (American Psychiatric Association, 1994).

These two factors also featured strongly in the male and female differentiated ASD models. The generic ASD model also highlighted the risks associated with being a smoker and the protective benefits of prior physical health problems. Nicotine dependence has been previously recognised as both a consequence and a risk factor for PTSD and, although the causal mechanisms are unclear, underlying neuro-physiological factors are thought to play a role (Morrisette, Tull *et al.*, 2007). Smoking was also associated with PTSD, but not with depression, suggesting the risk was confined to anxiety and not mood disorders. The pathway by which previous health problems were associated with less risk of ASD was unclear and requires further investigation of the mechanisms that buffered the effects of a RTC.

For PTS screening to be ethical, it must be able to robustly identify those who will develop PTS responses from those that will not (UK National Screening Committee, 2008). The ASD model relied on factors that could be assessed whilst casualties attended A&E but the model did not fulfil the requisite criteria for a screening tool, according to Wilson's criteria (UK National Screening Committee, 2008) since less than half the variance in ASD was accounted for by the model.

The generic model for PTSD was the strongest of the predictive models and accounted for 65% of the variance and included the ASDS and PDEQ scores, together with the subjective rating of social support satisfaction. A diagnosis of ASD has been strongly linked to the development of PTSD (Harvey and Bryant, 1998; Holeva, Tarrier *et al.*, 2001) and the diagnosis of ASD was controversially conceptualised to predict subsequent PTSD (Bryant and Harvey, 1997), so it was unsurprising that it featured in the model. Since dissociation also forms part of the diagnostic criteria for PTSD (American Psychiatric Association, 1994), the inclusion of the PDEQ was also anticipated. Satisfaction with social support was the third element in the PTSD model and highlighted the impact of the post-crash social environment on recovery. Within the gender differentiated models, low social support satisfaction was associated with female PTSD, together with perceived injury severity, being terrified and feeling unreal, whereas in men only being terrified (fear) and feeling unreal (dissociation) were related. The results of this analysis emphasised the association between extreme fear and dissociation that form the core concept of PTSD. However, amongst women, two peri-crash factors, unrelated to the diagnosis were also associated with PTSD.

Poor social support and low satisfaction featured within the generic model for depression, together with ASDS and previous mental health problems. This model differed from the anxiety disorders, since dissociation and terror did not feature directly, consistent with the diagnostic profile of depression. When explored from a gendered perspective, depression risk factors differed in the importance of tangible support for women, whereas satisfaction was linked to both genders. Social support has been reported to influence health and well being of both men and women. In a study of older people (50+), for women, the quality of support related to their appraisal of the amount received, whereas, for men, quantity did not affect their perception of quality (Antonucci and Akiyama, 1987), suggesting that women are more vulnerable to a reduction in the size of the social network.

Depression and PTSD, particularly when present comorbidly, can place a strain on inter-personal relationships and reduce the available support (Beck, Grant *et al.*, 2009). These results emphasise the importance of early acute stress symptoms and poor social support to the development of both PTSD and depression. The results reinforce the need for early assessment of social support, to prevent undue strain on relationships. This could be achieved through early identification and treatment of disorders, together with the provisions of external support to buffer close relationships from the strain of such pathology.

Healthcare Use

Study A had identified that few RTC casualties received any formal follow-up once discharged from A&E. Given that 66% of the participants had above case-level symptoms for at least one psychological problem, an exploration of their healthcare attendance was undertaken to determine the services accessed after discharge from hospital. This revealed that, despite the lack of formal arrangements, on average the participants usually had one attendance with a healthcare professional and that doctors and physiotherapists were the most frequently seen. Although the participants with psychological problems had slightly more healthcare appointments, only two participants received any overt psychological support. The prescribing of analgesic medication and physiotherapy was the most common treatment received. Poor physical health has been associated previously with PTSD (Friedman and Schnurr, 1995; Barrett, Doebbeling, Schwartz, Voelker, Falter *et al.*, 2002) and increased use of healthcare services by veterans with PTSD and depression (Deykin, Keane, Kaloupek, Fincke, Rothendler *et al.*, 2001), has been recognised.

These results for a sample of participants demonstrated elevated healthcare attendance and illustrated how the cumulative impact of RTCs, can result in societal implications. Although many participants received healthcare in the month after a crash, it appeared the focus was on pain relief and physical injuries, despite 50% of casualties having ASD. However, investigation of individual cases was necessary to determine whether participants received appropriate support and assessment of their psychological problems during their healthcare appointments.

PlaTO

Study B involved the collection of data to inform the development of the PlaTO model. Study A indicated that fewer than 37 out of the 10,676 casualty notes examined had signs of "distress" documented. However, the lack of acute distress in this population contradicted a similar study undertaken in a Northwest A&E department (Holeva, Tarrier *et al.*, 2001) and the results obtained for Study B in which 50% had ASD and subsequently 31% developed PTSD and 41% low mood. Although a proportion of these problems may resolve themselves, Koren, Arnon and Klein (2001) found that PTSD persisted at 3 years, in over half those diagnosed at one year, suggesting spontaneous remission rates were low. Therefore, Study B justified the need to develop a strategic approach to minimising the psychological consequences of RTCs on the ground of the scale of crash casualties, the proportion reporting acute pathology and the risk that PTS disorders would persist in a high percentage of individuals, if left untreated.

In view of the potential volume of casualties attending any A&E department annually, the challenge of discerning those at high and low risk of PTS disorders was considerable. Brewin (2005) had similarly commented on the screening challenges, due to the numbers involved, geographic dispersion, the need for involvement of clinical teams, the difficulty of follow-up and lack of availability of psychological trauma services after major traumatic events. Although the timescales may differ, the same obstacles apply to everyday disasters, such as RTC. Investigation of potential screening questions for completion whilst casualties attended A&E, led to the establishment of predictive risk models for PTS disorders. However, it was concluded that the pre and peri-crash factors investigated through the generic and gender specific models, did not permit suitable levels of discrimination between the high and low risk groups.

Consequently, A&E screening must be cautioned against, using these risk factors. Since ASD at a week was the strongest predictor of both PTSD and depression, post-discharge assessment was recommended. A follow-up assessment after a week would offer casualties the additional opportunity to receive further advice and support. From the results of Study B, it is highly recommended that all casualties are assessed after a week for ASD, satisfaction with support, support availability (MOS) and dissociative experiences (PDEQ), because these emerged as significantly associated with PTSD and depression at one month. Conducting such an assessment, a week post-crash, may enable casualties to be categorised into three potential risk groups (A-C), enabling resources to be targeted most effectively (Figure 101), through the adoption of a stepped-care approach (Bower and Gilbody, 2005).

Group A: Individuals with very high ASDS scores who were at high risk of further psychological problems and require intensive social support and possibly immediate treatment.

Group B: Individuals with ASD symptoms and risk factors for PTSD and depression who would be offered advice, interventions to enhance social support and reassessment after a month to establish whether early TF-CBT was necessary.

Group C: Individuals with below case-level ASD and low risk for PTS disorders, who would be offered advice and reassessment after a month.

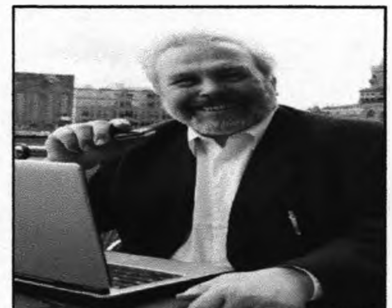
Such a strategy would entail a single assessment for every casualty after discharge. The use of a stratified system would enable targeting of early support and intervention towards casualties with greater psychological needs, whilst minimising additional disruption for those at low risk of subsequent disorder.

Thus, the PlaTO model would be able to fulfil the recommendations for the management of PTSD after a major disaster (NICE, 2005), in terms of screening and, furthermore, identify people at risk of developing depression in the absence of PTSD. The model would also provide "watchful waiting" through a follow-up assessment, undertaken after a month, recommended for the treatment of depression (NICE, 2007).

Figure 101: One week Assessment Process

Assessment Content

- ASDS
- PDEQ
- MOS
- Satisfaction with social support rating



Outcome Group A:

- Severe ASD
- Many risk factors for PTSD & depression

Intervention:

- Support & advice,
- Repeated monitoring
- Early TF-CBT if required

Outcome Group B:

- ASD
- Risk factors for PTSD and Depression

Intervention:

- Social Support / Advice
- Reassess again at 1 month
- TF-CBT if required

Outcome Group C:

- No ASD
- Few risks PTSD and depression
- Good support

Intervention:

- Reassess at 1 month
- Advice / self-monitoring
- Discharge after monitoring

The need for such a screening service was also justified through the investigation of casualties' healthcare attendances. Although many casualties had contact with healthcare, there was little evidence of those with ASD being identified, which was consistent with previous investigations into the ability of clinicians to recognise PTSD (Liebschultz, Saltz *et al.*, 2007). It appeared that, without specialist screening, timely recognition of a casualty's psychological problems may not occur and consequently, hinder access to early intervention. Gender differences were highlighted, both in the importance and differences in social support needs between men and women. Thus, within the PlaTO model, social support assessment of casualties must additionally adopt a gendered perspective.

Further Research

To understand the support needs following a RTC, required investigation at an individual level to test the feasibility and effectiveness of integrating a social support element into the previously recommended brief early TF-CBT (NICE, 2005). It was also essential to understand whether the healthcare appointments reported, did incorporate any psychological assessment and advice to ensure that a specialist service was justified. This study has explored the impact of a RTC for a large sample of casualties and determined some of the psychological and functional consequences that occurred following a crash. However, such a study did not illuminate the individual aspects of a traumatic crash and how such idiosyncratic elements may influence the subsequent pathology. For PlaTO to fulfil the needs of RTC casualties, it must also incorporate strategies to enhance the availability of social support during early recovery and intervention.

Limitations

Whilst the results from this study were obtained from a large sample of consecutive casualties, the participation rate was low, although consistent with previous A&E studies in the hospital. However, the response rate was good (72%) for Time 2, suggesting that few participants with PTS reactions avoided completing the second questionnaire. Although it may be desirable to attain high response rates to reduce participant bias, Asch, Jedrziewski, Christakis (1997) have argued that there was not necessarily a relationship between response rate and bias and it is more important to identify in which way participants differ from the original population. In this study, the participants were found to be slightly older with more women and drivers than the annual population.

Other characteristics indicative of crash and injury severity were congruent with the Hospital A crash population. These similarities and differences need to be taken into account when appraising the results. Whilst the overt differences have been presented, covert differences such as participation being influenced by personality traits (Waite, Claffey *et al.*, 1988) or low mood, cannot be estimated (Stroebe and Stroebe, 1989). However, the results were strengthened by the large sample size, good response rate at Time 2 and early recruitment of participants before chronic PTS disorders emerged. The study was also limited by the use of self-report questionnaires to assess prevalence rates of PTS disorders. However, the tools selected had good overall psychometric properties and were designed for self-report. Whilst diagnostic interviews could increase the validity of the reported prevalence rates they may have introduced a different bias towards casualties able to return to hospital and the resource implications of interviews, would have limited the overall sample size.

Given the recognised limitations in the quality of this study, it is important that the research is replicated in different regional hospitals, using larger sample sizes, before the results can be generalised to the target UK population.

This chapter has presented the results from Study B, providing a detailed exploration of the impact of a RTC on a sample of participant casualties. The extent of their psychological and functional problems, together with risk factors for subsequent PTS disorders in their pre, peri and post-crash experience have been investigated. This evaluation has concluded that the risk factors investigated did not provide sufficiently robust models for routine clinical use.

CHAPTER 9

Study C: Individual Case Investigation, Method and Results

This chapter will describe the process undertaken to conduct a single case study to understand the impact of a RTC for an exemplar participant, the response of existing healthcare services, the predictive value of risk factor models and to examine the feasibility of a novel intervention to minimise the psychological consequences of a RTC.

Study C (Ordnance Issues)

Study C Purpose

The primary purpose of the study was to investigate the impact of a RTC for an individual with PTS disorder, the individual's risk factors for PTS disorders and the response of the healthcare service in order to present an exemplar case study that illustrated some of the typical consequences of involvement in an everyday road crash. The secondary purpose was to evaluate the delivery and merit of incorporating social support into brief TF-CBT (TF-CBT^{SS}), through a process of disciplined enquiry (Peterson, 1991).

Study C Background

Study C involved a series of four linked research questions or hypotheses (C1-C4) to achieve the study purpose.

C1) Question: What was the impact of a RTC for a casualty who developed PTS disorder?

C2) Question: What healthcare did a casualty with a PTS disorder receive after discharge from A&E?

C3) Question: Were the predictive risk models from Study B consistent with risks reported by a casualty with a PTS disorder?

C4) Null Hypothesis: A brief TF-CBT^{SS} intervention was not effective in reducing symptoms of PTS disorders

Study C Design Considerations

The study was undertaken to inform a diverse audience about the impact of a RTC and to test a novel intervention to inform the Ordnance tier of the proposed PlaTO model. To achieve this dual purpose an exemplar case study was chosen to offer sufficient descriptive detail to inform diverse audiences and to enable the process of intervention to be examined closely. Experimental research designs usually involve collating data for groups, so poorly elucidate the mechanisms of therapy (Sim and Wright 2000). Another advantage of a case-study important within this study is the possibility to explore the process of therapy and describe the study in sufficient detail to permit replication. Such transparency also serves to illuminate threats to the validity of the study, through inherent uncontrolled extraneous factors (Lloyd-Jones, 2003) or unexplored alternative hypotheses.

The design of Study C was informed by Peterson's process of inquiry, (Peterson, 1991) (Figure 103) and systematic single instance case-research study (Sim and Wright, 2000). The study thus combined a systematic descriptive case-study with an N=1 time-series feasibility study (Turpin, 2001). Case research, such as this, uses a quasi-experimental design in which the impact of an intervention variable is tested on outcome variables through a process of repeated measurement (Sim and Wright, 2000). Whereas the quality of RCTs lies within the randomisation and the control comparator group (Greenhalgh, 2006), Turpin (2001) claimed the quality of a quantitative case-study rested upon fulfilling several criteria which can control extraneous variables (Lloyd-Jones, 2003). Turpin suggested a stable-baseline, repeated measurements, a single well-described intervention, reversibility and the potential to generalise the outcomes to the wider population and clinical settings were desirable.

In reality, some of these criteria may not be achievable or desirable within case-study research, because the needs of the client take precedence over the development of scientific knowledge (Peterson, 1991). Since many therapeutic interventions aim to bring lasting change in clients, neither would be theoretically predicted, nor desirable, for such changes to be reversed on withdrawal or termination of the intervention. Although desirable, a stable baseline may be hard to achieve, particularly when delivering early interventions and in the case of PTS disorders, where diagnostic criteria changes after a month.

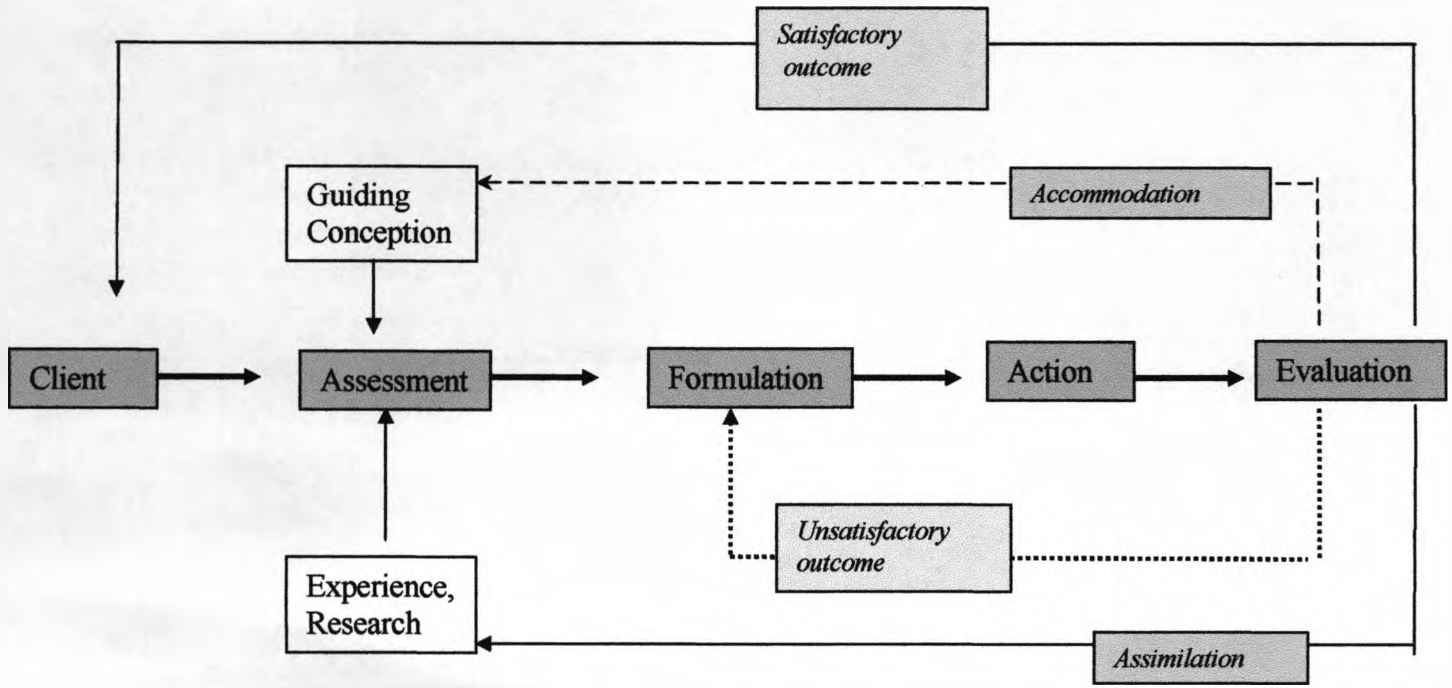
Repeated measurements, whilst necessary to demonstrate change, place a burden upon participants and may impede compliance or exert a confounding effect on the intervention, as their completion is not a neutral process (Turpin, 2001) and, therefore, distorting the results obtained. In this study, the experimental variable consisted of four sessions of TF-CBT^{SS} consistent with the number of sessions recommended by NICE (NICE, 2005) within a modified ABA design (Jones, 2005). Since it was neither predicted, nor ethically desirable, that the impact of TF-CBT (B) would be reversed on completion of the intervention, the second baseline period (A) referred to a follow-up assessment period, rather than the conventional reversal phase advocated for single-case experiments (Turpin, 2001).

So that the outcomes have relevance to the wider audience, participants within case studies should be representative of the target population in key features and the intervention delivered within an ecologically valid setting that mirrored routine practice, which inherently expose a study to the risk of uncontrolled variables.

As the primary purpose of this study was to demonstrate the impact of a crash upon an individual exemplar casualty, in order to obtain and report the necessary depth of description and level of transparency, a single-case study was indicated rather than a case series. Whilst a case-series may have increased the validity of the outcomes of intervention, testing of the intervention was not the primary purpose of the study.

The single-case methodology used to investigate the merit of the therapy delivered was consistent with the Boulder Model (Scientist- Practitioner Model), in which clinicians undertake the idiosyncratic delivery of interventions with the rigor of a scientist (Stricker and Trierweiler, 1995), in order to improve the delivery and outcomes of therapy in everyday practice. The integration of social support within TF-CBT was through a "case-formulation" approach to permit responsiveness to the individual's support strengths and deficits (Tarrier and Humphreys, 2003). Within CBT therapists use "case-formulation" to integrate disorder specific knowledge with individual client characteristics, (Kuyken, Padesky and Dudley, 2008) to guide intervention. Peterson (1991) also promoted the use of "case-formulation" within clinical practice (Figure 102) to ensure disciplined clinical enquiry within case-studies. Peterson's model was used to guide the design, method and reporting of Study C.

Figure 102: Professional Activity as Disciplined Inquiry (Peterson 1991)



To ensure the study had wider relevance than the individual participant, it was essential that they shared key features with the RTC population and, that intervention was delivered within a naturalistic setting. Selection criteria were established from the key outcomes of Study A and B. An independent blinded researcher selected the exemplar from participants that met the selection criteria.

Consent for participation in Study C was obtained after completion of Study B, at a time when the casualties had developed PTS disorders. Whilst all participants that met the selection criteria were eligible for Study C, only a single exemplar was selected. For ethical reasons all casualties willing to participate with identified PTS disorders were offered further monitoring, intervention and referral to appropriate therapeutic services. The detail contained within a case-study presentation demanded careful adherence to confidentiality. Additional measures were implemented to protect the anonymity of the participant. Non-essential information was omitted and some information was deliberately obscured within the results, to protect the identity of the participant. Ethical approval was granted for the research study by the LREC (Appendix 9).

Method

The case-study was undertaken following a procedural pathway derived from Peterson's model (Figure 103) preceded by a recruitment process.

Recruitment

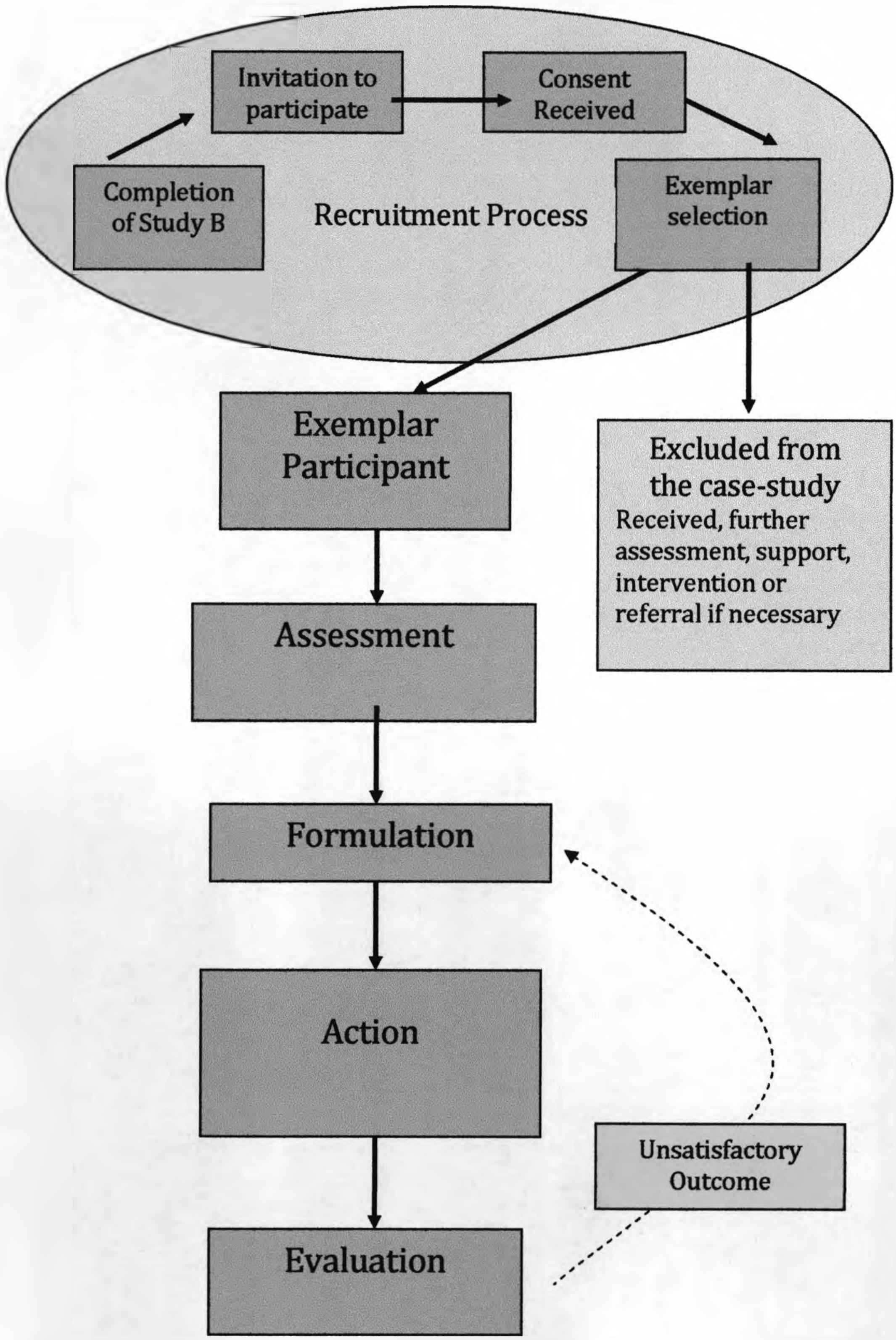
On completion of Study B, participants were sent a research pack for Study C and asked to return the consent forms if they wished to participate. On receipt of the consent details, the necessary information was retrieved from their hospital records and Study B questionnaires to determine whether they fulfilled the inclusion criteria (Table 28). The selection criteria were developed to ensure that the participant was broadly representative of the RTC population in key features. The criteria were informed by the profile of casualties discerned through Studies A and B. Gender was not included, as, although there was a male predominance in the Northwest sample, the sub-sample was the reverse. Casualties willing to participate were checked against the inclusion criteria. An independent researcher, blind to the participant details apart from their code number, selected the exemplar participant, who fulfilled the inclusion criteria, from the casualties willing to participate.

Individuals who wished to participate, but were not selected, were offered an assessment appointment, support and referral to services, if required. The exemplar participant was invited to attend an assessment interview the following week.

Table 28: Case-study Inclusion Criteria

Initial Inclusion Factors	**Criteria**	**Justification**
Age	18- 49 years	72% in Study A fell into this age range
Role in Crash	Driver	In Study A most frequent attendee category
RTC Severity	Minor	In Study A most frequent attendee category
Injury Severity	Minor (triage category green-blue)	In Study A most frequent categories. Indicated non-serious injury eg muscle sprains, WAD
Hospital treatment	None/Advice	In Study A and B most frequently reported interventions
Length of stay	< 1 day	In Study A and B mean LOS <1day
GP Appointments	Attended in month after crash	In Study B 55% reported seeing GP
Medical treatment after discharge	Prescribed Analgesia/ Physiotherapy	In Study B the most frequently reported interventions
Additional PTS disorder criteria		
Mood	Score of $\geq$10 on BDI	In Study B 41% had low mood
Posttraumatic Stress Disorder	Score of $\geq$ 33 on IES-R	In Study B 31% had PTSD

Figure 103: Study C following Peterson's Model (Peterson 1991)



Assessment

Chronologically diverse information was available from multiple sources (Figure 104) for the exemplar participant. Extant information was obtained from the participant's casualty notes and electronic hospital records. The Screening and One Month questionnaires had been completed by the participant during Study B. During Study C, the participant attended a structured interview, for an assessment of their past history, contextual information about the crash and details of current problems. Pain and driving anxiety were rated, during the assessment and each therapy session, using a 0-10 scale. During the assessment and therapy sessions, the participant rated their distress when reliving the crash using a 0-10 Subjective Unit of Disturbance scale (SUD) (Wolpe, 1991). This was then used to measure distress to be in connection with "hotspots" in the crash memory. The participant completed follow-up questionnaires at 12 and 26-weeks post-crash, to assess PTSD, depression, general psychiatric disorder and function. Further information about the crash emerged during the therapy sessions. Therapist observations were noted throughout the intervention process.

Action

Assessment and therapy took place in a room adjacent to the A&E department. The location provided a realistic clinical setting, with many of the issues and constraints associated with a hospital environment. The experimental variable consisted of an assessment session and four weekly 90 minute TF-CBT^{SS} sessions, following a structured format (Figure 105). Within the assessment session, the factory model of PTSD provided a rationale for trauma symptoms (Lovell and Richards, 1997). This model and behavioural experiments were used to collaboratively develop a case formulation that led to therapy goals and guided the intervention.

Evaluation

The progress and outcomes of therapy were evaluated using pre-post intervention testing and weekly in-session rating scales, to avoid over burdening the participant, whilst obtaining repeated measurements of change during the process of therapy. It also aimed to avoid distorted responses from repetitive use of the main questionnaires, which constituted the primary study outcomes. Weekly re-evaluation was undertaken, to permit a flexible response to the needs of the individual and address issues that emerged.

Figure 104: Sources of Case-Study Information Timeline

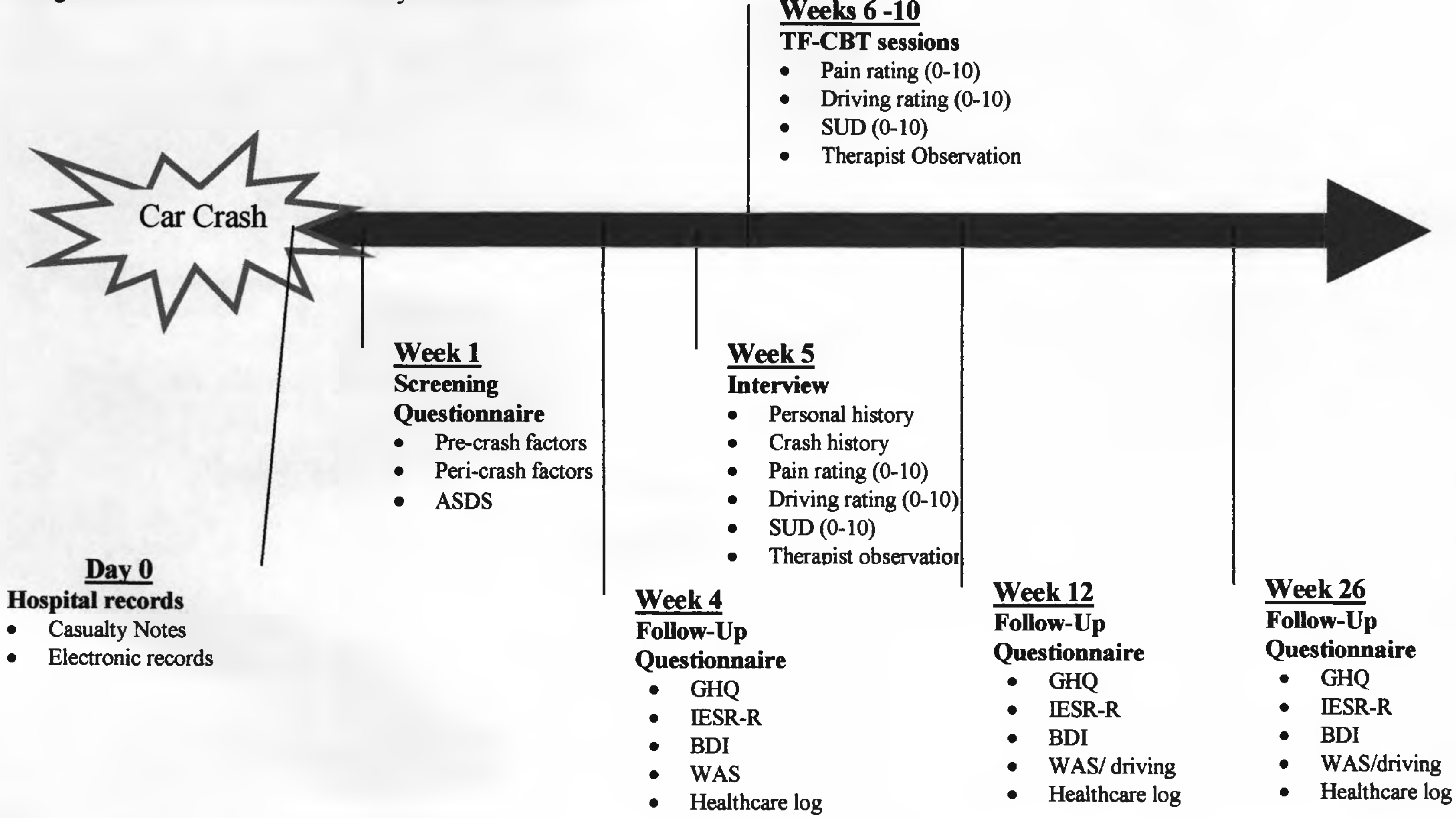
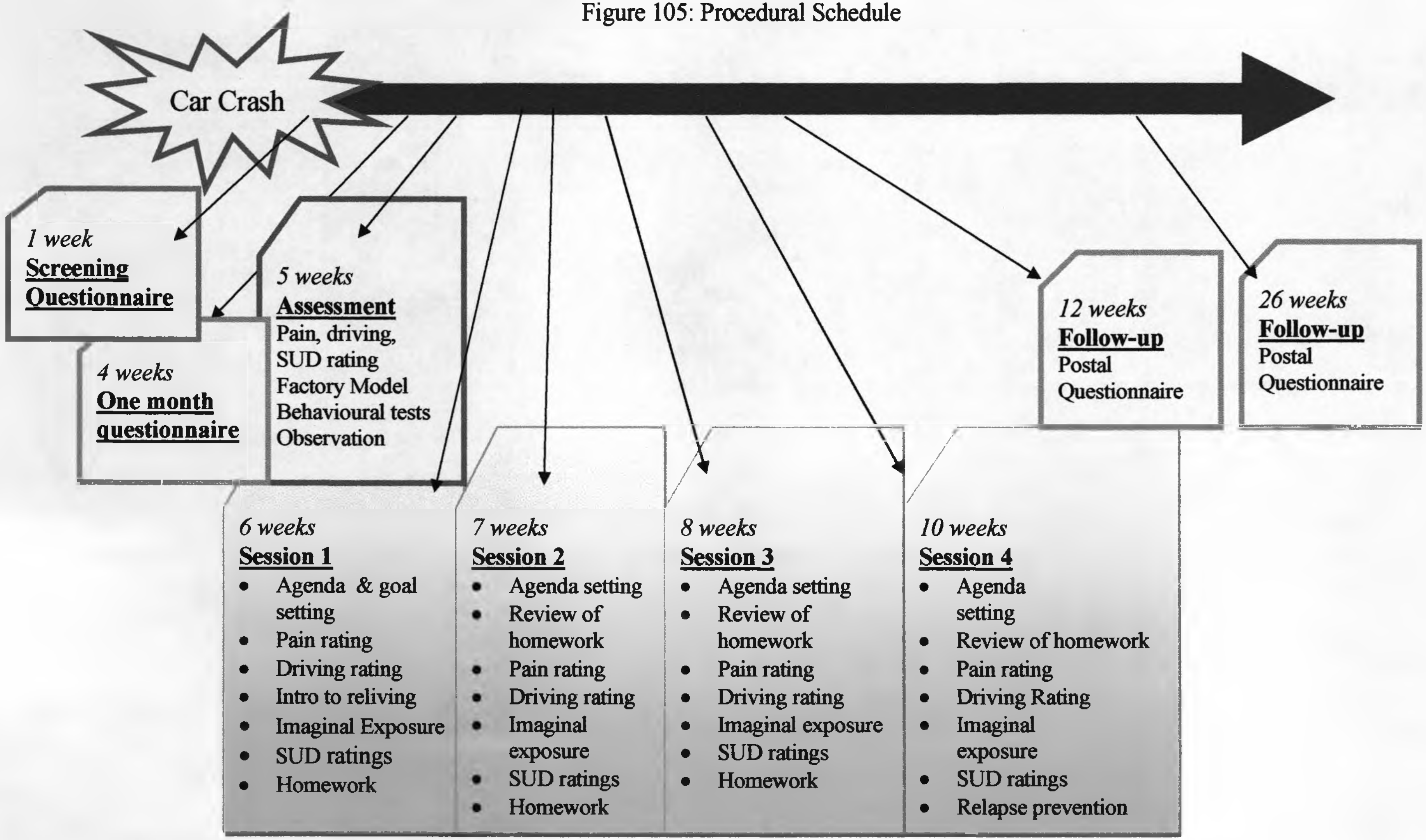


Figure 105: Procedural Schedule



Study C Results

Study C consisted of a series of five research questions or hypotheses (C1-C5) to achieve the study purpose.

Participation

A total of 32 eligible participants consented to involvement in Study C. 9 scored ≥ 33 on the IES-R and 13 scored ≥ 10 on the BDI, with 13 participants (40%) having case-level scores across both these measures. 3 participants met all the criteria and a single participant, Susan[7], was selected by an independent researcher, as the exemplar (Table 29).

Crash Context

Susan was involved in a minor crash and sustained non-serious physical injuries, warranting no specific intervention from A&E. Non-essential personal details have been obscured to promote anonymity.

Table 29: Case-study criteria for Susan

Initial Inclusion Factors	**Required Criteria**	**Achieved Criteria**
Age	18-49 years	Early 20s
Role in Crash	Driver	Driver, alone in car
RTC Severity	Minor	Low speed passenger side impact
Injury Severity	Minor (triage category green-blue)	Green
Hospital treatment	Advice	Advice documented in A&E
Length of stay	< 1 day	1-2 hours
GP Appointments	Attended in month after crash	6 attendances in one month
Treatment after discharge	Prescribed Analgesia	Prescribed diclofenac
Additional Criteria /eligibility for intervention		
Depression	Score of ≥ 10 on BDI	22
Posttraumatic Stress Disorder	Score of ≥ 33 on IES-R	44

[7] This is a pseudonym

Whilst on the way to a friend's house she was involved in a low speed side-impact collision, resulting in damage to her car. She attended A&E for minor physical injuries on the day of the crash.

Study C1) Question: What was the impact of a RTC for a casualty who developed PTS disorder?

This question was explored through a comparison of Susan's life, pre and post-crash and her peri-crash experience. Information was obtained from her initial assessment, Study B questionnaires, casualty records, therapeutic reliving of the crash and therapist observation.

Pre-Crash Life

Susan's pre-crash life (Figure 106) revealed that she was a young woman in full-time employment. She lived in the family home with major domestic responsibilities and took care of her mother, who had severe and enduring mental health and literacy problems. Her mother regularly attended a day centre. Susan's father had died from a chronic illness less than a year ago. She reported coping well with this bereavement. She had limited family support since her father's death and her brother now mostly worked away from home. Although she had a group of friends, her social network was based upon socialising. She appeared to lack reciprocal supportive relationships, particularly since her father's death.

Susan enjoyed driving and considered herself to be a safe driver, using her car daily to travel to work, socialise and transport her mother. She functioned independently in all aspects of her daily life. Prior to the crash she was in good physical health and took no medication. She never smoked and reported drinking 8-10 units socially with friends at the weekend. Before her crash, she had enjoyed her work, driving and social life and managing to cope with her considerable financial and practical responsibilities, towards her mother and with her father's relatively recent death.

Figure 106: Susan[8] Pre-crash

	Susan's Pre-crash lifestyle
Age	Early 20s
Home situation	Lived in small terraced family home with mother. Her brother mostly worked away
Occupation	Enjoyed a full-time administrative job
Function	Independent in all aspects of function Full-time carer for her mother Managed all household tasks and finances
Driving	Driving for 3 years. A "good driver". Drove 20 miles to work daily and socially
Physical Health	No health problems
Medication	None
Psychological Health	No previous problems
Alcohol use	She drank socially, usually at weekends ~8-10 units
Smoking	Non-smoker
Family mental health problems	Mother had long-standing severe mental health problems. Mother did not read or write
Family life	Susan did not get on with her mother but had to care for her financially and practically
Social life	Enjoyed socialising with friends and colleagues but limited to weekends due to other commitments. No current partner.
Social Support	Susan valued her brother's advice and support. Enjoyed social life with friends. Difficult to ask for help and looked after friends needs more than her own.
Previous trauma history	Her father died <1 year ago. Reported undisclosed prior trauma[9]

[8] Susan is a pseudonym used for reasons of confidentiality. Some specific details about Susan have been deliberately omitted or altered to maximise her anonymity, whilst preserving the relevant demographic and clinical information.

[9] This information was provided retrospectively, one-week post crash, via the completed Screening Information Sheet.

Post-Crash Life

In the month after the crash, Susan claimed and was awarded damages for her car from the other driver's insurance. She decided not to pursue compensation for her injuries to avoid delaying the settlement. By the time of her assessment, Susan had returned to work due to worries about her job and money. Numerous changes in her pre and post-crash life were reported (Figure 107), which she attributed directly to the crash. Susan had lost pleasure in all her previous interests, work and particularly driving, which she now avoided, if possible, due to anxiety and panic attacks. In order to travel to work, she had altered her route to avoid anxiety triggers. Functioning at home and work were difficult (Table 30), due to neck, head and shoulder pain (WAD), despite receiving a course of physiotherapy and regular medication.

Table 30: Work and Social Adjustment Scale (one month follow-up)

	Activity	Rating (0-8)
1	Work (if you are not employed, rate it imagining how your work would be affected)	6
2	Manage my home	7
3	Socialise with other people	7
4	Enjoy doing things alone	7
5	Form and maintain close relationships with other people (including the people you live with)	5
6	Other? Please specify --	None provided
7	Other? Please specify --	None provided

Her account of pain and reduced function was consistent with her presentation at assessment. She sat in a guarded "brace" position, her shoulders hunched and with difficulty sitting comfortably. Her pain and difficulty sleeping led to her drinking 5-10 vodka shots per day, in addition to taking analgesia.

Susan reported symptoms consistent, initially with ASD, then later PTSD and depression (Table 31) together with her accounts of panic attacks when driving. She scored the maximum score on the GHQ, indicative of severe psychiatric disorder.

Figure 107: Susan Post-crash

	Susan's Post-crash lifestyle
Age	No Change
Home Situation	Lived in small terraced family home with mother. Her brother mostly worked away
Occupation*	4 weeks off work, Loss of enjoyment due to pain
Function*(see WAS)	Unable or difficult to function in work or household tasks. Required assistance from friends or brother with shopping Financial worries Difficult providing practical care for her mother
Driving*	Driving to work, avoided minor/residential roads, increasing her journey time. Avoided driving at other times due to anxiety and panic attacks Hypervigilant in built up areas eg passing driveways, parked cars or junctions
Physical Health*	Pain in neck, shoulders and back. Reduced grip strength in left arm. Attended course of physiotherapy and attended GP regularly
Medication*	Prescribed analgesia (diclofenac)
Psychological Health*	ASD after 1 week, Depression, PTSD and Driving Anxiety
Alcohol use*	5-10 vodka shots per day to alleviate pain
Smoking	Non-smoker
Family life*	Valued her brother's advice and support but rarely saw him. Difficult to meet her mother's needs and more irritated by her
Social life*	Avoided socialising with friends in case they asked about the crash. Rarely went out socially as tired all the time and in pain. Sick leave reduced contact with colleagues
Social support*	Reduction in social and work contact and dissatisfied with support
Trauma History*	Father's death, Undisclosed traumatic event, Crash
*Denotes aspects of life affected by crash	

On assessment, Susan was tearful and distressed when describing the crash, had difficulty concentrating and dissociated on occasions. Her eye contact was minimal, and she had low volume, restricted prosody and minimal spontaneous speech. She also reported loss of appetite, feeling miserable, difficulty sleeping, disturbing memories of the crash and panic attacks, when driving.

Table 31: Susan's psychological measures after one month

Measure	**Participant's score**	**Scores suggestive of caseness**
ASDS	59	50
IES-R	44	33
BDI	22	10
GHQ	12	3

An area of considerable change was her social life and support. Her absence from work had hindered support from colleagues and she avoided seeing friends, to avoid mentioning the crash and because of tiredness and pain. She found her mother more irritating. Her main source of support was her brother, particularly his practical help with her car and insurance, although he was rarely at home.

These difficulties with relationships and socialising reported at interview were consistent with the information she provided in Study B, relating to these functional domains. In the week after the crash Susan rated her social support^{W} as 2/4 compared to a median value of 3 in Study B. After a month, Susan completed the MOS^{W} (Table 32) and although her network size was similar to the other participants, all other aspects of her social support were comparably lower. From Susan's account of her pre and post-crash life, despite only experiencing a minor RTC, the impact of it on her physically, psychologically, functionally and socially was considerable. To understand these changes in context Susan's peri-crash experience was explored.

Table 32: Susan's Social Support

Social Support factors	**Participant's response at 1 month n=1**	**Study B Participants Mean ±SD, n=144**
Network Size	8 friends or family to talk to	8.7± 6
Practical	2.5/5	4.± 1.1
Affection	1.3/5	4.2± 1.1
Socialising	3/5	4.1± 1.1
Emotional/ Informational	2.9/5	4± 1.1
Support with current problems	4.6/10	7.8± 2.3
Satisfaction with current support	4.4/10	7.5± 2.5

Peri-Crash Experience

Through the assessment and therapy sessions, imaginal reliving, questionnaire completion and hospital records, the peri-crash sequences of events was established for Susan's crash. At assessment Susan had a vivid recollection of the crash and her fear was evident during imaginal reliving of the event. Susan was terrified and confused at the time of the impact and her panic was evident when reliving the impact during therapy (see Appendix 12 for further details)

"From the other side a car is reversing, starting to reverse out. It's a black Skoda and got no time to, I haven't got enough time to stop without hitting it. My stomach's gone. Starting to panic. Hmm.........(staring into space, dissociated) *.....trying to get my foot on the brakes. See if I can avoid it. Hmmm............*(adopted brace position) *....... ....and I know I can't avoid it. I'm going to hit him. Hear all the car like all the bits fall off, smashing into the headlight....................*(eyes closed, fists clenched)
I'm hitting him. My heart is racing. Hmm ....radio is faded out, all I can hear is the noise of the crash.
Starting to get worried, starting to panic, he's hit my passenger side......... I thought wouldn't be able to open the..................... that door, but the driver's door I can't open it".

Susan exhibited distress and dissociative symptoms from the moment of impact, describing a feeling of being *"shaken up"* and everything seemed *"as if it was a story"*. Whilst reliving the moments after leaving the car, her anxiety and sense of unreality are apparent in the disjointed account.

*"I am shaking and in shock………. I can't believe what's just happened. Hmm….. just thinking………. if only I had left 5 minutes later then it probably wouldn't have happened ………………………………………………(*15 seconds silence, appears to have dissociated, staring into the distance)…………*I try and drink a bit of tea…………………I try to hold the pen to write the details but my hand is shaking too much……………… I can't write."* (Tearful and shaking, sitting in brace position)

Susan continued to feel shocked and cried repeatedly during the day, with further accounts of dissociative experiences, which are detailed below.

Several hours later in a pub with friends…

"I don't feel like going home. I still feel shaken. I feel numb, I am shaking, hmm………, a bit confused. To think…………. I don't believe that I have just had a crash………. well a few hours ago. Feels a bit like a dream and that I am going to wake up and my car is still going to be outside.
I can't pick the drink up ……….my hand is shaking, it's just………, I am drinking it with a straw."

Approximately 6 hours after the crash, Susan started to feel pain in her neck, back and legs. She went to A&E because it was late at night and she was frightened and in pain.

Notable features of her peri-crash account included Susan's immediate anxiety at the time of the crash, when compared with the objective severity of the impact. Her peri-crash account highlighted persistent oscillation between anxiety and dissociative symptoms. Her social support in the peri-crash period was limited. Her mother offered no emotional or practical support during this period. Her friend visited and went with her to the police station and they both went with friends to the pub. Her brother returned later provided practical support moving the car and drove her to hospital, but did not accompany her into A&E.

Impact of the Crash, Summary

Susan, although involved in a minor collision, experienced acute and persistent physical, psychological, social and functional changes after a RTC, which she attributed to the crash. Her primary concern was her pain, since it affected all aspects of her functioning. Exploration of the peri-crash period found that her immediate response to the crash was autonomic arousal, followed by oscillating dissociative and anxiety symptoms, which persisted through her account of the day. In contrast, her pain took several hours to develop. Her support in the immediate aftermath of the crash was impaired by her mother's disinterest and her brother's initial absence. Whilst her friends offered support, it was primarily social. Furthermore, her delay in returning to work distanced her from an important support network.

C2) Question: What healthcare did a casualty with a PTS disorder receive after discharge from A&E?

This question was explored using information provided by Susan at interview, the hospital notes and information Susan provided during Study B. Susan attended A&E ~ 14 hours after her crash because she was frightened and in pain after the crash. Her account indicated that she was still anxious and experiencing dissociative symptoms when attending hospital.

A&E: The triage notes stated that Susan was in pain, but in contrast to her account, the notes specifically exclude neck pain.

"Walked into dept. complaining of pain in both legs, worse on movement. No neck pain"

The triage form included a 0-10 pain rating scale, but it had not been completed. The Glasgow Coma Scale, heart rate and blood pressure were not assessed by the triage nurse. Triage rated her injuries from the crash as minor although Susan subsequently rated their severity as 3 /5. The later medical assessment reiterated the triage report.

"Complaining of pain behind both knees".

Although the notes stated that Susan was given advice, she later had no recollection of it. Susan reported that she was tearful and frightened whilst in A&E, but no comments were evident in her casualty records. No follow-up or referral to other services was recorded, consistent with Susan's report at interview.

Post-discharge Healthcare Pathway: In the first month Susan saw her GP six times within a month, for her pain. She was prescribed an anti-inflammatory pain-killer and took this regularly.

Figure 108: Susan's Healthcare Pathway in the Month after crash

Time after crash	Healthcare Pathway	Psychological problems
Day 1	Attended A&E Triage Nurse assessment Medical Assessment Discharged from A&E no follow up	Acutely distressed and dissociated
	↓	
Weeks 1-5	Attended GP x6 Prescribed Diclofenac Referred to Physiotherapy	ASD
	↓	
Weeks 3-5	Attended Physiotherapy x4 Discharged with exercises to continue at home	PTSD & depression

Susan saw her GP twice in the week after the crash. In the second week she was referred for four sessions of physiotherapy, which she had completed by her assessment at 5 weeks. However, at this appointment she was still in considerable pain and did not consider that anything had helped her so far. From her pathway it emerged that Susan had twelve contacts with four different healthcare professionals prior to her assessment within Study C. After the crash she had received, advice, medication and physiotherapy. The casualty notes stated advice on pain relief but Susan did not recall any advice being given.

In Figure 108, the results of Susan's psychometric assessments were placed alongside the healthcare delivered to illustrate the psychological problems she was experiencing at the time of these appointments. Without examination of the GP and physiotherapy notes, it could not be conclusively established whether they had identified her PTS disorders at any point. However, Susan was not aware that the GP or physiotherapist had recognised her symptoms of anxiety and depression and no suggestion of a referral to counselling or other psychological support services had been made. Furthermore, Susan was certain that no professional had assessed her alcohol consumption.

Healthcare Summary

PTSD and depression have previously been associated with elevated attendance of healthcare services in connection with physical health problems (Deykin, Keane *et al.*, 2001). These attendances were considered appropriate since it appeared physical problems drove the increased consultations. Susan's case study demonstrated how a "typical" casualty may repeatedly seek help from healthcare professionals. Examination of Susan's healthcare pathway, demonstrated her GP attendance in the first month exceeded the National average of 4-5 consultations per annum (QResearch and The Health and Social Care information Centre, 2008). Such increased presentation may be useful to trigger GPs to explore other causes for patients' symptoms.

Whilst Susan's physical problems and pain appeared to have been recognised and timely treatment offered, there was no evidence that her psychological problems had been recognised or addressed by any of the healthcare professionals she consulted, whereas her distress and particularly her low mood, were overtly evident at the 5 week assessment. This exemplar case-study highlighted the different healthcare pathways triggered for physical and psychological disorders, within both primary and emergency services. Whilst Susan's psychological symptoms were not addressed her WAD triggered a timely referral, assessment and treatment process.

Whilst the A&E notes indicated Susan was given advice, she had no recall of this. Dissociation can interfere with the ability to process information (Ehlers and Clark, 2000), thereby, hindering its subsequent retrieval. It is possible that Susan's high level of distress after the crash prevented her from absorbing advice given.

This is particularly pertinent because peri-traumatic and persistent dissociation have been linked to PTS disorders. Therefore, trauma casualties may have problems subsequently recalling verbal information given around the time of the crash and the most at risk could be the least able to recall advice given. Susan's case study suggested a need to provide RTC casualties, not only with verbal advice, but also written information about managing the psychological impact of a crash, consistent with the recommendations made to prevent chronic WAD (McClune, Burton *et al.*, 2002). Providing such information may also convey understanding and support from clinicians about their problems.

C3) Question: Were the predictive risk models from Study B consistent with risks reported by a casualty with a PTS disorder?

This question was informed through the responses Susan provided for both questionnaires in Study B and the predictive models for PTS disorders, developed in Study B. The factors within the generic and gender specific models for ASD, PTSD and depression were compared with Susan's responses.

ASD Model: Four factors in the generic model for ASD (Table 33) constituted the ASD predictive model and together accounted for 42% of the variance in ASDS scores. Susan endorsed two factors, feeling terrified and unreal. She did not report physical health problems or smoking, the two other factors within the generic ASD model. The female model for ASD accounted for only 33% of the variance in ASDS scores, comprising of only two elements (being terrified and feeling unreal). Susan reported both these factors, suggesting that this model was more congruent with Susan's risk of ASD, in the acute aftermath of the crash.

These results indicate that the gender specific model, but not the generic model for ASD, was congruent with the response provided by Susan on the screening questionnaire. Although this model was a better predictor, it accounted for less of the ASDS score variance than the generic model

PTSD Model: 16 factors were significantly associated with PTSD and the strongest generic predictive model included 3 factors; ASD score, satisfaction with social support and PDEQ score accounting for 65% of the variance in IES-R scores (Table 33).

Table 33: Overview of risk factors reported by Susan

Factor Type	Factors significantly associated with a specific PTS reaction	Susan's response	ASDS (ASD)	IES-R (PTSD)	BDI Depression
Pre-crash factors	Gender	female			
	Previous physical health treatment	no	■		
	Smoking	no	■		
	Previous Mental Health Treatment	no			■
	Family History M. Health Treatment	no			
	Previous traumas	yes			
Peri-crash factors	Social Support[W]	2			
	Subjective injury severity	3			
	Feeling Unreal	4	■		
	Perception of crash consequences	"Couldn't think"			
	Terrified at the time	yes	■		
	PDEQ score	2.9		■	
Post-crash factors	Social support Structure	8			
	Social support Tangible	2.5			■
	Social Support Affection	1.3			
	Social Support Positive Socialising	3.0			
	Social Support Emotional/Info	2.9			
	Social support Current problems	4.6			
	Social support Satisfaction	4.4		■	■
	ASDS score	56	N/A	■	■
	BDI Score	22			N/A
	IES-R Score	44		N/A	
	GHQ Score	12			
	WAS overall functional impairment	yes			
	WAS Work	6			
	WAS Home	7			
	WAS Socialising	7			
	WAS Alone	7			
	WAS Relationships	5			
	Legal proceedings	yes			

■ Denoted factors significantly associated with the strongest predictive model tested for each disorder.

Susan endorsed 15 of the significant factors, the only exception being smoking. She also reported an above ASD caseness score, low satisfaction rating and raised PDEQ score which matched the predictive model of PTSD generated in Study B.

The proposed female predictive PTSD model (Study B) accounted for only 45% of the IES-R variance and consisted of four factors. Susan endorsed being terrified, poor satisfaction with support, high injury severity and feeling unreal around the time of the crash. Susan's factors mirrored both the generic and female predictive models of PTSD. However, the generic model accounted for a greater proportion of the variance in IES-R scores.

Depression Model: 23 factors were significantly associated with low mood in Study B and Susan reported 18 of these. The strongest predictive model for depression incorporated 4 factors (ASDS score, previous mental health treatment, tangible support and satisfaction with support) and accounted for 54% of the variance in BDI scores.

Susan reported ASD, low tangible support, low satisfaction with social support but not previous treatment for mental health problems. Susan's questionnaire responses reflected the majority of factors in the generic predictive model of depression, but did not report the third most significant factor in the model.

The female model of depression accounted for 51% of the variance in BDI scores and included 3 factors from the generic model, only omitting previous mental health treatment (Study B). Therefore, Susan's responses were congruent with the female model of depression and this would have provided a stronger prediction of her subsequent mood problems than the generic model.

Risk Factor Summary

The results discovered that all gender specific models were congruent with the information provided by Susan, on the Screening and One Month Questionnaire. However, only the generic PTSD model fitted with Susan's reported risk factors. Application of these models to an exemplar casualty showed promise in the prediction of PTS disorders for the gender specific models.

The generic models for ASD and depression were less applicable to Susan. Although the gender specific models were the most congruent, they accounted for less of the variance in scores. Further work to develop stronger generic models for ASD and depression needs to be conducted, whereas the models for PTSD showed more promise clinically. The discrepancy in Susan's report of her mother's mental health problems between the self-completion questionnaire and at interview drew attention to some of the difficulties in using a survey method, as questions may be misinterpreted and responses cannot be clarified, unlike in interviews (Buckingham and Saunders, 2004).

C4) Null Hypothesis: A brief TF-CBT^{SS} intervention was not effective in reducing symptoms of PTS disorders

The hypothesis was tested through the results obtained from a single case experiment, undertaken following Peterson's model of inquiry (Peterson, 1991).

Assessment

Susan attended an assessment interview 5 weeks post crash (see Study C1) and completed the Screening and One Month Questionnaires in Study B. The One Month Questionnaire was completed post-therapy (3 & 6 months). Measurements of pain, driving anxiety and SUD ratings were taken at assessment and within each session using a 0-10 rating scale to assess changes specifically targeted within therapy.

Therapist observation notes were taken during each session. The assessment session followed a structured format to inform the development of an individual case formulation.

Case Formulation

During the assessment, a collaborative formulation (Figure 109), centred on the factory model (Lovell and Richards, 1997) was developed with Susan and used to construct a list of desired goals. Susan's limited concentration, evident distress and well developed avoidance and dissociation to crash reminders made this difficult for her. With prompting and guidance, she was able to consider what fitted in each box of the diagram and decide her goals (Figure 109). Susan's problems fell into two broad categories; pain and memory. Sleep, socialising and some functional activities, such as driving, were influenced by both problems.

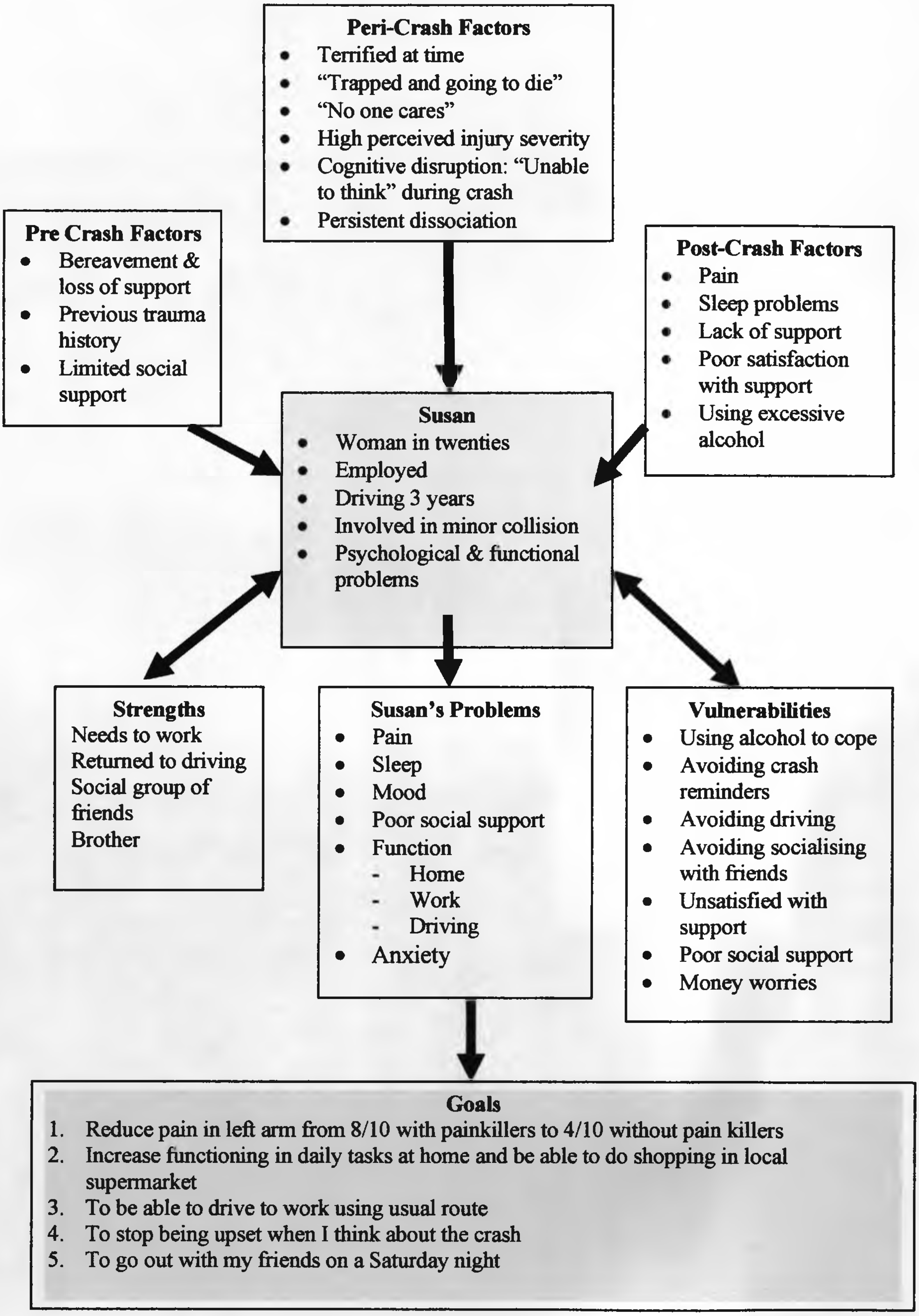
Through formulating her problem and using the factory model (Lovell and Richards, 1997), Susan was prompted to recognise avoidance patterns and how they may contribute to the maintenance of her distress. Susan's financial worries had motivated her to go back to work and drive, so were conceptualised as strengths within the formulation. A major area of concern for the therapist was Susan's paucity of social support. Using Tarrier and Humphreys' clinical assessment pathway (Tarrier and Humphreys, 2003) two significant areas were identified; disengagement from previous support networks and dysfunctional assumptions within her crash memory both of which were associated with social support dissatisfaction. These areas were targeted within therapy.

Susan conceptualised her pain as entirely physical in origin. Engagement in a psychological intervention to address her chronic pain was facilitated by a behavioural experiment. When recalling the crash, Susan adopted a "brace position" with her head down, shoulders hunched and her arms and hands tensely flexed. Susan was asked to note her posture and the therapist demonstrated it too. Susan recognised that she appeared to be bracing herself, as if about to crash. The therapist asked her to deliberately adopt this position for a minute and then note how it made her feel. She recognised it made her feel tense, anxious and increased the pain in her neck, shoulders and back. Through this experiment, Susan was more open to the possibility that, thinking about something could affect you physically. Having established this concept, Susan was able to draw up five goals she believed would improve her quality of life. Two were pain-related, two were crash- related and one linked both problems along with the need to target social support changes. Although she was willing to consider a psychological component to her symptoms, she was sceptical about whether her formulated goals were achievable because physiotherapy had not helped her.

Action

The planned intervention aimed to address Susan's PTSD symptoms, pain, mood and functional problems, whilst promoting re-engagement with her social support network, so she could achieve her goals (Figure 109) within four sessions. Susan was given a self-help booklet (Herbert, 1996) at the assessment, with relevant sections highlighted for her to read. She subsequently found it difficult to read, due to poor concentration.

Figure 109: Susan's Collaborative Case-Formulation



CBT-based interventions were recommended for the management of PTSD (NICE, 2005), but also in the treatment of chronic back pain (Ostelo, van Tulder, Vlaeyen, Linton, Morley *et al.*, 2005) and mild to moderate depression (NICE, 2007). These recommendations suggested that CBT was an appropriate intervention to address Susan's main concerns. However, addressing her co-morbidity within four therapy sessions necessitated additional therapeutic strategies.

Given the association between poor social support and the risk of PTSD and depression discovered in Study B, together with recognised association between social support and physical and mental well being (Israel, 1982), the merits of addressing Susan's social support limitations were considered. Assessment of her social support had identified two deficit areas; disengagement from previous social support networks and dysfunctional assumptions of peri-crash support. It was postulated that, by integrating interventions to address these social support areas overtly, there was the potential to enhance the recommended brief TF-CBT and achieve her goals within four sessions, despite her co-morbidity.

TF-CBT^{SS}

The TF-CBT^{SS} intervention was delivered according to a protocol, involving four sessions of repeated imaginal reliving of the crash together with *in vivo* exposure based homework tasks (Appendix 12). Activity scheduling was also carried out to address her mood and improve function (Appendix 13).

Cognitive appraisal of her peri-crash social support was targeted through imaginal exposure within each session. Whilst reliving the crash, Susan was directed to explicitly focus on elements of social support within the peri-crash experience (Appendix 16). This included recalling everyone she interacted with on the day of the crash, recalling, firstly, their general appearance, then facial expressions, gestures and behaviours. The difference between the original and social support focused account are evident when Appendix 15and Appendix 16 are compared. The aim of elaborating recall of social support was to offer a counterpoint to the fear orientated trauma-memory structure (Brewin, 2001) and to challenge the dysfunctional assumption she felt, that "No one cares".

Details of other people were largely absent from her intrusive recollections of the crash, but over time, she recalled support from the driver and his wife offering her a cup of tea (Appendix 16). She eventually recalled her friends being concerned and remembered her brother sounding worried, when she telephoned him. Changes in her recall of the peri-crash experience in terms of the event consequences and support received, emerged spontaneously during imaginal reliving and these changes in her cognitions, were accompanied by reductions in SUD ratings for the crash memory.

Re-engagement with her previous support network was addressed through weekly planned homework tasks and culminated in her arranging a Saturday night out with her friends, to commemorate her completion of therapy. Susan did not inform her family and friend that she had attended therapy. Although Susan did organise a night out with friends at the end of therapy, her friends were unaware of her commemorative reasons for arranging it. In the final session, a relapse prevention plan was developed and evaluation of the treatment goals carried out.

Table 34: Evaluation of Therapy Goals

Therapy Goal	Progress towards goal
Reduce pain in left arm from 8/10 with painkillers to 4/10 without pain killers	Pain in arm rated as 1/10 at end of therapy
Increase functioning in daily tasks at home and be able to do shopping in local supermarket	Rated as 2/10 only heavy lifting problematic other tasks completely independent
To be able to drive to work using usual route	Driving to work no problem and driving again socially
To stop being upset when I think about the crash	Anxiety reduced gradually during sessions. Ultimately described boredom when thinking about crash
To go out with my friends on a Saturday night	Attended a fancy dress night out with friends

At the end of her last imaginal-reliving, she appraised her account of the crash with the statement,

"That's my story....so what!" Susan

By this she meant that it hadn't been a big issue after all. Post-discharge, Susan did not request any further assistance. She completed questionnaires at 12 and 26 weeks post-crash and she failed to return the questionnaire at 36 weeks.

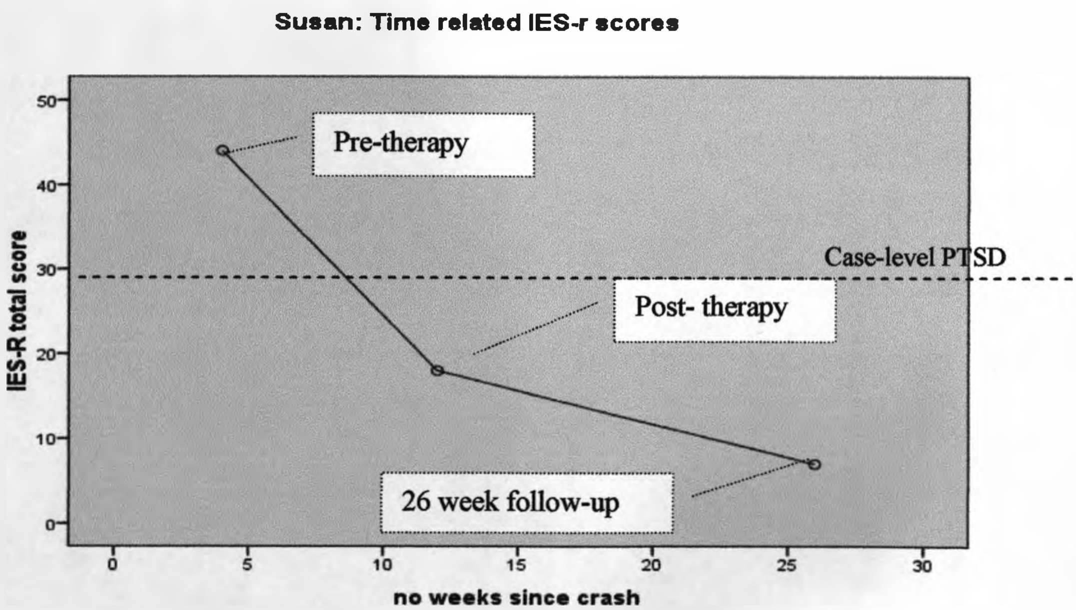
When reminded by telephone, she reported that she was really busy and was “fine”, with no problems from the crash. No further contact was received from Susan.

To analyse the impact of four sessions of TF-CBT^{SS} on PTSD symptoms

Two different PTSD related measures were used to monitor change. The IES-R (Weiss and Marmar, 1997) assessed PTSD symptom levels pre and post-therapy. The SUD (Wolpe, 1991) was used within therapy sessions to monitor distress during imaginal-reliving. Susan completed the ASDS at one week to measure ASD symptoms and the IES-R at four (pre-therapy), twelve (post-therapy) and twenty-six weeks (follow-up) after her crash to measure PTSD symptoms.

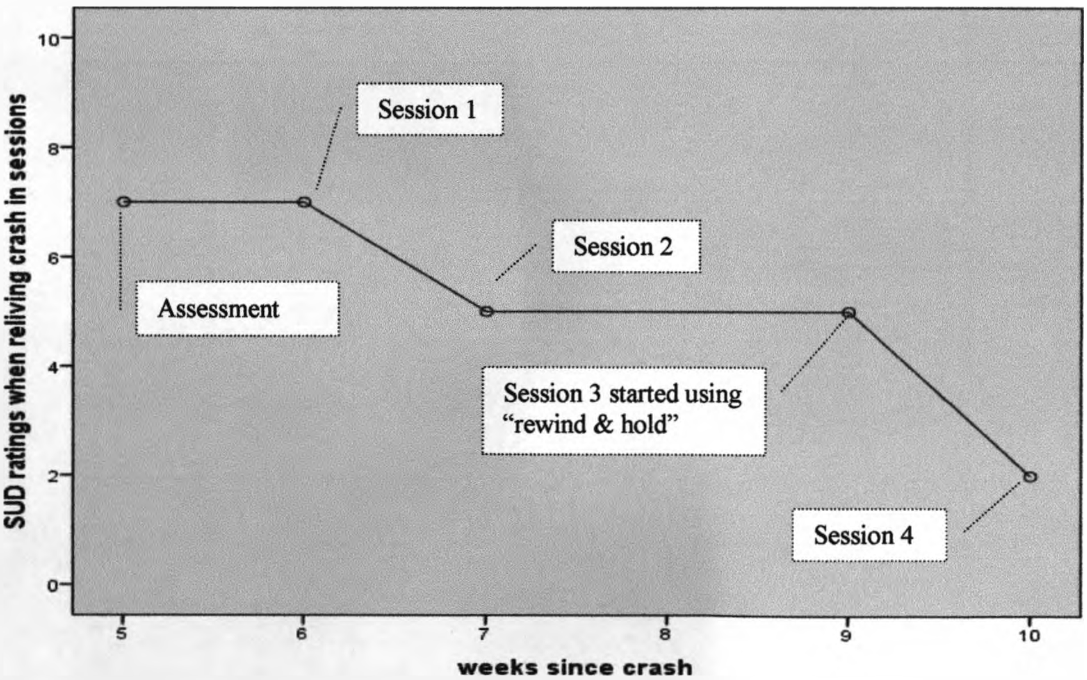
Visual analysis of Figure 110 demonstrated a marked decrease from pre to post-therapy in Susan’s IES-R score. Initially Susan’s symptoms fell within case-level scores and after were within the normal range. Whilst reliving the crash in therapy, Susan rated her subjective discomfort (SUD) in relation to the “hotspot” immediately before impact. Figure 111 demonstrated no change in SUD rating between the assessment and the first in-session reliving, despite discussing the crash during assessment and reading the information provided

Figure 110: Pre and Post therapy IES-R scores for Susan



As the sessions progressed there was a gradual reduction in SUD ratings, although the grading of exposure increased over the sessions, through increased focus on the crash and social support details (Appendix 15& Appendix 16). In session three, the "rewind and hold" technique was used to markedly increase the intensity of exposure to the peri-crash memory accompanied with a plateau in the SUD rating. By the final session, Susan reported boredom thinking about the crash, accompanied by a sizeable reduction in her SUD rating, despite using the "rewind and hold" procedure. Despite the increased vivid recall of crash details, Susan's SUD ratings for the crash "hotspot" fell from 7/10 at the start to 2/10 in the final session. Since SUD ratings were only possible within a therapeutic context, no ratings were obtained after discharge.

Figure 111: Susan's SUD rating in response to imaginal reliving



Impact on PTSD Summary

Following the delivery of the experimental variable (TF-CBT^{SS}), a reduction in PTSD (IES-R scores) occurred when compared to pre-therapy measurements and this improvement was maintained at follow-up. Delivering early intervention precluded a prolonged pre-therapy base-line, although the assessment of ASD^{W} and PTSD^{M} were both above case-level for two time-periods before commencement of therapy.

Measurement during repeated imaginal-reliving, again suggested that delivering the experimental variable ($TF\text{-}CBT^{SS}$) was associated with reduction in SUD ratings. No reduction in SUD rating occurred between assessment and the first session, which suggested the assessment did not alter distress associated with the crash. Alongside the reduction in SUD rating, Susan's recall of the crash and social support increased during therapy (Appendix 16).

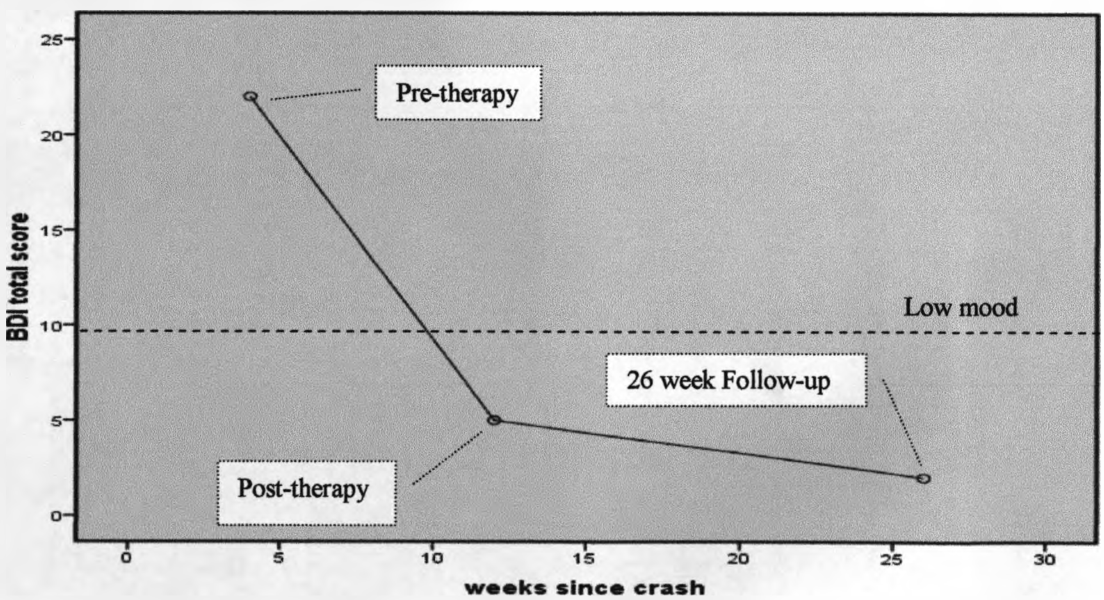
These results suggested that reductions in distress occurred following the delivery of $TF\text{-}CBT^{SS}$ and the change continued after therapy. This intervention showed promise in alleviating PTSD symptoms, enhanced recall and reduced distress when recalling the crash.

To analyse the impact of four sessions of $TF\text{-}CBT^{SS}$ on mood symptoms

Susan completed the BDI to measure mood, pre and post-therapy (4 and 12 weeks) and followed-up after 26 weeks post-crash. Behavioural activation and activity scheduling were implemented to address mastery and pleasure ratings for daily tasks.

Changes in activity were monitored using a Daily Diary (Appendix 14). A marked decline in Susan's BDI score was evident (Figure 112), from pre to post-therapy, with further improvement at follow-up, equating to a shift from moderate depression to normal mood.

Figure 112: Susan's Pre and post therapy BDI scores



Depression Summary

A marked reduction in BDI scores occurred from before to after the delivery of the experimental variable TF-CBT$^{SS.}$ However, the lack of a prior baseline minimised any inferences that could be drawn from this study. The NICE guidelines suggest that, where depression and PTSD are comorbid, the PTSD symptoms should be treated first (NICE, 2005). However, both were addressed in tandem, in this study, which did not appear to be detrimental to the outcome. This study demonstrated it was feasible to address PTSD and depression with four sessions for an exemplar RTC casualty.

To analyse the impact of four sessions of TF-CBT^{SS} on function

Susan's function was addressed directly through activity scheduling and planned, graded exposure to driving to overcome her anxiety. Susan completed the Work and Social Adjustment Scale (Mundt, Marks *et al.*, 2002) before and after therapy and at follow-up. Before TF-CBT^{SS}, she reported considerable functional problems across all the domains assessed (Table 35), whilst post-therapy and on follow-up she reported no functional problems.

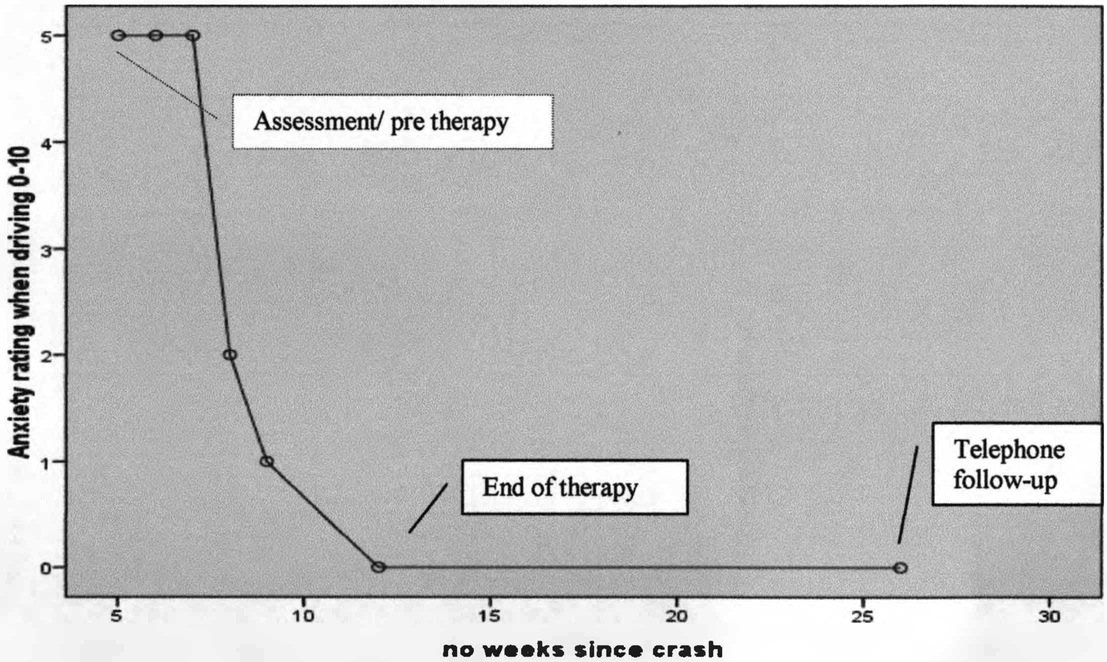
Her initial score of 32 exceeded the total score of 20 which Mundt, Marks et al (2002) suggested was associated with moderately to severe clinical symptoms. At assessment and at the start of each session, Susan rated her anxiety when driving using a 0-10 scale, with 10 as a maximum. Driving function was also monitored by adding it to the WAS as one of the domains in the 12 and 26-week follow-up questionnaires (obtained in telephone call as only function included in questionnaire).

Table 35: Susan's pre and post-therapy functioning as reported using the WAS

Functional Area ***Using 0-8 scale***	**4 weeks**	**12 weeks**	**26 weeks**
Overall problems	Yes	No	No
Managing work	6	0	0
Managing home	7	0	0
Socialising	7	0	0
Doing things alone	7	0	0
Managing relationships	5	0	0
Driving	N/A	0	0
Total score	32	0	0

No change in her driving anxiety occurred between assessment and the second therapy session (Figure 113). Subsequently, driving was addressed both in therapy and through *in vivo* exposure homework. On discharge, Susan no-longer avoided situations whilst driving and her anxiety was negligible. Post- therapy Susan had no driving problems (Table 35). Visual analysis demonstrated a lag between commencing TF-CBT^{SS} and any reduction in her driving anxiety, which corresponded with driving being addressed in therapy. Carrying out *in vivo* exposure at the site of the crash, led to a further reduction in Susan's driving anxiety and avoidance of crash reminders.

Figure 113: Susan's pre and post-therapy driving anxiety



Function Summary

Susan's function was impaired by pain and psychological symptoms at the start of therapy. Following delivery of the experimental variable, function improved in all areas and this was maintained at follow-up. Driving anxiety was rated during sessions and remained static before it was specifically targeted in therapy. Her anxiety reduction corresponded with carrying out driving related homework tasks. The improvements seen in response to *in vivo* exposure, above those achieved with imaginal exposure, were congruent with the superior value of in vivo exposure, reported by Richards, Lovell and Marks (1994). Improvements in Susan's driving function and anxiety paralleled *in vivo* exposure but a causal link cannot be conclusively established from this study.

To analyse the impact of four sessions of TF-CBT^{SS} on social support

Five domains of social support were measured pre and post-therapy and follow-up using the Medical Outcomes Study Social Support measure (Sherbourne and Stewart, 1991), together with visual analogue scales (McDowell and Newell, 1996) that measured perceptions of support provided and satisfaction. Prior to therapy, Susan had lower than the mean rating for all aspects of social support, apart from network size (Table 36). After TF-CBT^{SS} all aspects of social support availability increased, which was maintained at follow-up. However, her social network size decreased, whilst the availability, amount and satisfaction with support increased.

Therapy aimed to address cognitive distortions about her peri-crash support and promote re-engagement with Susan's previous social network. Although Susan was in contact with fewer friends by the end of therapy, she reported more social support in all other areas and was able to spontaneously recall her peri-crash support in greater detail (Appendix 16).

Table 36: Susan's Social Support pre and post-therapy measured using the MOS and rating scales

Social Support factors	Pre-therapy	Post-therapy	Follow-up
Network Size (friends or family to talk to)	8	6	5
Practical	2.5/5	3.5	4
Affection	1.3/5	3	3
Socialising	3/5	4	5
Emotional/ Informational	2.9/5	4	5
Support with current problems	4.6/10	5.3	7.2
Satisfaction with current support	4.4/10	6.9	8.1

Social Support Summary

The delivery of TF-CBT^{SS} was associated with improvements in many aspects of Susan's social support but inferences cannot be made as the influence of extraneous variables cannot be ruled out in this study, with a multifarious construct such as social support.

It was possible that access to a therapist was perceived as supportive, with a consequent impact on measurements. Moreover, changes in supportive behaviours of her friends and family could not be readily controlled within this study. However, the changes in Susan's peri-crash cognitions about her support, together with increases in her support availability and satisfaction were encouraging, since these factors that were associated in Study B with depression and PTSD.

C4 Summary

The results of this study demonstrated reductions in scores for all psychometric and functional measures following delivery of TF-CBT^{SS}. Post-therapy, Susan did not fulfil "caseness" for PTSD or depression and had no functional impairment.

The results of this study refuted the null hypothesis that: *A brief TF-CBT^{SS} intervention was not effective in reducing symptoms of PTS disorders.*

Further investigation is required to understand the process of change, which resulted in improvement in symptoms of PTS disorders after four sessions of TF-CBT^{SS} (Appendix 12)

Study C Discussion

Using a process of disciplined inquiry (Peterson, 1991), it was primarily possible to explore Susan's crash experience, consequences, healthcare responses and secondarily to investigate the merit of a novel experimental variable (TF-CBT^{SS}) upon a range of psychological and functional outcome measures.

Susan had characteristics commonly reported by casualties within Study B and therefore fulfilled the requisite criteria established for an exemplar. However, her characteristics could not be considered universally representative of all RTC casualties. Whilst Susan had many typical features of the RTC population with PTS disorders, she also reported idiographic characteristics, namely her recent bereavement and care responsibility for her mother. The degree to which these pre-crash personal issues influenced Susan's reaction to the crash must be considered when comparing her response with those of other casualties.

However, the emergent response of every casualty will be influenced by the idiosyncratic relationship between the specific details of the crash, together with individual and social variables (Briere, 1997), although Study B, consistent with previous research, found pre-trauma variables were the weakest predictors of PTSD (Brewin, Andrews *et al.*, 2000; Ozer, Best *et al.*, 2003). Susan was congruent with many of the casualties in Study B, amongst which 31% developed PTSD, 41% had low mood, and 86% experienced comorbid disorder. Moreover, 72% reported a functional impairment, even though most casualties sustained only minor physical injury. The case-study clearly illustrated the importance of the relationship between physical and psychological problems, previously recognised to occur following whiplash (Mayou and Bryant, 2002). Through an exemplar, it was possible to develop an understanding of an individual crash, which complemented the data presented in Study A and B, where only the aggregated consequences of RTCs were presented. Thus, Study C illustrated how an objective discrepancy between crash severity and consequences can become manifest at the individual level. It is often difficult for people to comprehend how anxiety continues for a past threat, observed in PTSD, but the intrusive visual and physiological reliving of the moments prior to impact demonstrated how this occurred for Susan. Such re-experiencing is common amongst traumatised individuals and may function as a warning signal, alerting the individual to similar future dangers, giving rise to the perception of future threat (Ehlers, Hackmann *et al.*, 2002) and hence the high arousal such intrusions generate. Susan's reactions when reliving the crash consisted of fluctuating arousal and dissociation. These were recognisable as acute survival responses to extreme stress (Rothschild, 2000), although persistent dissociation has been associated with subsequent pathology (O'Donnell and Creamer, 2005). Consistent with Susan's presentation, a study of RTC casualties found that persistent dissociation at four weeks, was linked to chronic PTSD (Murray, Ehlers *et al.*, 2002), suggesting that, in the absence of intervention, she may have been at risk of long-term disorder. Susan's risk of persistent disorder was also elevated by the combination of pain and PTSD, which are considered to be mutually maintaining conditions (Sharp and Harvey, 2001; Otis, Keane and Kerns, 2003). For Susan, these conditions were further exacerbated by depression. Whilst depression after trauma, is recognised (Breslau, Davis *et al.*, 2000; O'Donnell, Creamer *et al.*, 2004), it is less prominent within the trauma literature.

Susan experienced moderate symptoms of depression, that when combined with her pain and PTSD severely hindered her function. Other studies have also recognised that depression is more widespread after trauma than PTSD (Galea, Ahern, Resnick, Kilpatrick, Bucuvalas *et al.*, 2002; Iversen, Dyson *et al.*, 2005; Van Ommeren, 2005) and a more pessimistic prognosis has been reported for individuals with comorbid disorder (O'Donnell, Creamer *et al.*, 2004). Susan's low mood impacted on her function and demonstrated the importance of recognising and treating depression after a RTC, rather than focusing exclusively on trauma specific disorders.

Study C discovered the range of consequences that Susan's "minor collision" had in the month after her crash. The apparent discrepancy, between the objective and subjective severity of the crash, can also arise through cognitive distortions as the event becomes integrated with the pre-existing schemas (Simmons and Granvold, 2005). Integration can be adaptive or maladaptive; influencing how an individual responds to a traumatic event (Tolin and Foa, 2002) and it is such cognitive distortions that were addressed through TF-CBT (Ehlers, Clark, Hackmann, McManus and Fennell, 2005). TF-CBT^{SS} additionally aims to address maladaptive integration of social support memories over the peri-crash period. Differences in women's cognitive processing of traumatic events, in terms of greater self-blaming and negative self-schemas (Foa, Ehlers, Clark, Tolin and Orsillo, 1999), together with a more dangerous world-view (Tolin and Foa, 2002), can also influence their subjective perception of a RTC and, in part, explain discrepant stimulus response patterns. Therefore, clinicians must remain mindful of gender differentiated responses and potentially vary intervention requirements, particularly as Study C only explored a female exemplar.

Despite early intervention to alleviate her WAD-related pain, comparison of Susan's pre-post crash life illustrated the effect the crash had upon her daily life, mediated by the interaction of pain and psychological disorders. Some of the wider implications of crashes were evident through Susan's increased healthcare use, her reduced occupational roles as carer and clerical worker, together with the negative influence upon her social relationships. Hence, the individual impact of a crash like Susan's can result in wider ramifications for society, in the absence of interventions to alleviate such problems.

Susan had considerable contact with healthcare, including primary care and A&E, in the month after her crash, consistent with the increase in healthcare costs reported for traumatised Vietnam veterans (Marshall, Jorm, Grayson and O'Toole, 2000), accumulated, in the main, due to physical health issues.

However, the intervention Susan initially received, appeared to have a purely physical rationale, despite her having symptoms consistent with ASD by a week after the crash. There was no evidence suggesting that a psychological perspective to her pain, such as a fear-avoidance approach (Denison, Asenlof and Lindberg, 2004) (Vlaeyen and Linton, 2000) had been considered by any of the healthcare professionals. This was, despite the known synergy between chronic pain and PTSD (Mayou and Radanov, 1996; Jaspers, 1998; Otis, Keane *et al.*, 2003; Shipherd, Beck, Hamblen, Lackner and Freeman, 2003; Ehlers, Clark *et al.*, 2005), as well as between whiplash and PTSD (Verhey, Stapert and Jolles, 1999), and also between chronic pain and depression (Tunks, Crook and Weir, 2008). Furthermore, the need to assess psychological conditions following traumatic injury, was emphasised by the Trauma Recovery Project, since they found PTSD and depression were independent predictors of long-term quality of life and well-being (Holbrook, Anderson *et al.*, 1999) and considered their investigation should be integral to the treatment of casualties, irrespective of the primary presenting problem.

A&E departments are identified in the NICE guidelines as proffering opportunities to detect traumatised individuals. Study B and C suggest obstacles to these guidelines, due to the difficulties identifying casualties at high risk whilst attending. Support, advice and signposting to other services may be a more valid role for A&E, rather than attempting to screen individuals for psychological risk. Susan's hospital notes suggested that neither psychological assessment nor support occurred when she attended A&E. Notes stated she was give advice on pain-relief, but she could not recall this. This reinforced the need to overcome communication barriers that can occur with acute trauma casualties.

General Practitioners have responsibility for the initial assessment and coordination of subsequent care for trauma survivors, although the whole primary care team are expected to have an awareness of trauma reactions and be sufficiently skilled to question patients (NICE, 2005).

The multiple contacts with her GP and physiotherapist afforded opportunities for formal and informal assessment of her psychological state and substance misuse to occur. Study C and B, suggest that GPs and physiotherapists were ideally placed to assess and monitor an RTC casualty's psychological response, but did not fulfil this role. This exemplar emphasised the need to offer widespread training and supervision to all healthcare professionals, who may come into contact with RTC casualties, to ensure they are sufficiently skilled and alert to this role. Alternatively, all RTC casualties must be directed to a specialist service for assessment and monitoring after a crash. Whilst the healthcare response to Susan's physical injuries was timely, the assessment and intervention for her psychological problems was not comparable.

Susan's case study illustrated the discrepant healthcare response to her physical and psychological problems. However, the efficient referral from the GP for physiotherapy provided a useful template, on which to base a psychological service after a RTC. Given the apparent synergy between WAD, chronic pain, PTSD and depression both for Susan and reported within the literature, consideration should be given to the development of services capable of assessing and monitoring these typical consequences for RTC casualties. Further deliberation on the design of such a service needs to occur through examination of early WAD intervention models (Spitzer, Skovron *et al.*, 1995) (Lamb, Gates, Underwood, Cooke, Ashby *et al.*, 2007).

Screening for PTSD and depression risk, whilst casualties attended A&E would have proved potentially beneficial for casualties at high risk, whilst minimising the inconvenience for casualties at low risk. Unfortunately, it was not possible from Study B, to develop predictive models with sufficient clinical utility to discriminate between high and low risk groups based on the pre and peri-crash factors investigated. Furthermore, the generic models developed in Study B, for ASD and depression did not parallel Susan's pre and peri-crash information. When compared with Susan's responses, the gender specific models for the three disorders were the most promising, although these generally predicted less of the variance in the psychometric scores. Concerningly, the generic risk model developed for ASD would not have identified Susan as a high risk casualty.

Further investigation of pre and peri-crash risk factors must be conducted, if screening of A&E attendees for subsequent PTS disorders is to prove feasible.

Study C demonstrated that Susan's case-level ASD was identifiable at one week and this was more promising in terms of risk prediction. Consistent with the recommendations in Study B, direct assessment of her symptoms at one week, could have highlighted her need for further support and monitoring, in order to subsequently diagnose her subsequent PTSD and depression, thereby, facilitating early intervention.

As an exemplar, Susan offered insight into the potential complexity of individual trauma responses and the confounding influence of comorbidity and social environment. Although Susan's cumulative problems were idiosyncratic, such complexity is not alien within clinical practice and hence her case provided clinicians an exemplar, with a complex presentation and potentially more similar to their clients, than participants in other types of research studies. For healthcare services to meet the needs of "typical" RTC casualties, appropriate interventions must encompass the physical, psychological and social factors that may underlie PTS disorders. Such multifaceted problems restrict the merit of manualised treatment protocols and favour a case-formulation approach, informed by evidence based interventions (Kuyken, Padesky *et al.*, 2008). This approach was used within Study C, permitting the integration of TF-CBT with recommended assessment and intervention to target social support needs (Tarrier and Humphreys, 2003). Whilst TF-CBT was recommended for the treatment of PTSD (NICE, 2005) and CBT recommended for depression (NICE, 2007), Susan in common with 86% of participants with PTSD in Study B, had both PTSD and depression, necessitating that both disorders were addressed through the proposed TF-CBT^{SS} within the short timescale. The design of this novel intervention was based upon the premise, that social support deficits were associated with PTSD, depression and chronic pain. Therefore, it was speculated that addressing these social support deficits and reducing arousal to intrusive reminders of the crash, would alleviate post-trauma psychological and pain disorders with a concomitant impact on function. Whilst TF-CBT focuses on exposure to the trauma memory with the aim of reducing arousal, TF-CBT^{SS} additionally focused on elaborating recall of peri-crash support to address associated cognitive distortions.

Alternative Explanations

The results reported by Susan demonstrated improvements across all pre to post-therapy measures, apart from a reduction in the size of her support network. However, the reduction in network size following a social support intervention, was less surprising than it appeared, since network size correlates poorly with functional support, because an individual who offers one type of support is likely to provide other types too (Sherbourne and Stewart, 1991). In contrast to the reduction in her network size, were the improvements Susan reported in the availability of support and her satisfaction. Although the TF-CBT^{SS} delivered, did not directly address the behaviour of her friends and family, such changes cannot be ruled out, particularly since clinical symptoms and low self-esteem in young adults has been found to negatively impact the quality of friendships and satisfaction therein (Bagwell, Bender, Andreassi, Kinoshita, Montarello *et al.*, 2005). It is, therefore, possible that Susan's improved mood positively influenced her relationships with others, which may have increased the reciprocity in their relationship. Social interaction within the sessions may also have influenced Susan's altered support satisfaction ratings, although emphasis was not placed upon developing a relationship with Susan. However, the sessions provided Susan with opportunities to talk about the crash and her difficulties, and the general therapeutic milieu, which conveyed interest and hope within an encouraging and non-pejorative forum, could have been perceived as supportive. Therefore, it is possible that the therapeutic relationship played a contributory factor in the outcomes achieved (Hubble, Duncan and Miller, 1999). Research into therapeutic effectiveness has suggested that a proportion of the variance in therapy outcomes are related to common factors, rather than specific techniques or theoretical orientation and as much as 30% may be attributable to the relationship between client and therapist (Hubble, Duncan *et al.*, 1999). Where social support is limited, amongst people with mild depression, it has been suggested that common factors, particularly a supportive relationship within therapy may be helpful irrespective of the inclusion of specific therapy factors (Arkowitz, 2003). Therefore, it remained possible that Susan's improvement in social support satisfaction was influenced by the therapeutic relationship, rather than the specific therapeutic techniques described in the protocol. Further investigation through case-studies that do not include specific therapeutic techniques may help to elucidate the merit of common factors for recovery from PTS disorders.

In session SUD ratings were recorded during imaginal reliving, and reductions in her scores occurred both within sessions and each week, despite increased elaboration of the trauma narrative and exposure to anxiety triggers. However, unlike TF-CBT, reliving incorporated an additional focus upon social support within the narrative. Over time, greater elaboration was associated with more helpful appraisals by Susan of other people's actions after the crash. Whilst it appeared that her cognitive reappraisal was instigated by elaborating support within the narrative, it may have been influenced by simultaneous reductions in arousal due to prolonged exposure to the trauma memory.

The changes reported on all psychological measures, together with improvements in her social support over the time course of therapy, support the effectiveness of TF-CBT^{SS} for Susan. However, many alternative explanations rival the premise that these changes occurred as a direct result of the changes in social support and exposure therapy. Firstly, the possibility that her physical and psychological recovery was spontaneous must be considered and cannot conclusively be dismissed. However, physiotherapy had not improved her pain and Susan had reported considerable symptoms of psychological distress for five weeks preceding her therapy. Spontaneous recovery was also challenged by the lack of improvement in driving anxiety or SUD ratings between assessment and the first therapy session. Although common factors may have influenced the perception of social support, they were unlikely to account for the in session reductions that occurred in SUD ratings achieved after repeated reliving.

Having considered these rival explanations, the results continue to support the premise that changes in psychological and functional measures were associated with TF-CBT^{SS}. This preliminary feasibility study into the merit of TF-CBT^{SS}, suggests that the mechanisms of these changes now need to be investigated. This will require testing this multi-component intervention as single strands (Turpin, 2001) to evaluate their relative efficacy. Whilst such studies are less directly relevant to clinicians, they are important to undertake in order to discern the merit of including social support manipulation within existing interventions. Return to below case-level symptoms for all PTS disorders and full restoration of function was reported following four sessions of TF-CBT^{SS}.

These results of this study refuted the null hypothesis that: *A brief TF-CBT^{SS} intervention was not effective in reducing symptoms of PTS disorder.*

Limitations

The causal pathway whereby such improvements occurred requires further investigation in order to explore further the underlying premise that social support was associated with PTSD, depression and chronic pain and that changes in support effected changes in PTS symptoms. However, the difficulties already discussed in terms of obtaining baseline stability meant that spontaneous recovery could not be conclusively excluded as a possible mechanism of change. The inclusion of daily measures for Susan to rate her symptoms and support may have helped to clarify the underlying processes of change but this places high demands upon participants, which can alter the profile of individuals willing to participate (Waite and Claffey et al 1998) particularly when depressed (Stroebe and Stroebe, 1989). Furthermore, assessment itself is not a neutral process (Turpin, 2001), and increased monitoring may also contribute additional variables for which to control. Ehlers, Clark, Hackman et al (2003) in an RCT of cognitive therapy found that 12 % of participants improved through self-monitoring prior to entering the study. This preliminary case-study aimed to mirror routine practice to determine whether the intervention process was firstly feasible, in everyday practice. Increasing the burden of assessment and monitoring would have shifted the delivered intervention away from routine practice, potentially distorting the relevance of the outcomes for everyday clients. Increasing the overall burden of the study could also alienate the clients most affected by their crash, particularly those with pain, low mood and poor motivation. Therefore, Study C aimed to balance these competing demands through weekly in-session monitoring, in addition to pre and post-therapy measurement, whilst recognising the limitations of this strategy to discern “cause and effect” processes.

When testing the theoretical proposition of the case-study, the complexity of the intervention was limiting. Whilst this has been addressed, in some part, through the detailed description of the process, it was not possible to establish which aspects were effective in achieving change. Dismantling the TF-CBT^{SS} into single-strand therapies would result in a significantly different intervention from the one delivered.

However it would enable specific components of TF-CBT^{SS} to be evaluated and determine whether further development of social support focused interventions will prove worthwhile in the armoury against PTS disorders. Such single strange studies must also include more intensive monitoring of key symptoms and cognitions to enable understanding of the processes of change. Longer follow-up time over a year would also be valuable, in view of the poor long-term prognosis for PTSD, in the absence of intervention (Koren, Arnon *et al.*, 2001).

PlaTO

This study clearly demonstrated that an individual's psychological response after a RTC may be disproportionate to the severity of the crash and injuries sustained. In contrast to previous strategies that have endeavoured to address the psychological consequences of traumatic injury (Zatzick, Roy-Byrne *et al.*, 2004; O'Donnell, Bryant *et al.*, 2008), the PlaTO model for all RTC casualties, irrespective of injury severity. It also became evident, whilst there may be some common characteristics amongst casualties; idiosyncratic features also influence the trauma response. The study also highlighted the increased use of healthcare resources by Susan after her crash and the significant secondary implications for society, if psychological problems are not recognised and treated in a timely fashion. When considering service design, the limitations of relying on self-referral were evident, particularly given that avoidance is central to two common RTC consequences, PTSD (American Psychiatric Association, 1994) and chronic pain (Vlaeyen and Linton, 2000). The predictive models developed in Study B and evaluated here, emphasised the importance of following up all casualties after discharge to assess the development of ASD and evaluate the risk of subsequent PTS disorders.

Within the PlaTO model, interventions were conceptualised as Ordnance and in order to minimise established psychological disorder, these must be effective in addressing the typical problems presented by RTC casualties. Susan's case-study demonstrated the physical, psychological and social factors that influenced her trauma response and thereby highlighted the importance of social support at both a functional and perceptual level. This study found, that the delivery of four sessions of TF-CBT^{SS} was associated with improvements in all of Susan's identified problems.

However the causal mechanisms for such changes require further research, using different methods to this study. The importance of social support identified in Study B and recognised again in Study C suggest that social support should be considered as a vital part of the armoury at all phases of the PlaTO model. However, until manipulation of social support can be thoroughly tested through the proposed research studies, casualties with PTSD or depression should continue to be offered CBT as recommended by NICE (NICE, 2005; NICE, 2007).

In part, the case-study was undertaken to determine the feasibility of delivering a brief psychological intervention for RTC casualties within an ecologically valid setting. There were many challenges when delivering therapy to a RTC casualty within A&E. For some individuals attending the hospital in itself may well prove a challenge. However, Susan appreciated the anonymity of the location, as it obfuscated her attending for psychological therapy. Whether people would be deterred from accessing a PlaTO service located alongside A&E, must be evaluated in situ, since it entails revisiting their previous peri-crash experience and sensory reminders to their crash. Whilst this setting may prove too steep an exposure gradient for some casualties, it may provide opportunities for *in vivo* exposure, if therapy so dictated.

Study C demonstrated it was feasibility to deliver a brief psychological intervention from A&E, although additional locations may be necessary to include casualties who are unable to physically or psychologically attend session based within an A&E department.

Susan's case-study has also provided a communication device (Yin, 2003) to potentially draw disparate audiences into the discourse about road crashes and consideration of strategies to minimise the psychological consequences for individuals and society. When viewed from an individual perspective, it is possible to demonstrate some of the concerns that affect many RTC casualties, raised within Study A and B. However, the individual perspective cannot be allowed to influence the discourse beyond its rank in the hierarchy of evidence (Sackett, Gray *et al.*, 1996), because of its accessibility for the audience, over other research methods.

This study has provided an exemplar case-study, accessible to a wide audience in order to highlight the extensive impact of a "typical" crash on an individual, irrespective of the crash severity and to promote a discourse about services to address both the psychological and physical consequences of such everyday disasters. Through a single case-experiment, a novel intervention incorporating TF-CBT with social support assessment and targeted intervention was reported and favourable outcomes were discussed. There is now a need to develop the intervention further and test its effectiveness through more rigorous empirical methods, particularly with men. This chapter has primarily explored the impact of an RTC and secondarily the merit of early intervention for an individual. The following chapter will re-examine such issues within the context of the wider RTC population, already reported following Study B and A in order to refine the key requirements for a service delivery model.

CHAPTER 10

Synthesis of Research Studies A-C to Inform the PlaTO model

This chapter will synthesise the research studies conducted and thereby report that the impact of an RTC, even when considered minor, can be significantly disruptive to the life of a casualty, with ramifications extending beyond those individuals directly involved. It will also be discussed that, in view of the numbers affected by crashes each year, current national guidance for healthcare practice does not satisfactorily address the psychological consequences for RTC casualties. The chapter will argue that there is a need to adopt a strategic approach, if the consequences of these everyday disasters are to be minimised for individual casualties and wider society.

Key Research Outcomes

Studies A-C were undertaken to inform the justification and design of the three tiers of the proposed PlaTO model. This model is intended to alleviate some of emergent issues for individuals, clinicians and healthcare systems that arose from the psychological consequences of RTCs. Before finalising the design of the model the pertinent findings from studies A-C were reviewed (Figure 114) and placed within the context of existing research and relevant policies.

Implications for Individuals

Study A demonstrated that although the Police STATS19 data has been used to guide government policy and international monitoring of crashes (Department for Transport, 2008) the reported information inaccurately reports the scale of RTC casualties in the UK. The northwest Police data corresponded to less than half the reported RTC attendances at the region's A&E departments. Where direct comparison was possible between the Police and A&E data, the hospital records contained 2.3 times as many casualties as those of the Police, although other patterns were similar between the two sources. This finding was consistent with a study of serious injury comparing admitted patients with Police records, which found a similar level of under-reporting of such injuries. Extrapolation of Study A to the national population would to 569,894 casualties annually, compared to the reported 247,780 (Department for Transport, 2008).

The profile of RTC casualties attending the sub-sample of northwest hospitals in Study A, were consistent with the general profile of casualties reported nationally (Department for Transport, 2008) and internationally (World Health Organization, 2004). When examined using a mosaic approach, the casualties attending the three northwest hospitals (Appendix 5, Figure 114) were primarily young adult male car users. The most common injury type was whiplash, consistent with previous studies of vehicle occupant injuries (Murray, Pitcher *et al.*, 1992; Quinlan, Annest *et al.*, 2004), for which they received advice with no directed follow-up after discharge from A&E. However, Study B demonstrated that, on average, casualties had at least one healthcare appointment in the month after the crash and that a small group had multiple attendances with a range of different healthcare professionals over that time. This pattern was clearly highlighted in Study C by the exemplar case "Susan", who had 11 appointments within a month of her crash.

Although the A&E data analysed in Study A found only 0.3% out of 10,476 casualties reporting any signs of psychological distress, this was not consistent with the prevalence of PTS disorders reported by a sample of participants in Study B (Figure 114). A week after their crash 50% of casualties had ASD and 40% had symptom severities that placed them at risk of subsequent PTSD disorder (Bryant, 1999). When participants were reassessed after a month 31% had PTSD level symptoms and 41% had low mood. Overall 64% of casualties in the study, developed clinical level psychological problems after a crash and 72% reported problems with everyday functioning. Given that the majority of the casualties were only involved in minor crashes, the prevalence of psychological problems is remarkable, but not inconsistent with previous RTC studies (O'Donnell, Creamer *et al.*, 2008).

Gender differences in trauma reactions have been commonly recognised (Norris, Foster *et al.*, 2002), although in this study only ASD was found to be greater in women, since no differences were found for PTSD and depression contrasting with previously published studies for PTSD (Brewin, Andrews *et al.*, 2000) and depression (Roy and Steptoe, 1994).

Figure 114: Key results from a study to minimise the psychological consequences of RTCs

Study	Key Results
Study A Key Results	Police used a standardised RTC recording system (STATS19) but this provided an unreliable data source to investigate the size of the RTC population at risk of PTS reactions. Hospital data collection processes did not follow a standardised format rendering any detailed comparison between hospitals inherently flawed. When covering the same geographical area Police data under-recorded RTC casualties (1680) compared to the NHS hospital data (3,890). Hospital and police data reflects similar patterns in terms of age, gender, road user type, and month. More males crashed (56%) than females. The northwest group with most RTCs were 20-29yrs (mean 32yrs) and 52% of all RTC casualties were drivers. Injuries reported in hospital casualties were predominantly whiplash associated disorders (WAD, 62%) and required only a brief admission to A& E with 63% having no further formal follow-up. RTC medical notes did not routinely include details of any psychological symptoms (0.3%) or assessment. Poor recording of medical information limited the quality of the RTC casualty data and necessitated a prospective study to build a more reliable picture of the population.
Study A Recommendations	Develop consistent RTC databases between NHS & Police. To improve the quality and consistency of NHS injury, treatment and discharge records for RTC casualties. Proactive systems will be required to locate RTC casualties as formal follow-up is rare. Promote the use of NHS sources rather than police sources to develop a stronger overall profile of the typical characteristics and patterns of all UK RTC casualties at risk of PTS reactions.

Study	Key Results
Study B Key Results	WAD was the most frequently recorded injury in A&E for participants but the quality of the clinical records limited statistical interpretation. 40-50% of RTC casualties reported ASD level symptoms[10] after a week. 31% of RTC casualties reported PTSD level symptoms after a month. 41% of RTC casualties reported symptoms of low mood after a month. 38-64% of RTC casualties reported case-level general psychiatric symptoms[11] after a month. 72% of RTC casualties reported problems a month after the crash with dysfunction reported across many domains of daily life. More women reported ASD caseness (57% v 43%) and had a higher mean symptom severity. No significant gender differences in general psychiatric disorder, PTSD or depression caseness were found. Women had significantly difficulty managing the home, but in other domains no gender differences emerged. Analysis of predictive risk factors found that peri and post-crash variables were more strongly linked to PTS reactions than pre-crash variables. Fear, smoking and previous physical health treatment were linked to ASD, but the model was not suitable for clinical screening in isolation. Predictive modelling of depression and PTSD was linked to ASD symptoms and satisfaction with social support, but models were not sufficiently robust for diagnostic use in isolation from clinical assessment. RTC casualties reported most contact with doctors and the most common treatments received were medication or physiotherapy in the month after a crash.
Study B Recommendations	After a crash, PTS reactions should be routinely assessed since the psychological consequences affected 64% of casualties. The predictive models for ASD lacked validity so clinical assessment of ASD symptoms is required. ASD symptoms together with social support satisfaction were linked to risk of subsequent PTS reactions. Social support should be assessed and deficits addressed if casualties are unsatisfied with their support.

[10] Values relate to use of 50 or 56 as cut-off points for caseness

[11] Values relate to use of 3 or 6 as cut-off points for caseness

Study	Key Results
	Gender differences in initial PTS responses need to be considered in the assessment process. Healthcare professionals involved with RTC casualties need to be aware of PTS reactions. Training of healthcare professionals, especially doctors and physiotherapists in the assessment and appropriate treatment of PTS reactions needs to be considered. Strategies need to be developed to improve access to psychological assessment and support after a RTC.
Study C **Key Results**	A minor RTC resulting in WAD had a wide impact on the person's function and psychological state. The psychological impact of the crash was influenced by social context and support. Healthcare professionals poorly documented the full impact of the participant's crash in A&E. Psychological symptoms were not treated by healthcare professionals when treating participant for WAD. RTC casualties may have difficulty recalling information given in A&E when highly anxious or in pain. Pain and PTS reactions may be linked by a common psychological pathway after a crash. Timely and comprehensive physical health intervention was available to the participant after RTC, but not for psychological problems. Peri and post-crash variables were more strongly linked to PTS reactions than pre-crash factors. Improvements in psychological symptoms and function corresponded with the delivery of four sessions of TF-CBT within a naturalistic setting. Improvement in function and psychological symptoms was maintained after cessation of therapy.
Study C **Recommendations**	Improve awareness of healthcare professionals in A&E to ensure they assess and document full crash impact. Ensure that RTC casualties have access to advice and information in various formats after discharge from A&E. Further testing of the reported TF-CBT with RTC casualties delivered within a naturalistic setting. Further exploration of the intervention effectiveness with both men and women, particularly to investigate the role of social support and common factors within therapy. Establish a service delivery model to improve access to psychological support and intervention for RTC casualties with psychological problems. Consider physiotherapy and major disaster service models as a template for a psychological service.

Study	Key Results
Overall project Key Points	RTC casualties exceed the numbers reported to the police. Psychological problems after even minor crashes are widespread. PTSD is not the only psychological problem that emerges after a crash. Function is impaired for the majority of casualties a month after a crash. Predictive screening around the time of the crash was not able to satisfactorily predict future pathology. Assessment of ASD at one week could identify severe distress and inform a risk assessment for PTS reactions. Individuals with PTSD or depression may benefit from brief TF-CBT. Attention needs to be paid to the interaction of pain and PTS reactions. Access to timely psychological intervention after a crash was rare. Systematic approach is required to minimise the consequences of a RTC in a judicious manner.
Overall Project Recommendations	To establish and test a PlaTO service model designed to improve the overall healthcare response and increase access to psychological assessment, support and intervention for RTC casualties, consistent with the NICE guidance for major disasters.

Social support has previously been recognised to provide a buffer against stressful events. In this study, although social support availability was strongly related to depression, subjective satisfaction with support was the most strongly related to both PTSD and depression. Therefore, it appears from this study that it is important to ensure that the expectations of support are consistent with support offered, particularly as men and women are reported to assess the quality of support differently. Although satisfaction was equally important for men, it has previously been reported that men do not base their assessment of "support quality" on the quantity available, whereas the opposite appeared true for women (Antonucci and Akiyama, 1987). Additionally, lack of available practical support was associated with low mood in women, which may in part be related to their greater risk of WAD and poorer long-term prognosis (Dolinis, 1997; Versteegen, Kingma, Meijler and ten Duis, 2000).

These studies highlighted the scale of casualties and the complex patterns of comorbid physical and psychological problems, which can arise following a crash. Although the majority of participants were involved in minor crashes their psychological problems greatly exceeded (Schnyder, Moergeli, Klaghofer and Buddeberg, 2001; Creamer, O'Donnell *et al.*, 2004) those of severely injured casualties. Study C demonstrated the process whereby such a discrepant stimulus-response reaction can occur. However, many studies have also found a poor correlation between physical and psychological injuries amongst casualties (Koren, Arnon and Klein, 1999; Piccinelli, Patterson, Braithwaite, Boot and Wilkinson, 1999; Mason, Wardrope, Turpin and Rowlands, 2002), which may result in people with minor injuries being erroneously considered by clinicians to be at low risk for psychological problems.

Implications for Clinicians

The under-reporting in the police data limited its overall value as a basis on which to estimate the total RTC population. However, Study A found that, although more casualties were accounted for through A&E records, the details they contained hindered comparisons between hospitals or accurate discernment of crash consequences. If A&E records are to be used to inform understanding about crashes and their consequences then further education is required to ensure that clinicians document casualties in more detail.

Greater clinical detail would also enable casualties' initial reactions to be documented, which is relevant to the diagnostic criteria for ASD and PTSD and would also permit more consistent approaches between the A&E department and a psychological service operating alongside.

Given the annual scale of RTC and the prevalence of PTS disorders identified, being able to screen casualties for risk of such problems was appealing. However, despite identifying significant risk factors associated with the development of ASD, PTSD and depression, none of the predictive models were sufficiently reliable for clinical screening in the absence of further assessment. However, several factors were identified that may be useful to include within an A&E assessment to discern individuals, who may be at elevated risk and who may benefit from greater support and attention whilst in A&E. Being terrified by the crash, feeling unreal afterwards and being a smoker were all positively associated with ASD, whereas previous physical health problems was protective. From the results of these studies it appeared that the current role of A&E clinicians was limited, but they could have had an important role in sign-posting people to appropriate services and assisting other professionals in their roles, through the documentation of their physical and psychological assessments and details of intervention, including advice given.

The development of PTSD and low mood were found, through Study B, to be most strongly associated with ASD after a week, together with severity of dissociation and social support satisfaction. Depression too, was associated with ASD and support satisfaction but, additionally, previous mental health treatment and tangible support were significant in the predictive model. These models demonstrated the stronger relationship of peri and post-crash variables with PTS disorders, compared to pre-crash factors, which was consistent with previous studies (Brewin, Andrews *et al.*, 2000; Ozer, Best *et al.*, 2003). This opens the possibility of altering the trajectory of such disorders through improving support satisfaction and reducing ASD symptoms.

Therefore, healthcare professionals may need to re-align their interactions with RTC casualties to perceive social support and interpersonal skills as powerful clinical tools, particularly in the early recovery stages.

Study B and C demonstrated that, although most casualties were discharged from A&E without directed follow-up, most had at least one healthcare appointment in the month after discharge and there was a trend for those with ASD to present more frequently. This suggests that physicians seeing "repeat attending "RTC patients, particularly those with WAD, should be alert to underlying psychological problems as it may be difficult to discern such problems amongst complex presenting pathology such as Susan's, which highlights one of the difficulties with self-referral. The range of healthcare professionals, with whom participants in Study B reported contact, was diverse, with GPs and physiotherapists having the greatest contact with RTC casualties and yet, no one overtly received psychological services. This study demonstrated the vast training that would be necessary within the healthcare service to train all such clinicians to recognise PTS disorders and suggests that it may be cost effective and beneficial to casualties to access a central assessment service where they could also receive low-intensity stepped care, within the first month of a crash, accompanied by active surveillance of emergent psychological problems. Rather than relying on individual primary care services to undertake "watchful waiting" (NICE, 2005; NICE, 2007), this approach would be able to offer greater parity and access to services for all RTC casualties within a region.

Implications for Services

The WHO claim that 15-50% of the reduction in RTC mortality achieved in trauma care has been the result of the implementation of strategic approaches, which included organisational change and training (Mock, Lormand *et al.*, 2004). Barach (2001) recommends that strategic approaches to RTC must be based upon accurate information. In contrast, this study identified that the scale of RTC casualties attending a local hospital was 2.3 times greater than the Police data and this trend seemed to occur across the Northwest. The inaccuracy of the existing data, firstly, hinders full recognition of the scale of RTC casualties and, secondly, the costs involved in treating them. Whilst it was possible to achieve accurate information for some of the northwest A&E departments, the majority of departments had difficulty retrieving even attendance information. The value of both the Police and NHS data was inhibited by recording errors, albeit different ones. In order to develop a strategic approach to minimising the psychological consequences of crashes, the national data cannot be relied upon without review of their accuracy.

However, it was possible at a local level, in some hospitals, to achieve valid attendance data, whereas the clinical information from some of these hospitals was lacking. This study has recognised that improvements in the clinical records of RTC casualties, together with use of A&E attendances, rather than Police records as a basis for estimating the RTC casualty population, is essential to the adoption of a national strategic approach to crashes and their consequences. However, in the absences of robust information, then each PlaTO site must undertake an evaluation of the local RTC records from A&E, to inform the development of the service platform.

The array of healthcare services attended by casualties in the month after discharge from hospital, many involving repeat attendances, highlights the considerable healthcare costs directly and indirectly incurred as a result of RTCs. It is estimated that a minor collision costs £1,180 in public services (Department for Transport, 2007), with the addition of primary care costs after discharge from A&E. However, previous studies have reported increased physical healthcare costs in people with PTSD (Deykin, Keane *et al.*, 2001) and amongst women in particular (Farley and Patsalides, 2001). Despite the majority of casualties being discharged from hospital without directed follow-up, this trend was also observed in this study amongst casualties in Study B and Susan frequently attended healthcare services in the first month with significant healthcare costs incurred, in addition to her time off work.

Whilst it may have been most cost-effective and efficient to screen casualties for psychological risk when in A&E, the results from Study B, consistent with the literature, indicated that direct assessment of ASD was necessary after discharge. Although recalling all RTC casualties for a follow-up appointment carries considerable logistical and resource implications, it does offer the opportunity to offer further support, advice and risk assessment for other PTS disorders.

The provision of such low-intensity intervention is postulated to reduce some of the resources required to provide high intensity therapies, since such a session may increase satisfaction with post-crash support and positively influence the trajectory of PTS disorders in some casualties. However, this theory will need to be tested to determine the cost effectiveness.

Study A identified the largest sub-group of RTC casualties to be young adults and predominantly males. This group is of working age and since early intervention aims to return and maintain people within work, it is important that the needs of this population are catered for when designing a service. Therefore, services may need to operate a greater capacity outside of 9-5 working hours including weekends, to accommodate this group. The location of a service is also important to consider, in order to engage this population, who, like Susan, may prefer to attend an anonymous service in a physical healthcare setting, rather than a psychological unit.

These studies have highlighted the need to improve the data recording for RTCs and their consequences, in order to promote accurate surveillance of crash patterns and develop strategic approaches to their minimisation, since the scale of the problem necessitates the development of clearly defined healthcare pathways to facilitate the efficient use of resources and maximum clarity and consistency for casualties during the early stages of recovery.

Summary

This study has reported the annual volume of RTC casualties within the UK and the major implications that they can have both for the people directly involved, their support networks and wider society, irrespective of the severity of physical injuries sustained. The prevalence of psychological consequences and functional impairment from such crashes, reported within this study, places a large group of individuals at risk of long-term problems due to the potential chronicity of PTSD (Koren, Arnon *et al.*, 2001) and of WAD (Galasko, 2006) in the absence of treatment. These disorders also appear to be mutually maintaining (Jenewein, Wittmann *et al.*, 2009), which adversely affects the comorbid prognosis. This study has investigated the implications of the psychological consequences of RTC, in order to design a model to improve the post-impact psychological care and "chain of help" for casualties, in line with clinical pathways, which have improved the post-crash care of physical injuries (European Road Safety Observatory, 2007). Whilst the introduction of the NICE guidelines for the management of PTSD have recommended post-disaster strategic plans (NICE, 2005), no equivalent pathway was recommended for RTC casualties.

The results of these studies have demonstrated the need to develop such a strategic pathway for this specific population, due to the prevalence and comorbidity of physical and psychological problems reported. The study has demonstrated, that in the absence of such pathways, although casualties may repeatedly present at healthcare services, their psychological and social support needs may remain unaddressed. The preliminary study to investigate the feasibility of integrating social support interventions within a brief course of TF-CBT proved that this can be achieved and whilst further research is necessary to develop novel interventions, this must occur in tandem with development of the infra-structure to promote access to therapy (Lovell and Richards, 2000).

This chapter has presented the individual, clinical and service level implications of RTCs identified through the completion of this research study. The study has investigated the psychological impact of RTCs from a macro to micro level through three linked research studies. The outcomes of these studies have been placed within the context of existing research, in order to inform the design of a three tier model to minimise the psychological consequences of road traffic crashes within the UK. The following chapter will present the emergent model.

Chapter 11

PlaTO Model: A strategic approach to minimising the psychological consequences of road traffic crashes

This chapter will present the proposed service model PlaTO, designed to offer a strategic approach to minimising the psychological consequences of road crashes. The design of the resultant model has been informed through appraisal of the research study outcomes, extant research and national guidelines. Further lines of enquiry will be discussed to ensure the model is underpinned by research evidence and the limitations within the existing research addressed.

Introduction

Improvements achieved in the field of physical trauma care suggest that organisational responses may be effective in minimising psychological RTC trauma, since effective post-impact care strategies have been developed in many countries, thereby reducing the severity of injury consequences after a RTC (European Road Safety Observatory, 2007). Organisational strategies have been associated with increased survival rates and the WHO suggest that, between 15 and 50% of the reduced mortality achieved, was attributable to the implementation or improvement of organised trauma management systems (Mock, Lormand *et al.*, 2004). Although there are acknowledged links between physical recovery and mental health problems (Holbrook, Anderson *et al.*, 1999), the integration of psychological care into post-impact management is not typical and the involvement of mental health services within this arena can be fragmented (Zatzick, Roy-Byrne *et al.*, 2004), despite awareness that they should be integrated into the "chain of help" (European Road Safety Observatory, 2007) after a RTC. Occupational health procedures for managing everyday trauma are rare, but have been successfully implemented by the Royal Mail Group, while the outcomes of a longitudinal study of early intervention (Rick, O'Regan and Kinder, 2006), have additionally informed the development of PlaTO.

The poor integration of psychological and physical care for RTC casualties identified in this study, is compounded by the difficulty clinicians can have identifying psychological trauma responses within primary care settings (Liebschultz, Saltz *et al.*, 2007).

Meredith, Eisenman, Green *et al.* (2009) also found that people with PTSD face organisational barriers accessing appropriate services, which they suggested could be overcome by improving clinicians' skills and confidence in psychological assessment, through structural integration of physical and psychological services. However, enhancing the assessment of psychological trauma for RTC casualties in A&E may require both structural and cultural changes, since the prevailing tradition may value "processing" of patients and technological skills more highly than interpersonal skills (Crowley, 2000).

It is widely appreciated that, although effective psychological therapies have been developed, access to them is often poor (Bower and Gilbody, 2005) and Lovell and Richards (2000), in their seminal paper, argued that CBT services should offer more equitable and accessible modes of entry to therapy, not evident in traditional secondary care models. Tarrier and Wykes (2004), likewise, recognised the necessity of adopting an organisational approach to treat people with psychosis. They used the naval analogy of platform and ordnance to illustrate the necessity of integrating both service structure and therapy, considering it insufficient to develop effective interventions in isolation, for people with psychosis. The analogy is equally valid for interventions to minimise the psychological consequences of RTCs and O'Donnell, Bryant, Creamer *et al.*, (2008) have, similarly, proposed the need for a healthcare model to promote the delivery of early psychological interventions after a crash, amongst hospitalised patients. Tarrier and Wykes (2001) only focused on the integration of ordnance and platform, but the scale of the RTC population and the requirement to actively assess individuals for PTS disorders demanded that an intermediate screening stage was incorporated. This additional stage is important to "target" services towards casualties with greatest psychological problems. Targeting of intervention for RTC casualties fits within a stepped-care approach, since only a proportion of casualties may develop chronic psychological problems and effective low-intensity early interventions may reduce the numbers requiring more intensive therapy (Bower and Gilbody, 2005) . There is growing recognition of the need to adopt health-system models to ensure that injured casualties, who experience clinical level psychological impairment, receive early interventions (Zatzick, Roy-Byrne *et al.*, 2004; O'Donnell, Bryant *et al.*, 2008). Previous strategies have only focussed on casualties who have sustained greater injury severity than is common after RTCs.

The strategies also fail to take into full account the importance of social support within post-impact care healthcare pathways. The conceptual model presented here, termed PlaTO, consists of three synergistic tiers (Figure 115) which address the limitations of previous healthcare strategies.

Pla*tform* relates to the organisation of the service, knowledge of the population, engagement strategies and the necessary infra-structure.

T*argeting* relates to active surveillance for psychological risk and emergent problems, otherwise termed "watchful waiting" (NICE, 2005).

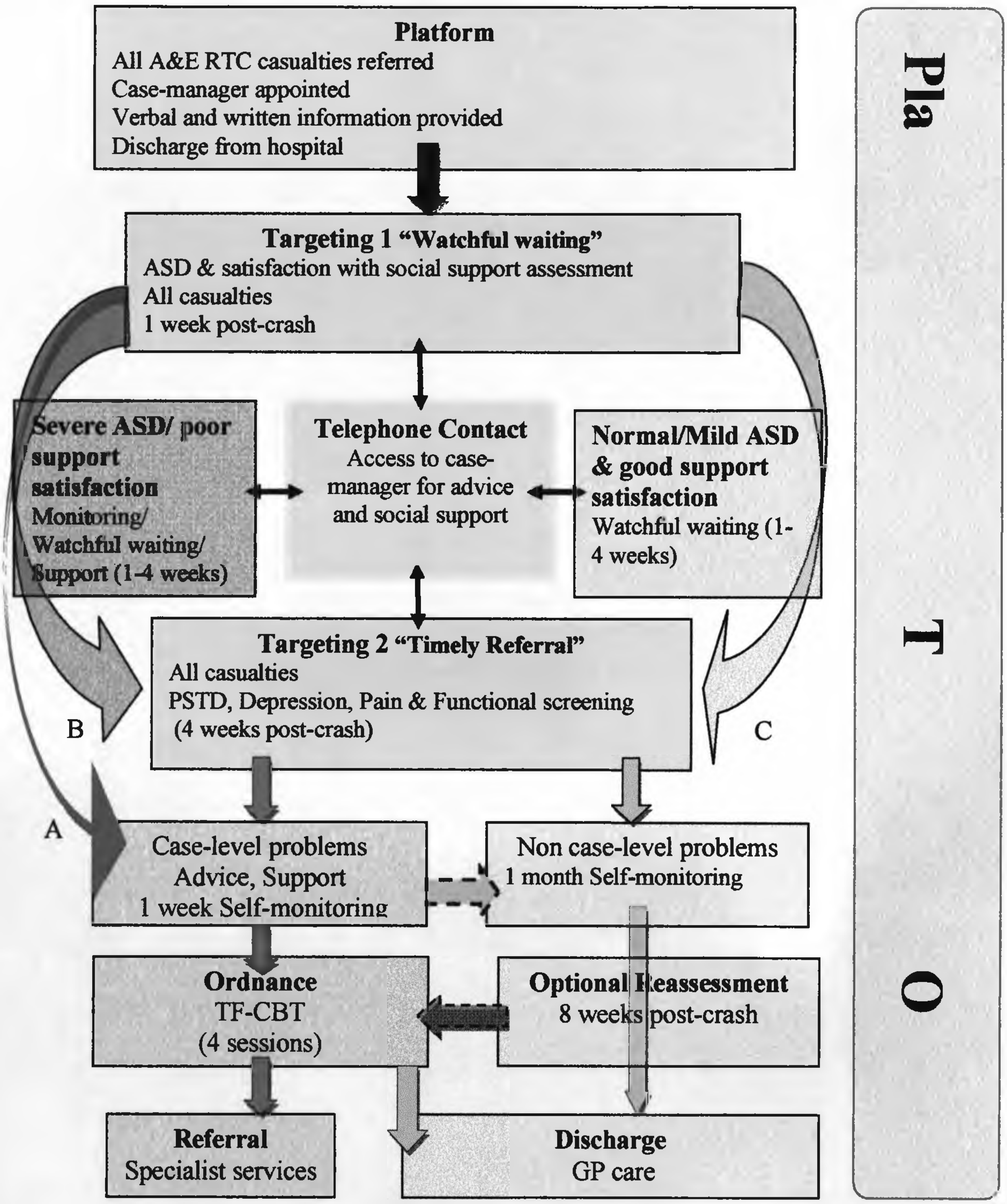
O*rdnance* refers to a brief effective therapeutic intervention for PTS disorders, offered a month after a crash.

The emergent PlaTO model therefore, offers a strategic post-impact care pathway to minimise the psychological consequences of a RTC, through active surveillance, advice and support in the initial recovery period, coupled with timely psychological interventions for people, who do not recover through this low-intensity intervention in the first month. Each tier of the model will be described, along with the rationale for its design.

Platform: The aim of the platform is to develop the infra-structure to support clinicians and promote equitable access to appropriate post-impact psychological care for all casualties. Everyone attending A&E after a crash should be assessed by clinical staff and the casualty's initial psychological reaction should be documented to facilitate subsequent diagnosis and advice given both verbally and in writing.

Informed by a collaborative care intervention (Zatzick, Roy-Byrne *et al.*, 2004), all casualties will be referred to PlaTO after discharge from A&E and assigned to a specific case manager, to ensure they receive consistent advice and support. Advice must be proffered, both verbally and in a simple written format, to assist retention after discharge.

Figure 115: PlaTO Model



The focus of such advice must be early re-engagement in activities, effective pain management and normalisation of symptoms to promote recovery, consistent with recommendations by NICE (NICE, 2005) and the Quebec Task force for WAD (Spitzer, Skovron *et al.*, 1995). Therapeutic input should be confined to "Psychological first aid", including simple support and empathy, in addition to ensuring that basic physiological needs and practicalities have been addressed before casualties leave the hospital. The model stipulates that telephone advice and support, should be provided to ensure that all casualties have access to such resources after discharge. Active surveillance for psychological problems and support deficits will be undertaken through the Targeting element of the model. The priority at this stage is to engage the casualty in the service and proffer a supportive stance.

Targeting: Whilst a large proportion of people were initially distressed a week after the crash many spontaneously improved. Following a major disaster, NICE recommends that survivors are monitored regularly in the first month and screened after a month. However, the process whereby this is feasible for other trauma survivors is less clearly prescribed (Figure 5). The aim of Targeting within PlaTO is to offer RTC casualties an equivalent level of support and monitoring as that recommended following a major disaster. It is crucial that individuals with severe disorder are identified and receive early intervention, because of the risk of long-term problems, if left untreated (Koren, Arnon *et al.*, 2001). However, care must be taken to avoid pathologising normal trauma responses, amongst casualties who will recover unaided (Bryant, 2003; McNally, 2003).

The Targeting phase endeavours to differentiate between casualty risk groups. Using a stepped-care approach, casualties will initially be offered low-level intervention, with the aim of reducing the numbers requiring more intensive interventions. For individuals reporting poor social support satisfaction, early management must address this deficit, since this study, consistent with a meta-analysis of PTSD risk factors (Brewin, Andrews *et al.*, 2000), identified the importance of social support for the development of PTSD. Additionally, this study discovered that satisfaction of support was associated with PTSD and depression following a RTC.

WAD and chronic pain have also been associated with PTS disorders (Mayou and Radanov, 1996; Jaspers, 1998; Otis, Keane *et al.*, 2003; Tunks, Crook *et al.*, 2008), while un-controlled pain has been suggested as a mediating factor in the development of PTSD (Schreiber and Galai-Gat, 1993). Given the synergy between pain and PTS disorders reported in Study C and the prevalence of WAD after a crash that emerged from Study B, it is recommended in the model that the assessment and management of pain should also be integrated within the Targeting phase. This also raises opportunities for integrating the proposed PlaTO model with healthcare pathways (MINT) being developed for the prevention of chronic WAD (Lamb, Gates *et al.*, 2007).

From the results of Study B, Two Targeting stages are recommended, since it was not possible to satisfactorily predict the development of PTS disorders (UK National Screening Committee, 2008), using the pre and peri-crash factors examined in Study B. However, the results from Study B (Figure 101) distinguished three categories of RTC casualty, with very different monitoring priorities. The clinical pathways taken by these groups during the targeting phase are outlined in Figure 115. "Watchful waiting" is a critical process in the targeting phase and involves the assessment of all casualties after a week, for ASD, pain and social support, in order to gauge their level of risk and provide relevant advice and support. Open access to advice and support is embedded within the Targeting phase of the model, since "good" support post-trauma was associated with symptom reduction amongst Royal Mail Employees (Rick, O'Regan *et al.*, 2006) and support satisfaction was a strong predictor of PTSD and depression amongst the participants in Study B .

Group A will be offered weekly monitoring and support sessions, together with commencement of high-intensity treatment within a month, if the symptom severity warrants it.

Group B will be offered scheduled monitoring and additional face to face or telephone advice and support and reassessed after a month.

Group C will be offered access to *ad hoc* telephone advice and support and reassessment after a month.

Whether assessment and contact after the initial meeting are conducted through face to face appointments, scheduled telephone contact or postal questionnaires, may depend on the resources available and the preferences of the casualty. The crucial consideration in the decision about the mode of contact must centre on maximising engagement and support for the casualties and maximising equitable access to the service (Lovell and Richards, 2000).

The second Targeting phase aims to differentiate individuals, who require high-intensity intervention and facilitate their timely access to therapy. To achieve this, all casualties must be assessed for PTSD, depression, pain, function and social support (including satisfaction) after one month. Usually, the greatest distress occurs in the initial aftermath and delayed-onset PTSD rarely emerges amongst people without sub-threshold PTSD (Carty, O'Donnell and Creamer, 2006; Andrews, Brewin *et al.*, 2007). Therefore, individuals without PTS disorders after a month will be deemed to be at low risk and offered the non-intervention pathway (Figure 115,blue pathway), whilst casualties with clinical problems will be offered the intervention pathway (Figure 115, red pathway). After assessment, all casualties, regardless of risk, will be offered the option of monitoring their own symptoms, as it has been previously shown to reduce PTSD symptoms (Tarrier, Sommerfield, Reynolds and Pilgrim, 1999; Ehlers, Clark *et al.*, 2003) and these studies suggested self-monitoring may be most effective in people with less severe symptoms.

All casualties with case-level PTS disorders after self-monitoring will be offered a brief high-intensity intervention. A few casualties within Group A with severe symptoms may need to be fast-tracked into therapy or other appropriate interventions (Figure 115), consistent with the NICE recommendations (NICE, 2005).

Ordnance: In the absence of effective preventative interventions (Wessely, Rose *et al.*, 2000; Bisson, 2003; Ehlers, Clark *et al.*, 2003; Turpin, Downs *et al.*, 2005; Roberts, Kitchiner *et al.*, 2009), the management of psychological trauma relies, firstly, on active surveillance to recognise PTS disorder (Targeting), followed by early intervention.

Timely access to therapy, whilst important to minimise the development of secondary problems, was also deemed to be as cost-effective as delaying intervention until three months (NICE, 2005). Within the PlaTO model, casualties who are medically stable and have a PTS disorder would commence therapy around six weeks post-crash, preceded by a period of symptom-monitoring. This timescale is consistent with current guidance for early interventions (NICE, 2005).

For chronic PTSD, both TF-CBT and EMDR were recommended therapies (NICE, 2005) and CBT was recommended for the treatment of established depression (NICE, 2007). A number of studies have investigated brief early TF-CBT and intervention typically includes psycho-education, imaginal reliving, reversal of behavioural avoidance and cognitive change (Ehlers and Clark, 2003). Research evidence to support brief TF-CBT continues to develop and whilst the studies generally report superior outcomes compared to controls, the limited number of studies and methodological concerns, inhibit firm conclusions on the effectiveness of such intervention (Ehlers and Clark, 2003). However, whilst it acknowledged the limitations in the available evidence, NICE recommended brief TF-CBT for the early treatment of PTSD (NICE, 2005). Within the PlaTO model, all casualties with PTS disorders will receive four sessions of TF-CBT and be reassessed on all measures after completion of therapy. Individuals who have achieved their therapy goals and no-longer meet case-level criteria would be discharged to their GP, with the recommendation that their recovery is reviewed after another month. Casualties who continue to experience case-level symptoms would be referred to the appropriate clinical services, such as physiotherapy, pain management, psychiatry or psychology.

Susan's case study illustrated the complex interplay between the physical, psychological, pain and functional problems that can occur after a crash. Such multi-faceted presentation amongst RTC casualties may merit specific investigation to ensure their complex needs are fully addressed by intervention (O'Donnell, Bryant *et al.*, 2008). It is unlikely that clinical guidelines will be developed to address such complex comorbidity and clinicians, in their endeavour to deliver evidence-based interventions, will still be required to integrate the best available evidence with their judicious clinical judgement (Sackett, Gray *et al.*, 1996) when providing intervention for an individual casualty.

Peterson's model offered a guide for the formulation, delivery and evaluation of such idiosyncratic interventions (Peterson, 1991), in the absence of appropriate clinical guidance.

The research study demonstrated it was feasible, through the use of Peterson's model to integrate social support focused intervention, within brief TF-CBT, for an individual with support deficits. Whilst the outcomes were promising and changes in Susan's physical and psychological symptoms were consistent with the therapeutic input, the study design did not permit causal relationships to be established. The case study also suggested that it was practicable to address both mood and PTSD simultaneously, within a brief number of sessions, whereas NICE advocate treating the trauma symptoms first (NICE, 2005) and the depression guidance does not specifically relate to post-trauma depression (NICE, 2007).

Further PlaTO Considerations

It is apparent that the *Platform* for the PlaTO model must be established through a robust understanding of the RTC population, since the patterns of crashes vary considerably across a region and even between adjoining hospitals, as with Hospital A and C, in this study. The relevance of the service platform rests upon accurate information regarding the national and regional RTC patterns, but especially on the demographic profile of the local crash population (Barach, 2001). This study demonstrated that the police data, although reliably reported, was not appropriate to use to inform the Platform, due to the scale of national, regional and local under-reporting of RTCs. Therefore, A&E data offers the most comprehensive information to inform a PlaTO service. Establishing an appropriate platform entails knowledge of the annual, monthly, weekly and daily variations in RTC casualty attendances, together with the typical patterns of casualties' injury severity, gender and age. These factors are influenced by the catchment area's geography, prosperity and transport infra-structure, as illustrated in Study A. Without such knowledge, staffing levels, hours of operation and evolving patterns cannot be established. For example, Hospital A saw on average 10-12 casualties per day, with minor variations between weekdays and weekends. Peak attendances came after the morning and evening rush hour, with the majority of casualties attending between 7am and 9pm.

Although casualties did occur at night, they typically involved more severe injury requiring admission, for treatment or observation before discharge. PlaTO, in this setting, would therefore require its highest staffing levels from 7am to 9pm daily, the majority of injuries being minor, with discharge occurring within 4 hours of attendance. However, this detail must be determined at each PlaTO site to ensure the platform is tailored to the local casualty patterns

For many hospitals, the quality of the RTC data was of poor quality or non-existent. Whilst electronic data systems may have improved A&E data is still not integrated into the HES system, limiting understanding of National RTC injury and treatment patterns. The weakest data was the clinical information, due to failure of clinicians to document their interventions. Development of the PlaTO *Platform,* therefore, requires education of clinicians to appreciate how documentation can inform surveillance of RTC patterns. However, changes in the reporting practice of clinicians will require management support and IT systems implemented to ensure compliance. Since this study, one hospital has developed its electronic records and now ensures clinicians' compliance in completing all casualty records through embedded IT systems.

Having discovered the close relationship between social support, particularly satisfaction, and PTS disorders, it is essential that support is integral to the PlaTO model, although social support is not an inert interaction. It has been found to be both beneficial and detrimental to health and well-being (Cohen and McKay, 1984; Chandola, Marmot and Siegrist, 2007), with gender differences in the type and amount of support also recognised (Direiter, 1998; Andrews, Brewin and Rose, 2003; Kendler, Myers and Prescott, 2005). Therefore consideration must be given to timing and type of support offered. Joseph suggested that practical support and advice were more appropriate immediately after a trauma, whereas social and emotional support were more important later (Joseph, 1999). PTSD can reduce social support (Davidson, Hughes, Blazer and George, 1991), through avoidance and cognitive distortions. Limiting these symptoms may help to protect social relationships. In Study B poor practical support was associated with depression, for women and in Royal Mail workers the availability of practical assistance along with emotional support was linked to less PTS symptoms (Rick, O'Regan *et al.*, 2006).

Results from this study demonstrated the association of support satisfaction, in men and women to PTSD and depression. In light of the recognised gender differences in the structure and type of support perceived as beneficial (Wilson and Stokes, 1983; Antonucci and Akiyama, 1987; Matud, Ibanez, Bethancourt, Marrero and Carballeira, 2003), any provision of social support must be considered from a gendered perspective, to ensure it satisfies both men's and women's different expectations.

What form early practical help should take will need further investigation amongst RTC casualties and its delivery may be more appropriate through the voluntary sector eg Roadpeace or Victim Support, to provide the range of assistance necessary. A service available in Australia provides a range of practical support to RTC casualties (Remember Me, 2009). They report that practical assistance, such as homecare, was requested long before emotional support underlining the need to assess availability of social support during early recovery, to tailor intervention towards identified deficits.

Service setting will also need to be considered according to facilities available, albeit this study, undertaken entirely within an A&E department, found that the challenges of such an environment were surmountable and that the anonymity of the location was actually preferred by the exemplar casualty. Operating such a service within A&E, may also help to overcome some of the barriers faced by trauma survivors when trying to access mental health services (Meredith, Eisenman *et al.*, 2009). The inter-relationship between post-crash psychological problems and whiplash (Stirling, Jull *et al.*, 2005) has been previously recognised. A stepped-care approach being tested in the UK (MINT) for the reduction of chronic WAD (Lamb, Gates *et al.*, 2007) together with the overlap with PTS disorders found in Study B, suggest that it may be possible to integrate the advice, assessment and support (Spitzer, Skovron *et al.*, 1995; NICE, 2005; NICE, 2007) aspects of the two models, for greater efficiency as they operate over similar timescales and may frequently involve the same casualties.

Further economic implications of PlaTO will also need to be considered. Case-management and telephone support must be developed with associated costs, although integration of these with MINT (Lamb, Gates *et al.*, 2007) may reduce the overall overheads.

Total therapy costs of £229.27 per individual have been estimated for 5 sessions of CBT (NICE, 2005). Given that up to 64% of the participants in the study experienced case-level psychiatric symptoms in Study B, this equates to only £560,000 when annualised for Hospital A. In context, this was equivalent to 0.25% of the hospital's annual budget (Appendix 5) and this cost for the running of PlaTO clearly has to be balanced against all expenditure, which would be incurred in the absence of treatment as reported in Study B, such as increased medication, physiotherapy, repeated GP visits, increased healthcare attendance, as well as lost earnings and workdays. However, if low-intensity intervention proved effective, the proposed stepped-care approach should reduce the numbers who subsequently require high-intensity therapy. However, detailed economic modelling and potential savings analysis for the service needs to be conducted in conjunction with the piloting of the model to ensure its economic and therapeutic effectiveness.

Summary

The study has identified how national RTC data has concealed the full enormity of road crashes, the sizeable proportion of casualties who develop psychological problems and the considerable impact such an everyday trauma has upon individuals, together with the encouraging alleviation of crash-related symptoms following a brief TF-CBT^{SS} intervention. These different lines of enquiry together with the difficulties discovered when endeavouring to screen for PTS disorders, led to the design of the PlaTO model. The PlaTO service must now be piloted, so that practical issues such as staffing, administration and cost effectiveness can be determined, alongside the evaluation of therapeutic effectiveness.

PlaTO fundamentally differs from the NICE recommendations in that it does not rely on self-presentation (NICE, 2005). It instead endeavours to proactively engage and support casualties, whose problems can be characterised by avoidance and difficulty accessing services (Meredith, Eisenman *et al.*, 2009). However, further validation of the model is necessary, in view of the methodological limitations of the studies undertaken to inform the design of PlaTO.

Research Limitations

The design of the model was informed by the results of Studies A-C. However, the service must be piloted, to test the logistics and effectiveness of operating PlaTO *in situ.*

The studies used complimentary designs to investigate the impact of a RTC from a macro to micro level. Whilst each of the studies inevitably had methodological limitations, with some potential to influence the results, the overall design was strengthened by having the overlapping perspectives provided by the three studies, which compensated for some of the limitations. Although Study A interrogated large extant data sets from the police and NHS, the nature and quality of the original information limited the strength of any conclusions drawn. The data sources collected RTC information for two entirely different ends (road safety for the Police and reimbursement of costs for the NHS), neither of which were congruent with this study (American Society for Training and Development, 2009). Both national data sources had major limitations, which were partially overcome, by using multiple-overlapping information to form a mosaic impression of the population. Whilst the police data was generally reliably collected using a standardised format, the propensity of some casualty groups to not report their crash to the police (Department for Transport, 2008) considerably impaired the value of the resultant information. Without legislation, under-reporting amongst casualties will be hard to overcome, creating difficulties using this information to estimate the target RTC population size. The limitations in the police data were off-set against greater reporting to A&E.

However, the inconsistent information systems across the NHS, combined with the poor completion of clinical data in the original casualty notes, impaired the quality of the hospital records. In spite of these problems, the A&E data provided a more complete overview of RTCs and their consequences. Unfortunately, the non-existent or discrepant electronic recording systems used across the Northwest hospitals, limited the analysis of clinical treatment or follow-up data, between hospitals. The quality of the A&E data was generally impaired by internal influences, making them more amenable to improvement. A more valid understanding of the immediate consequences of a RTC could be achieved through consistent record-keeping between hospitals and better documentation of clinical information.

Whilst the demographic details in these records were reliably completed due to the IT system designs, the poor quality of the clinical data erroneously indicated low levels of distress amongst the RTC population, in the immediate aftermath of a crash.

The noted limitations in the clinical information within Study A, were somewhat compensated for by the design of Study B, wherein participants provided information about their own crash reaction (information that was missing from the A&E records). Although this was a prospective study, the participants had to retrospectively describe details of their initial crash response, since ethical constraints prohibited them from entering the study, whilst attending A&E. Consequently, some of the benefits of adopting a prospective design were tempered by the retrospective reporting of the peri-crash response. Although Study B identified a relationship between peri-crash dissociation and subsequent disorder, consistent with other studies (Harvey and Bryant, 1998; Ursano, Fullerton, Epstein, Crowley, Vance *et al.*, 1999), this would have had greater validity if reported nearer to the crash, as dissociation interrupts memory formation and subsequent recall of events. Future screening would need to overcome ethical constraints and directly assess symptoms within the peri-trauma time-frame. Furthermore, dissociation itself is a vague concept, lacking diagnostic precision and McNally (2003) suggested it would be more useful to investigate specific dissociative symptoms, rather than an overall rating, as used in the screening questionnaire.

The results from Study B were compromised by the low participation rate. Whilst high responses rates are desirable to minimise bias, this is not an inevitable consequence. Asch, Jedrziewski and Christakis (1997) recommend that it is more important to describe the bias within the sample, than an overall response rate. The reporting of this study made the age and gender differences in the sample overt, which must be taken into account when evaluating the results reported. The study aimed to inform the design of the PlaTO service hence the propensity for an older, more female population to participate, may equally reflect the individuals who would choose to take up such a service, thereby reducing the concerns around the skewed demographics upon service design. The response rate also raised concern that participation may have been affected by avoidance or low motivation amongst individuals with the most psychological problems.

However, this was countered by the participation of casualties before the disorders developed and the high response rate at Time 2, suggested that those who developed PTS disorders, did not avoid completing the questionnaires.

Since PTSD will spontaneously remit for many RTC casualties (Blanchard, Hickling *et al.*, 1997), the limited time-span of this study measured the early prevalence of PTS disorders and did not investigate remission rates. Since spontaneous recovery that occurs within the first few months of a crash, may reduce the number of individuals that require early TF-CBT, it will be important to investigate the level of remission in the population, to inform the cost/benefit analysis of the service. Additionally, 12 month follow-up would enable spontaneous remission and incidence of delayed trauma responses to be investigated, which is important in view of the multiple pathways to PTSD over the first year (Harvey and Bryant, 1999). This would enable evaluation of the model, to ensure that the needs of individuals with delayed onset disorders were included within the proposed PlaTO design.

In order that Study B's results complemented the large data sets utilised in Study A, casualties completed self-assessment questionnaires. These permitted the involvement of the recommended sample size (O'Donnell, Creamer *et al.*, 2003) and avoided the reactive effects of direct contact (Sim and Wright, 2000) with participants. In this study, interviews could have introduced a confounding variable, by conveying social support through direct contact, whilst also presenting barriers for casualties with difficulty attending the hospital. However, self-report measures can suffer from response bias (Hammond, 2000), which can affect scores. The self-report measures used in Study B were selected for their response time, readability and their relevance to the required diagnostic criteria (National Centre for PTSD, 2009) as well as their application in clinical settings. Achievement of these criteria, consequently limited the tools' diagnostic validity, compared to the "gold standard" of a diagnostic clinical interview (First, Spitzer, Gibbon and Williams, 2002). However, the primary intention was to detect pathological symptom levels and associated risk factors, rather than provide a definitive diagnosis. Although cut-off points were sometimes used in the studies, these were not intended to imply fulfilment of diagnostic criteria, rather to indicate the degree of symptom severity.

As the study desired clinical relevance, the aim was that all patients with problems were initially identified, since false positives could be recognised through subsequent assessment within the PlaTO protocol, rather than risk failing to identify distressed individuals. It is acknowledged that the true prevalence of disorder may differ from the values reported in this study, if diagnostic criteria were directly assessed. However, sub-threshold PTSD can also result in dysfunction and distress (Stein, Walker, Hazen and Forde, 1997) and is a risk factor for delayed-onset disorder (Carty, O'Donnell *et al.*, 2006). Therefore, it is important that the service adopts a wider remit than strict adherence to diagnostic criteria. Whilst the prevalence of disorders reported here, may differ somewhat from the general RTC population, it may also provide a more useful estimate of numbers requiring the PlaTO service.

The concept of social support investigated in Study B is a complex construct with idiosyncratic meaning. Study B assessed social support in the first week, initially using a rating system and later using a VAS, to measure support provided and satisfaction with support. However caution in interpreting VAS scores has been called for by Flanagan, Vogensen and Haase (Flanagan, Vogensen and Haase, 2006) in the context of pain on the grounds that such a complex experience cannot fully be represented through uni-dimensional rating scales and that ratings can be readily influenced by mood. Similar caution may need to be exercised when interpreting the social support and satisfaction ratings within this study due to the complexity of the phenomenon and the mood problems recognised in the sample. Alongside the VAS a standardised measure of support availability was used to triangulate the results. Both methods of assessment have recognised reliability and validity (McDowell and Newell, 1996) and the use of several social support assessment tools within Study B strengthens the value of the results obtained. Nevertheless the idiosyncratic and complex subjective nature of social support for crash casualties may additionally benefit from qualitative investigation through interviews, to explore how support relates to PTS disorders, amongst RTC casualties.

Whilst Study A examined data from several hospitals, Study B relied upon data from a single A&E department, which could have been influenced by covert factors specific to that department.

The results provide a profile of Hospital A casualties, but this may not generalise to other emergency departments. Replication of this study should be undertaken more widely in A&E departments serving different populations and road networks. However replication within the specific setting of a planned PlaTO service, would ensure the platform and targeting meet the needs of the catchment area.

Study B aimed to obtain a broad overview of the prevalence of PTS disorders, associated risk factors and consequences of a crash. In order to achieve a large sample size, the assessment of the functional consequences of a crash and the impact upon the casualty's everyday life was limited to only one functional assessment. Some compensation for this limitation was achieved through the single case-study which offered a deeper understanding of a crash and its functional impact, for an individual. However the results from Study B suggest that this significant area should be focused upon more extensively in subsequent RTC research. The functional impact of a crash could be investigated more fully by more specific measures of function such as the FIM(TM) (Wright, 2000) or directly through the "yesterday interview" which is a semi-structured method that involves detailed reconstruction of the previous 24 hours in terms of daily activities, environmental contexts and pleasure (Lomax, Brown and Howard, 2004).

Whilst case-study methodology has a long history and it has been suggested as an ideal approach when in-depth investigation is required (Feagin, Orum and Sjoberg, 1991), it is often portrayed as a weak method (Sackett, 1993), despite its rich contributions to the exploration and description of complex phenomena (Yin, 2003). Study C importantly permitted the exploration of process issues and provided a "multi-perspectival" analysis (Tellis, 1997) of an individual with complex comorbidity, than could not be achieved using RCT designs (Zatzick, Simon and Wagner, 2006). Whereas RCT designs rely on the validity of the sample selection, case study research does not aim to be sampling research but cases are selected to maximise understanding within a specific time-frame (Tellis, 1997). Whilst a criticism of single-case research lies in the lack of generalisability to the population, clinicians may equally struggle to relate the results of highly selected research populations to their specific clients. The exemplar was selected according to pre-defined criteria, so they possessed many of the typical characteristics of RTC casualties.

The use of multiple cases to form a case-series has been recommended by Yin (2003) since it can strengthen pattern-matching, thereby increasing confidence in the robustness of the results, although such studies are also vulnerable to bias (Round, Garside and Stein, 2003).

The detailed information included within the case–study primarily aimed to provide the reader with enhanced understanding of the individual and the idiosyncratic impact of the crash. A limitation of this study was the lack of triangulation, utilising data collected by other investigators, particularly those from different theoretical viewpoints (Tellis, 1997). Within qualitative research member checking is another strategy used to verify the researcher's perspective fits the participant's experience (Lincoln and Guba, 1985), this was not undertaken in this study as Susan did not wish further commitment to the study after completion of therapy. However the ability of participants to accurately recall their experience many months later has been questioned (Angen, 2000) and this may be a relevant concern amongst participants with dissociative problems, limiting the validity of such an approach.

Secondarily Study C enabled exploration of the process and outcomes of TF-CBT^{SS}, with sufficient transparency to promote external scrutiny and inform discussion about the intervention delivered. For methodological reasons, trial studies aim to recruit participants who are homogeneous in a particular variable, but consequently, they may not resemble a "typical" client (Wessely, 2002). Through single case research, it was possible to focus upon an individual with a complex array of physical, social, psychological and functional problems and describe the implementation of a multi-strand intervention. Repetition of case experiments will help to develop TF-CBT^{SS} and understand differences between male and female social support. Pre-post therapy measurements identified changes in symptoms and function that occurred. Since rival explanations could not be ruled out (Yin, 2003) causality between the intervention and improvement cannot be assumed. Spontaneous symptom reduction may have occurred through natural recovery, although the "within therapy" changes suggest otherwise. However, extraneous variables outside of therapy, such as returning to work, reducing alcohol consumption, changes in friends' behaviour or the impact of the therapist-client relationship, could not be ruled out.

Further investigation of the intervention through a multiple-case series would help to develop the probity of these preliminary results (Tellis, 1997) and test the merit of TF-CBT^{SS} amongst a more disparate group of participants, particularly if gender and age differences formed part of the purposive sample criteria.

Each study design demanded a compromise between the idiographic and the nomothetic with a different equilibrium achieved between these competing demands for the three studies. Overall the research design aimed to compensate for the limitations of an individual study, through their complementary design. Collectively, these research studies have advanced understanding of RTCs from a macro to a micro level. New knowledge arising from these studies included the under-estimates of RTCs in the police records, the comparison of A&E and police recorded RTC patterns. The studies also informed of the sizeable prevalence of PTS disorders and dysfunction a month after a RTC, together with the importance of social support satisfaction as a risk factor for such disorders. Furthermore understanding of the interaction of PTS disorders and dysfunction at an individual level was developed and the feasibility of integrating social support interventions within four sessions of TF-CBT was established at the individual level.

Future Research

Before the PlaTO model can be piloted, further research must be conducted to develop a more robust understanding of the target RTC population, the prevalence of specific PTS disorders, the long-term prognosis after crash and the effectiveness of TF-CBT compared to TF-CBT^{SS}.

Whilst Barach (2001) emphasised the need for accurate data to develop crash services, the paucity of the quality of national and local RTC data, either from the police or the NHS, still limits accurate evaluation of the target population size and demographics. The under-reporting of crashes to the Police prevents this being remedied by a census study of RTCs and compels the use of NHS data. At the time of this study, hospital IT systems were rarely capable of reporting RTC attendances. Advances in NHS electronic records may now permit easier retrieval of such information, with the possibility that the incidence and demographics of crashes across the UK can be surveyed more easily via A&E departments, thereby developing more realistic estimates of the total RTC population.

Access to more detailed clinical information, to inform understanding of typical injury and treatment patterns following a crash may remain problematic, in the absence of systems to bring about behaviour change amongst A&E clinicians. Encouragingly, this has been achieved by one of the hospitals participating in this research. Wider implementation of similar standardised electronic record systems coupled with the education and training of clinical staff regarding the importance of documenting their psychological and physical assessment, would enable more extensive investigation of the immediate crash consequences, than was feasible within the current study. Knowledge developed from such investigation could identify existing post-impact care pathways and complement the limited evaluation of the patient journey undertaken in Studies B&C.

To test the accuracy of the PTS disorder prevalence reported in this study, further research must consider improving the validity of the results through triangulation which could be achieved by comparison of the prevalence determined by self-completion measures and a sample assessed using a clinical interview such as the SCID (First, Spitzer *et al.*, 2002) or CAPS (Blake, Weathers, Nagy, Kaloupek, Gusman *et al.*, 1995). Such a clinical survey must also extend the disorders assessed, because a range of post-traumatic responses have been reported, including OCD (Pitman, 1993) and phobic disorders (Blanchard and Hickling, 2004), which may also benefit from the proposed stepped-care approach. By re-assessing casualties at 3, 6 and 12 months after their crash, delayed responses and spontaneous remission rates could be established for the population, although the potential influence of regular assessment on their perception of social support must be considered.

Effective brief early intervention is essential to the stepped-care PlaTO model and whilst evidence exists to support the effectiveness of early TF-CBT, further research is necessary to develop a stronger evidence base for its effectiveness. It is also necessary to evaluate its acceptability amongst RTC casualties, since drop-out rates for PTSD intervention hinder their effectiveness (Tarrier, Liversidge and Gregg, 2006). This study has presented a preliminary novel single case-experiment that demonstrated the feasibility of integrating social support interventions into brief TF-CBT, thereby, addressing PTS disorders alongside risk factors for the development of such problems.

This intervention, since it addressed both symptoms and risk factors for PTS disorders, would theoretically have be expected to offer superior outcomes compared to TF-CBT. However, this notion remains at a theoretical level until further evaluation of TF-CBT^{SS} occurs. Further development and investigation of this intervention, through a series of case-studies, must initially be conducted to determine the validity of these results. Whilst case-series research has also been considered poor evidence of effectiveness, the results from such studies have been widely incorporated in reviews undertaken for NICE (Round, Garside *et al.*, 2003). However careful consideration must be given to strategies to minimise bias within case-series (Round, Garside *et al.*, 2003) in order that any emergent results can be used to appropriately inform the subsequent research step. This would be to test TF-CBT^{SS} against the more parsimonious TF-CBT, in a randomised controlled trial in conjunction with a qualitative study to explore the acceptability of both interventions from the viewpoint of the participants (Tellis, 1997) to minimise drop-out rates which presently affect the effectiveness of CBT (Tarrier, Liversidge *et al.*, 2006).

The outcomes from these studies could be utilised to strengthen the ordnance aspect of PlaTO (Figure 115), before piloting the model within a naturalistic setting, where it can be compared against the usual A&E and primary care response, for its effectiveness and acceptability in minimising the psychological consequences of a RTC.

Conclusions

Cars have become integral to Western society, but along with all the advantages come crashes, and their frequency is so great, that they now appear an inevitable and commonplace consequence of everyday life, with 1.2 million RTC deaths annually (World Health Organisation, 2009). Despite policy and legislation to reduce the annual number of crashes in the UK, the numbers remain steadfast. Whilst improvements in vehicle design and trauma-care have improved survival rates and limited serious injury, there has been a concomitant increase in minor injuries. Indeed, the most common condition after a crash is whiplash (WAD), which can be associated with considerable pain and impairment, can persist for years and is strongly associated with psychological problems, such as PTSD (Stirling, Jull *et al.*, 2005).

PTSD is reported to affect 10 - 30% of RTC casualties (O'Donnell, Creamer *et al.*, 2008), with comorbid disorders such as depression and substance abuse also being commonplace (Brady, Killeen *et al.*, 2000) . These problems are exacerbated by GP's reported difficulty recognising PTSD (Liebschultz, Saltz *et al.*, 2007) hence access to appropriate psychological therapy can be hindered by structural and temporal barriers for many individuals (Lovell and Richards, 2000; Meredith, Eisenman *et al.*, 2009). These combined problems can result in an immense group of casualties with psychological problems going unrecognised in the immediate aftermath of a crash.

The introduction of NICE guidelines for the treatment of PTSD, offered recommendations for management strategies following major disasters, although everyday events such as RTCs, were offered less rigorous early management protocols (Figure 5). The value of the guidelines for RTC casualties were also limited by the need for casualties to self-refer and by the need for GPs to have the skills and confidence to diagnose PTS disorders (Liebschultz, Saltz *et al.*, 2007). Since the subjective perception of an event is associated with the development of PTSD, the differentiation between major disasters and everyday ones lacks logic, further evidenced by the high prevalence of PTS disorders identified amongst participants with only minor injuries. This study makes the case for the development of a "post RTC impact" care pathway, equitable with services available for people following a major disaster, since both types of event can result in considerable personal suffering and consequences for wider society.

There is growing recognition that developments in therapy must be combined with healthcare delivery strategies and to offer graded intervention through a stepped-care approach, in order to increase access to services and reduce the need for high-intensity therapies (Lovell and Richards, 2000; Bower and Gilbody, 2005). To develop a model based upon these principles and the NICE guidelines for major disasters, a series of three studies were undertaken. The proposed PlaTO model is based upon understanding of the population (Barach, 2001), the prevalence of PTS disorders, risk factors and crash consequences, which emerged from the three research studies. The research was undertaken using multiple methods to provide a macro to micro level of insight into RTCs and their psychological consequences.

This study discovered that extant Police and NHS records considerably under-estimated the RTC population size at a national and regional level, which is of major concern given their use in the development and monitoring of policy. However, at a local level it was possible to obtain verifiable demographic data from an A&E department, which when compared with corresponding police data, exposed immense under-reporting of RTCs to the Police (Figure 114). In the hospitals studied, crash casualties were typically young adults (mean age 32yrs), over half were drivers and slightly more were men (56%). Whiplash injuries were the most common complaint (62%) amongst casualties. Surprisingly, in spite of taking a very broad definition, less than 0.3% of casualties were distressed after their crash, according to the A&E records, compared to 50% with ASD after a week. The large majority of casualties attended hospital for less than 4 hours and 63% were discharged without any directed follow-up. This study found that the poor quality of the clinical information documented for RTC casualties in A&E, distorted the apparent physical and psychological consequences of crashes.

In contrast, when A&E casualties were directly surveyed for psychological symptoms and risk factors, 50% reported symptoms consistent with ASD a week after the crash. After 1 month, 31% reported PTSD level symptoms, whilst low mood was also common (41%). Overall, 64% had developed psychological problems by a month after a crash and a greater number (72%) reported problems functioning. Despite gender differences being reported for PTSD prevalence after trauma, (Norris, Foster *et al.*, 2002) only ASD prevalence was greater for women in this study. In light of the preponderance of men involved in crashes, their equal prevalence for PTS disorders may serve to increase the size of the overall population at risk. A series of generic and gender specific predictive models for PTSD and depression were developed from the theoretical stance of being able to identify at risk casualties in A&E.

These models, despite accounting for a sizeable proportion of the variance in ASDS, IES-R and BDI scores, did not fulfil Wilson's screening (UK National Screening Committee, 2008) criteria Therefore, this study has cautioned against screening of A&E casualties and amended the design of the proposed PlaTO model accordingly, to stipulate follow-up assessment for all.

Although previous studies have identified social support as a risk factor for the development of PTSD, this is the first study to report that satisfaction with support over and above support availability was a risk for the development of PTS disorders. However, this finding also opens new opportunities for early interventions, since social support and attendant satisfaction may be amenable to change (Joseph, 1999), potentially through stepped-care approaches recommended within the PlaTO model. However, the introduction of social support interventions needs to include a gendered perspective in view of the greater significance of support, in general, as well as practical support in particular to women, identified in Study B. In view of the relative importance attached to post-crash social support for RTC casualties' psychological recovery, the findings from the preliminary case-study, which integrated social support within TF-CBT, were encouraging. Now that it has proved feasible to deliver TF-CBT^{SS} within the confines of four sessions and in a naturalistic environment, additional research must be undertaken to develop the intervention further and test its efficacy through comparison with the currently recommended TF-CBT

The results of these studies have informed the development of a three tier model (Platform, Targeting and Ordnance), which aims to offer an accessible stepped-care approach for the immediate management of psychological problems after a road traffic crash and offers parity with the recommendations for survivors of major disasters (NICE, 2005) and is consistent with the guidelines for the management of depression (NICE, 2007). Following further recommended research to inform the model, PlaTO (Figure 115) must be piloted within a naturalistic setting, to test whether its implementation can minimise the psychological consequences of a road traffic crash which are currently suffered by a large proportion of RTC casualties in the UK.

If the PlaTO healthcare model proves to be successful in alleviating some of the personal psychological suffering and societal consequences of crashes, its extension to other UK locations and internationally may offer assistance to the 50 million people worldwide that are injured on the roads each year (World Health Organisation, 2009).

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APPENDICES

Appendix 1: Number of Road Crash A&E attendances recorded by hospital

	1998	1999	2000	Information source
Blackburn Hyndburn & Ribble Valley	Not available	Not available	Not available	
Blackpool Victoria	2,216	2,133	1,085 (6mths)	A&E dept
Bolton Hospitals	2,656	Not available	Not available	A&E dept
Burnley Healthcare	2,632	2,745	Not available	R&D dept
Bury Health Care	Not available	2,291	Not available	HR dept
Central Manchester Healthcare	Not available	Not available	Not available	
Chorley & South Ribble	Not available	Not available	Not available	
Countess of Chester	2,466	2,395	2,501	A&E dept
East Cheshire	1,534	1,524	Not available	IT dept
Fazakerley	4,771	4,684	4,356	A&E dept
Furness General Hospital	Not available	Not available	Not available	
Halton General Hospital	Not applicable	Not available	Not available	
Lancaster Acute Hospitals	Not available	Not available	Not available	
Mid Cheshire Hospitals	2,149	2,139	Not available	R&D dept
North Manchester Healthcare	Not available	Not available	Not available	
Oldham	2,624 (9mths)	3,479	2,208 (9mths)	A&E dept
Preston Acute Hospitals	2,690	2,749	1,300 (6mths)	A&E dept
Rochdale Healthcare	2,673	Not available	Not available	Audit dept
Royal Liverpool	3,848	4,181	Not available	A&E dept
Salford Royal Hospitals (Hope)	2,666	2,679	2,005 (10mths)	A&E dept
South Manchester (Withington)	Not available	Not available	Not available	
St Helens & Knowsley	5,037	4,398	1,992 (6mths)	Audit dept

	1998	1999	2000	Information source
Stockport Acute	5,378	5,159	1,342 (5mths)	A&E dept
Tameside Acute	Not available	Not available	Not available	
Trafford Healthcare	Not available	Not available	Not available	
Warrington DGH	2,351	2,613	Not available	A&E dept
Southport & Formby	Not available	Not available	Not available	
West Lancashire	Not available	Not available	Not available	
Westmorland (Barrow in Furness)	Not available	Not available	Not available	
Wigan & Leigh	Not available	Not available	Not available	
Wirral	3,831	3,807	3,819	IT dept
Mean no of attendances (Standard Deviation) Range of attendances	3095.13 (SD+/- 1129) 1534 - 5378	3131.73 (SD +/-1082) 1524 - 5159		
No of Hospitals with data	16	15		
No of hospitals with data missing	14	15		
Total Hospital Crash attendees	49,533	46,976		
No of crash casualties in Northwest STATS 19	44,815	44,750	44,514	

Appendix 2: Scoring system for A&E electronic record quality

Category of Information	Criteria for scoring A&E Records				Score (Maximum score =4)
Patient Related Information	Age/ Date of Birth	Gender	Residence (Postcode used as indicator)	Occupation	
Crash related Information	Type of road user	Direction of crash impact	Location of crash	Speed of impact	
Crash Consequences Information	Injuries	Injury severity	Treatments	Follow-up Referrals to specialists	
A&E system	System linked to other hospital computer systems	System allows patients to be tracked after A&E			

The quality assessment was carried out using a 0-4 scale with one point was awarded if a minimum of 2 out of 4 of the required criteria were met for each category.

Appendix 3: Pro-forma for recording original A&E casualty notes

Category of Information	**Categories of information taken from A&E Casualty Notes**					
Patient Related Information	Age/ Date of Birth	Gender	Occupation/ School	Residence	Marital status	Social situation
Crash related Information	Type of road user	Direction of crash impact	Location of crash	Speed of impact	Seatbelt / helmet worn	Others involved
Crash Consequences Information	Injuries	Injury severity scored	Treatment given or not given	Follow-up after A&E	Referrals to specialists	Previous medical & trauma history

Appendix 4: Road Crash Data Approval and Demographic Records held in selected Northwest hospitals

Hospital	Data approval process	A&E and OT info systems linked	Age/DOB	Gender	Injury	Intervention	Occupation	Postcode	Discharge/ Follow up	Quality of IT system 0-4 (4 excellent)	Able to participate in study?
A	Caldicott	Yes	Y	Y	Y free text	Y free text	N	Y	N	3	Yes
B	Caldicott	No	N	N	Y free text	N	N	Y	Y	2	Yes
C	Caldicott	No	Y	Y	Y free text	Y free text	Y	N	Y free text	2	Yes
D	LREC	No	Y	Y	N	N	N	N	Y	1	No
E	LREC	No	Y	Y	Y	Y	Y	Y	Y	3	No
F	Caldicott	No	Y	Y	N	N	N	Y	Y	2	No

Appendix 5: Profile of Three Northwest Hospitals and their A&E departments

Variable (year)	**Hospital A**	**Hospital B**	**Hospital C**
Annual Budget in millions[12] (2008)	£244	£211	£140
Approximate Population catchment (2001)	312,293[13]	330,000[14]	199,882[15]
Population density of area/ per hectare (2001)	19.89[13]	39.29[16]	2.64[17]
A&E attendances annually[18] (2008)	91,250	87,900	65,800
A&E attendances annually [18](2000)	77,949	79,470	54,712
RTC attendances at A&E annually (2000)	3,819	4,356	2,501
RTC attendances as % of total A&E attendances (2000)	4.9%	5.5%	4.6%

[12] Figures all obtained from hospital information sources

[13] Figure obtained from 2001 census information for the region

[14] Figure obtained from hospital website

[15] Figure obtained from census data

[16] Figure from 2001 census for region

[17] Figure obtained from 2001 census for region

[18] Data obtained from Department of Health form KH09 reporting

Appendix 6: Casualty Patterns at three Northwest Emergency Departments for year 2000

A&E Departments	**Hospital C**		**Hospital A**		**Hospital B**		**Total for 3 Depts**	
	N	%	N	%	N	%	N	%
No Casualties in 2000	2,501		3,819		4,356		10,676	
Gender	Male=1358 Female=1143	M= (54%) F = (46%)	Male=2097 Female=1716	M=(55%) F= (45%)	Male = 2477 Female=1877	M=(57%) F= (43%)	Male = 5932 Female=4736	M=(56%) F=(44%)
Age								
0-16	275	11	520	14	Category not available		795	13
17-25	638	25	960	25			1598	25
26-50	1243	50	1783	47			3026	48
50+	335	13	556	15			891	14
Unknown	10	0.4	0	0			10	0.2
Mean age (yrs)	32		32				32	
Role in Crash								
Driver	1356	54	1999	52	2203	51	5558	52
Passenger	737	30	1278	33	1751	40	3766	35
Pedestrian	178	7	264	7	196	5	638	6
Motorcyclist	119	5	167	4	99	2	385	4
Cyclist	92	4	111	3	98	2	301	3
Unknown	19	0.8	0	0	9	0.2	28	0.3
Injury								
No Injuries	82	3	142	4	39	1	263	2
Upper limb/spine sprain	1426	57	1951	51	3274	75	6651	62
Lower limb sprain	42	2	79	2	206	5	327	3
Contusion/laceration	424	17	316	8	51	1	791	7
Fracture	143	6	72	2	67	2	282	3
Significant head injury	41	2	10	0.3	26	0.6	77	0.7
Chest/internal injuries	16	0.6	10	0.3	50	1	76	0.7
Psychological problem	1	0.0	2	0.0	33	0.7	35	0.3
Other	66	2.6	29	0.7	115	3	210	2
Not known	260	10	1207	32	496	11	1964	18

A&E Departments	Hospital C		Hospital A		Hospital B		Total for 3 Depts	
Treatment								
None	276	11	120	3	Not Available		396	7
Advise	1179	47	664	17			1843	31
Admit	11	0.4	102	3			113	2
Fracture	35	0.4	23	0.6			58	1
Analgesia	633	25	36	0.9			669	11
Dressing/suture	200	8	35	0.9			235	4
Referral to speciality	164	7	Category not available				164	3
Not known	0	0	2839	74			2839	48
Follow-up								
None	1412	57	Not Available for 2000		3005	69	4417	64
GP	491	20			1050	24	1541	22
Out Patient Clinic	145	6			118	3	263	4
Admit	174	7			149	3	323	5
Transfer	12	5			5	0.1	17	0.2
Refused/left	136	5			10	0.2	146	2
Died	7	0.3	2	0.05	9	0.2	18	0.2
Unknown	124	5			10	0.2	134	2
Length of stay								
	Category not available		Mean 0.32 (SD +/-3.5) Range 0-129		Category not available			
Marital status								
Single	1376	55						
Married/separated	921	37						
Divorced	117	5						
Widowed	46	2						

Appendix 7: Comparison of Casualty Patterns between the national police data and Northwest Emergency Departments for year 2000

Locality	Great Britain		Northwest including Merseyside		Merseyside		Northwest A&E Depts	
	N	%	N	%	N	%	N	%
No Casualties in 2000	320,283		44,514		9,898		10,676	
No Killed	3,409	1%					18	0.2%
Gender	Male 184,259 Female 135,803	M 58% F 42%	*Not Available*		*Not available*		Male 5932 Female 4736	M 56% F 44%
No killed by gender	Male 2533 Female 876	M 74% F 26%	*Not Available*		*Not Available*			
Age							*Age available only from Hospital A&C*	
0-15	39,715	12%	*Not available*		*Not available*		719	11%
16-19	34,772	11%					619	10%
20-29	75,517	24%					1,754	27%
30-39	65,137	20%					1,413	22%
40-49	39,077	12%					852	13%
50+	58,219	18%					964	15%

Role in Crash			*Not Available*		*Not Available*			
Vehicle driver	133,928	42%					5558	52%
Vehicle passenger	93,563	29%					3766	35%
Pedestrian	42,033	13%					638	6%
Motorcyclist	28,212	9%					385	4%
Cyclist	20,612	6%					301	3%
Unknown	N/A	N/A					28	0.3%
Injury*								
Slight injury	278,719	87%	40,213	90%	9,139	92%	5,958	87%
Severe Injury	38,155	12%	3,931	9%	688	7%	603	9%
Killed/Severe injury	41,564	13%	4,301	10%	759	8%	619	9%
Killed	3,409	1%	370	0.8%	71	0.7%	18	0.2%
Not known/refused	0	0	0	0	0	0	280	4%

Appendix 8: Hospital & STATS 19 reported casualty patterns

	Hospital A 2000		Hospital A 2003		Police Data 2003		STATS19 2003	
Casualty No	3819		3890		1680		290,607	
No Killed	1*		8	0.2%	9	0.5%	3,508	1.2%
Seriously injured	Not known		395	10%**	186	11%	33,707	12%
Slightly Injured			3487	90%	1485	88%	253,392	87%
Age								
0-4	136	4%	113	2%	40	2%		
5-15	337	9%	312	8%	164	10%		
16-19	388	10%	434	11%	180	11%		
20-29	1022	27%	971	25%	371	22%		
30-39	825	22%	859	22%	335	20%		
40-49	521	14%	548	14%	235	14%		
50-59	303	8%	329	9%	143	9%		
60-69	152	4%	174	5%	96	6%		
70-79	93	2%	110	3%	70	4%		
80+	42	1%	40	1%	37	2%		
Mean Age	32		33					
Gender								
Male / Female	2097	1716	2092	1798	934	746		
M-F %	55	45	54	46	56	44		
Injury type								
Upper limb/spine sprain	1951	51%	210	5%				
Lower limb sprain	79	2%	29	0.7%				
Contusion/laceration	316	8%	23	0.6%				
Fracture	72	2%	61	2%				
Significant head injury	10	0.3%	8	0.2%				
Chest/ Internal injuries	10	0.3%	18	0.5%				
Psychological problem	2	0%	1	0%				
Other	30	0.8%	22	0.5%				
No injury	142	4%	0	0				
Not known	1209	32%	3511	90%				
Treatment								
None	120	3%	93	2%				
Advice	664	17%	499	13%				
Admit	102	3%	205	5%				

	Hospital A 2000		Hospital A 2003		Police Data 2003		STATS19 2003	
Fracture	23	0.6%	135	4%				
Analgesia	36	0.9%	81	2%				
Dressing/sutures	35	0.9%	85	2%				
Not known	2839	74%	2785	72%				
Follow-up								
None	**Not available for 2000**		1366	35%				
GP			73	2%				
Out-patients			117	3%				
Admit			205	5%				
Died			8	0.2%				
Not known			1838	47%				
Road user type								
Pedestrian	264	7%	280	7%	188	11%	36,405	13%
Cyclist	111	7%	81	2%	77	5%	17,033	6%
Motorcyclist	167	4%	241	6%	111	7%	28,411	10%
Driver	1999	52%	2015	52%	868	52%	208,758	72%
Passenger	1278	33%	1265	33%	425	25%		

* Dead on arrival, not those who died later

** Injury records had 90.3% of injuries not recorded so this value has been calculated from the discharge information. Severe injury = further intervention after A&E.

Appendix 9: Ethical Approval

92/02/DJM/BP

Mrs
Operational Management
Hospital

23 January 2003

Dear Ms Humphreys

Protocol 92/02: Minimising the psychological effects of road traffic accidents (a feasibility study)

Thank you for your helpful letter dated 16 January 2003 responding to the concerns raised by the Committee when it reviewed the protocol for the above study at its meeting on 18 December 2002.

I have now had the opportunity to review all the information provided and am pleased to confirm that formal ethical approval has been granted to enable you to proceed on the understanding that you ensure that the dates of the information sheets referred to on the consent forms are correctly stated. An updated list of the documents received is detailed below.

LREC Application Form: Ms A-L Humphreys	Dated 25/11/02
Letter: Ms Humphreys - Dr Manning	Dated 28/11/02
CV: Ms Humphreys	Undated
Dr M Leitner	Undated
Prof. Tarrier	Undated
Research Summary	Undated
Patient Information Sheet: phase 1	Version 1 dated 14/01/03
Patient Information Sheet: phase 2	Version 1 dated 15/01/03
Supporter Information Sheet: phase 2	Version 1 dated 15/01/03
1 month follow up questionnaire: phase 1	
CT questionnaire	
Therapist rating scale	
3 months follow up questionnaire: phase 2	to incorporate amendment
6 months follow-up questionnaire: phase 2	detailed in your letter dated
9 months follow-up questionnaire: phase 2	28 November 2002
12 months follow-up questionnaire: phase 2	

As usual for studies of this nature the committee's approval will initially remain valid for only 12 months (from the date of this letter) and is conditional upon you:

- Informing me immediately should it be necessary for any amendments to be made to the way in which the project is to be undertaken. *Please note that no changes should be implemented without prior approval from the committee*
- Submitting a report of progress with the project, which includes an estimate of the likely completion date nearing the end of the 12 month period if an extension of the committee's approval is required. *Please note that approval will be deemed to have ceased unless this progress report is received*
- Informing me immediately should the project, or your involvement with it, be terminated early for any reason
- Informing me as soon as the project has been completed and providing the committee with a copy of your findings (or a summary of these) in due course.

Yours sincerely

Dr
Chairman
Local Research
Ethics Committee

Appendix 10: Screening Questionnaire

Part A: We would first like to find out a little about you

1. Gender Male /Female (please circle the correct answer)

2. What is your age? ....years

3. Are you employed? Yes / No (please circle the correct answer)

4. How would you describe your social support at the moment?

(please place a tick in the box that most fits your situation)

No support 0	Poor support 1	Some support 2	Good support 3	Excellent support 4

Part B: We would like to know a little about your health prior to the accident

(Please circle the correct answers)

1. Have you ever been treated for any chronic physical health problems? Yes / No

2. Do you smoke? Yes / No

If you smoke, has this changed since the accident?

(please place a tick in the box that most fits you)

Stopped Smoking -2	Smoke less -1	Smoke the same 0	Smoke more 1	Smoke a lot more 2

3. Do you drink alcohol? Yes / No

If you drink alcohol has this changed since the accident?

(please place a tick in the box that most fits you)

Stopped Drinking -2	Drink less -1	Drink the same 0	Drink more 1	Drink a lot more 2

Part B: Continued

4. Have you ever been treated for any mental health problems? Yes No

5. Has anyone in your family ever been treated for mental health problems? Yes No

6. Have you ever experienced events in your life that you considered traumatic, *(not including this accident, we will ask you about this later)***?**

Yes No

7. If you have answered Yes to question 6 it would be helpful if you could briefly say what the events were and when they happened to you.

You do not have to provide this information if you do not wish to.

i) How many years ago did they happen? ....

ii) What were the events? ....

....

....

8. If you have answered Yes to any of the questions in this section and would like to provide any further information about your past or current health please use this space below.

Part C: We would now like to understand a little more about your recent accident

1. Date of your traffic accident ..../........./200

2. How would you rate the severity of the injuries you sustained in the accident?

(please place a tick in the box that most fits what happened to you)

None 0	Very mild 1	Mild 2	Moderate 3	Severe 4	Very severe 5

3. Around the time of an accident, some people report feeling as if they or their surroundings seemed strange or unreal. How did you feel?

(Please place a tick in the box that most fits how you felt at the time)

Felt Normal 0	Slightly unreal 1	Definitely unreal 2	Severely unreal 3	Completely unreal 4

4. Briefly, describe what happened in the road traffic accident: ____________________

____

5. At the time of the accident, what did you think might happen?

____

____

6. Did the experience frighten you? Yes No

(please circle the answer that most fits you)

Appendix 11: Health Care Appointments Log

1. Please write in each box the number of times you have attended any of these appointments in the last month.
Example:

GP $\boxed{3}$

Hospital Consultant ☐

GP ☐

Out-patients Clinic ☐

Practice Nurse ☐

Physiotherapist ☐

Occupational Therapist ☐

Counsellor ☐

Community Nurse ☐

Other (please provide details of who they are)....................

2. Have you been prescribed any medication for problems related to your accident? **Yes / No** (please circle correct reply)

If you have been prescribed any medications, please name them.

____

3. Are you continuing to receive any medical treatment as a result of the accident? **Yes / No** (please circle correct reply)

If you are having any ongoing treatment, what is it?

____

____

4. Are you currently involved with legal proceedings to do with the accident? **Yes / No** (please circle correct reply)

Appendix 12: A detailed log of Susan's assessment and therapy sessions

Initial interview

Susan was able to respond to the interview questions although she had poor concentration and minimal eye contact throughout. Susan provided a very limited account of the crash circumstances and consequences.

As part of another research study Susan was asked to complete a five minute speech sample (FMSS) as an assessment of the level of high expressed emotion in her relationship with her mother. Susan was unable to continue the FMSS after 30 seconds due to becoming distressed and then apparently dissociated and unresponsive for several minutes.

She participated in the use of the factory model to provide a rationale for some of her symptoms and the process of intervention. At the end of the interview a full explanation of the 4 session intervention was provided and after agreement the first session was arranged. To maximise the four sessions Susan was asked to try and write down as much as she could recall of the crash on the day before her next appointment to use as a basis for the first session. Susan was given the PTSD information booklet (Herbert, 1996), with sections relevant to her symptoms highlighted, for her to read before the first session.

Session 1

The session followed the protocol. Four goals were established and the first imaginal reliving carried out. Susan had difficulty consistently using the present tense and recalled the events of the day with limited detail.

"Nice day, starting to drive up the road, getting closer to the top, see a blue van. It's coming out, hit me onto pavement, hear a loud bang, can still hear the radio. The car is right up against me".

The reliving was repeated in the session with a greater level of detail emerging in her narrative. The SUD rating for the moment of impact reduced from 8/10 in the first account to 6/10 in the second despite greater level of detail and focus on the crash.

"I am getting in the car and putting the sun visor down. The street is quiet. I turn the engine on and can hear 80's music playing. I am driving to the top of the road and can see a blue van on the left. I am passing it and can see a car reversing out of the drive. He hits me on the front of the car and I'm pushed onto the pavement. I can hear a loud bang and see the bonnet is sticking up".

She had very limited detail in recall of the actions of others in first account, so was directed to focus primarily on a conversation with brother as he was the most supportive. She was able to hear him sounded concerned and he helped to move the car off the road.

Homework was negotiated as

- To either write about the crash or listen to the tape repeatedly to assist reliving for an hour three times per week
- To monitor activity using a daily diary
- To record intrusive thoughts, feelings & behaviours when thinking about the crash in a weekly diary

Session 2

The session followed the protocol. Review since the previous session found, a reduction in pain, improvement in Susan's mood and a marked reduction in the use of alcohol. Collaborative analysis of the homework highlighted prolonged periods of the same activity with limited pleasure derived from it. Exploration of the weekly diary identified links between focusing on the crash and dissociation as a coping strategy. In the imaginal reliving Susan still found it difficult to maintain the narrative in the present tense but there was a marked increase in detail when recalling the event.

"I get in and put the key in the ignition. The radio comes on its radio city Sunday Sess playing 80s tunes. The sun is out. I pull my sun visor down. I am getting towards the top of the road on the left hand side there is a blue transit van. I'm getting next to the van and there is a car reversing out. It's a black Skoda. I can see its reversing out. It hits my front passenger wing and knocks me over onto the right side towards the pavement. The car goes back into its drive. I put the car on the pavement. Switch the engine off. I can see the bonnet is dented up".

Further reliving in the session demonstrated more extensive sensory recall of the event.

"From the other side of the van there's a car reversing, it's starting to reverse out. It's a black Skoda and I've got no time to.... I haven't got enough time to stop without hitting him. I'm hitting the brakes but I know I can't avoid it. End up smashing into him. My heart is racing. I can hear all the car like all the bits are falling off, smash as he went into the headlight. He pulls back into the drive. I can see the bonnet is dented up. Pull over, drive the car over onto pavement. I was going over the bits of headlight, crunching, all the bits that came off."

The final reliving in the session included direction to focus specific attention on the other driver and his wife and how they reacted towards her. She was able to include some details about his appearance and his wife being kind when she relived the crash on this occasion. This memory was focused on specifically again when planning the week's homework tasks.

Homework was negotiated as

- Write a list of people who supported you after the crash and what they did.
- Listen to the tape repeatedly to assist reliving for an hour three times per week
- Complete weekly diary when carrying out reliving
- Carry out in vivo exposure by driving repeatedly past crash site and around narrow local streets (40 minutes x3)
- To complete daily diary and work on breaking up low pleasure activities into ½ hour periods

Session 3

The session followed the protocol. Review since the previous session found further reduction in pain and improvement in Susan's mood and not drinking during week. She reported not really thinking about the crash during the week and that driving locally and to work was easier. Collaborative analysis of the homework found that reducing prolonged periods of the same activity was associated with less pain and improved mood. In the imaginal-reliving Susan was able to recall even greater detail about the crash circumstances and once habituation to the crash had occurred, exposure to "hotspot" memories was increased through use of the rewind and hold technique rewinding and holding particularly intense images.

At "hotspots" Susan was asked to firstly hold an image, rewind then replay it again describing her sensory experiences in as much detail as possible. In this case the memory was of when she first realises she is going to crash. Such a warning "hotspot has previously been recognised by Ehlers and Clark to emerge through associative learning of trauma predictors (Ehlers and Clark, 2000).

"I am next to the van. I am seeing a car reversing towards me. My stomachs gone I'm panicking. Hmmm.... trying to get my foot to go on the brakes. See if I can avoid it. Hmm I know I can't avoid it........ I'm going to hit him...There was nobody else. I can hear the song and the engine running in the car. My heart is racing. The radio has faded out. All I could hear was the noise of the crash Hmmm then the radio seems to there again ....the song is still playing".

This technique was used several times in the session to promote a more detailed recall of each identified "hot spot", together with habituation to the attendant anxiety. Social support recall focused on driver and his wife again, recalling his appearance and their actions towards her. Following on from the previous homework diary other supportive people were also focused on during reliving.

Homework was negotiated as

- Listen to the tape or write repeatedly to assist reliving for an hour three times per week and record anxiety levels
- To complete daily diary and work on balancing pleasurable and mundane activities throughout the day.
- Carry out In vivo exposure by using normal route when driving to work
- Carry out In vivo exposure by revisiting the crash site on foot and record anxiety
- Contact two friends to arrange a night out

Session 4

The session followed the protocol. Review from the previous session found a further reduction in pain and improvement in Susan's mood. She reported driving was much easier from both a pain and anxiety perspective.

She found that the site no longer triggered her anxiety or influenced her route to work. She had also been in touch with friends to arrange a fancy-dress night out to commemorate the end of her therapy. In the final reliving session Susan registered no significant anxiety to the "hotspots". Susan was then asked to relive the crash and its aftermath but focusing her attention on the people who were supportive to her (integrated from homework).

Encounters with her friends, the police and her brother's return were all focused on in this final reliving session with the aim of further elaborating rating her recall of support received. Addressing her social support dissatisfaction was furthered through encouraging her to re-engage with her available network through the planning of a social event with friends to mark her recovery and completion of therapy. At the end of this session the goals were reviewed. Susan reported that it now bored her to think about the crash and such memories rarely automatically intruded upon her and if they did they caused her negligible anxiety. There was minimal functional impairment in her routine activities of daily living or driving. She had stopped drinking during the week, taking painkillers and reported her overall pain as 1/10.

Relapse Prevention Plan

- Maintain regular contact with friends
- To continue once a week to use reliving techniques for next four weeks.
- To continue driving along usual routes and pass crash scene each day on way to work.
- To contact therapist if any further support or advice required.

Appendix 13: Weekly Record Form (Susan week 1 homework)

Date/Time	Situation	Feelings	Behaviour	Thoughts
E.g. Monday, 13 January 2003 2pm	Telephone Rings	Stomach Churning, tense hands, dry mouth	Left phone to ring then rang 1471	What if I have a panic attack when talking? Who is it? I'm stupid
Wednesday 9-10pm	Writing about crash	Strange, unreal	Tried to carry on writing	Strange to think about it in so much detail.
Friday 9-10pm	Writing	Weird, not sure	Staring into space, can't concentrate	Can't describe. Not really thinking
Sunday 9-10pm	Writing	Felt unreal	Laughing	It's like a story. It didn't happen to me

Appendix 14: Daily Diary Record (Susan Week 1 Homework)

After each activity recorded, rate the mastery/pleasure score using the following scale

0 ← 4 → 8

No Pleasure
No Mastery

Maximum pleasure
Mastery

Time	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
7am							
8am	Drove to work 4					Woke up 3	
9am	Work 5					Breakfast 3	
10am						Housework 3	Woke up 4
11am							
12noon	Lunchtime 6					3	
1pm	Work 4					Lunch 4	Shops 6
2pm						2	Washing 4
3pm						3	
4pm							Ironing 4
5pm	Drove home 3					Supermarket 4	
6pm	Watched tv 4					Watched tv 5	
7pm						Cooked tea 3	Cooked tea 7
8pm						Went to bed 6	Watched dvd 7
9pm							Bath 7
10pm	Went to bed 5						Went to bed 7
11pm							
12am							
2am						Awake 2	
4am							
6am							

Appendix 15: Susan's Within Session Imaginal Reliving of Peri-Crash Sequence

Therapist's instructions to the participant: "When you are ready tell me about the crash as if you are reliving it now, in the first person and present tense in as much detail as you can and as slowly as you can."

Session 1

"Start to drive up the road, where, getting closer to the top and coming up to a blue van and car is coming out and it just hit me on my passenger front wing. Knocked me onto pavement, there was a loud bang." **SUD rating 10/10**

Session 2

"Start to drive off, get towards the top of the road, can see a blue van on the left and as I am next to the blue van, a car reverses out from the other side of it, from the drive and hits me on the front passenger side. Pushes me over towards the pavement and all I hear is a bang from where he hits me, you can see the bonnet sticking up and he pulled back into the drive." **SUD rating 8/10**

Session 3

"Open the car door. Get in and put the key in the ignition. Radio comes on and it's Radio City. Quite bright. Put the car into gear, lift the handbrake up, turn the wheel and start to go. I am getting towards the top of the road on the left hand side is a blue van. A transit van. Getting next to the van, there is a car reversing out of the other side of the van. It's a black Skoda, it reverses out and it hits my front passenger wing, knocks me over onto the right side towards the pavement. Car goes back into the drive, I put the car on the pavement. Switch the engine off, can see bonnet is dented up, trying to open the driver door, won't move". **SUD rating 4/10**

Session 4

"Go outside, walk towards the car. Put the key in the door, open it. Get in. Put the radio panel on. Put the key in the door, open it. Get in. Put the radio panel on. Put the key in the ignition, turn the key, the radio comes on. Got radio City's Sunday sesh on. It's about 10 o'clock in the morning. Pull the visor right down, its bright. Put the car into gear, start to drive off. Heading up towards the top of the road. Coming up I can see a blue transit van on the left hand side of the road. Get next to the van. From the other side of it there is a car reversing, starting to reverse out. It's a black Skoda and got no time to, I haven't got enough time to stop without hitting it. Hit the brakes but end up smashing into him. Hear all the car like all the bits fall off, smash into the headlight. He pulls back into the drive. I can see the bonnet is all dented up. Pull over drive the car over onto the pavement. Was going over bits of headlight and all the bits that came off. Switch engine off, try to open the door to get out but the door won't open, try a few times still can't open it."

SUD rating 1/10

Appendix 16: Susan's Within Session Imaginal Reliving of Peri-Crash Support

Therapist's instructions to the participant: "When you are ready tell me about the crash as if you are reliving it now, in the first person and present tense in as much detail as you can and as slowly as you can focusing on people's expressions and behaviour towards you ."

Session 1

"………Trying opening the passenger door, can't do it, climbing over the passenger seat to get out. Bits of the car all over the road. Bloke is asking me am I ok? Didn't see me. Talking on about insurance and swapping details. Go into his house sort all details……shaking quite a bit." **SUD rating 10/10**

Session 2

" ……I lean over to open the passenger door, it opens, climb across the passenger seat to get out, close door again. By this time the man has got out of his car and he is asking me if I am ok? He is an oldish bloke, maybe mid 50s……he has got shaved head and goatee, there are bits of the car all over the road, bits of the bumper, the head light ………and his wife has come out of the house she's heard the noise. She is asking me if I am ok……" **SUD rating 8/10**

Session 3

" The man gets out of the car, he is bald with a goatee, quite big, asks me if I am ok. He is looking at my car and then his wife comes out , asks if we are both ok.....what happened?...Asks about insurance details, so he offers we go inside his house to get them instead of me having to stand in the street …………His wife makes me a cup of tea, ...Mmmm ..sweet cup of tea. He says sit down on the chair, lets carry on. He is getting a notepad and he is writing down his details for me. There are two little dogs running around". **SUD rating 4/10**

Session 4

"....The bloke is in the middle of the road. He is asking me if I am ok? He is sorry he didn't see me. He looked but he didn't see me…………He is wearing a blue checked shirt and jeans. He has got a bald head and moustache....He doesn't seem to be as shaken up as me. ……….His wife ask , we are ok? She suggests we go inside to sort everything out instead of standing out on the street……I follow them inside...His wife offers... asks me to sit down and asks if I want a cup of tea. She has gone into the kitchen to make it. He's writing his details down……and his wife comes in with the tea. She puts it on the table next to me and smiles. I try and drink a bit of tea, it's hot. I phone my friend to tell her I can't come...." ***SUD rating 1/10***