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How common is hazardous and harmful drinking in the UK Police Service, and

what is the relationship with mental health and job strain?

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Declaration.

<center>PSYCHOLOGY (SCIENCE)</center>

<center>**DECLARATION IN HIGHER DEGREE THESES**</center>

I hereby declare that this thesis is the result of my own work. The material has not been and will not be submitted, in whole or in part, for any other degree or qualification at this or any other University or Institute of Learning.

Signed: *Miss Patricia Irizar* (Candidate)

Date: 16.10.2021

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Abstinence: the complete avoidance of any alcohol intake.

Hazardous alcohol use: a quantity or pattern of alcohol consumption that places one at risk of future adverse health events (National Institute for Health Care Excellence (NICE), 2010).

Harmful alcohol use: a quantity or pattern of alcohol consumption which causes current health problems directly related to alcohol (National Institute for Health Care Excellence (NICE), 2010).

Binge drinking: drinking large quantities of alcohol in a short space of time or drinking to get "drunk" (NHS, 2019).

Alcohol use disorder (AUD): both harmful drinking and alcohol dependence are categorised as AUDs according to the Diagnostic and Statistical Manual of Mental Disorders – 5th edition (DSM 5), but alcohol dependence differs from harmful drinking, as alcohol dependence is characterised by a cluster of behavioural, cognitive, physical and psychological phenomena which develop after repeated alcohol use (American Psychiatric Association, 2013).

Police officer: warranted officers who have been granted specific powers which enable them to complete their duties (UK Statutory Instruments, 1999).

Police staff: non-warranted staff who perform duties to assist police officers (Statute Law Database, 2002).

Police employees: this term will be used throughout this thesis, to collectively refer to officers and staff. However, police officers are locally appointed crown servants, rather than employees.

Abstract. How common is hazardous and harmful drinking in the UK Police Service, and what is the relationship with mental health and job strain? By Patricia Irizar.

Policing can be a stressful occupation, characterised by operational stressors and organisational stressors, both of which have known associations with poor mental health. There is strong evidence indicating a relationship between poor mental health and alcohol problems, with emerging evidence also showing a link with abstinence from drinking. Due to the nature of their work, UK police employees may be using alcohol to cope with stress or trauma. This thesis aimed to understand the level of alcohol problems in the UK Police Service and examine the relationship with poor mental health and job strain.

This thesis took a multi-method approach. First, a systematic review and meta-analysis was conducted, to collate the evidence on the prevalence of hazardous and harmful alcohol use in trauma-exposed occupations. Next, representative data from 40,000 UK serving police employees was analysed, to determine the prevalence of hazardous and harmful alcohol use (and abstinence), and their co-occurrence with poor mental health and job strain. Then, the level of harmful alcohol use and poor mental health was compared in police employees and military personnel, analysing men and women in separate studies. Given that harmful drinking often co-occurs with other harmful behaviours, this thesis examined the classes of health (risk) behaviours, and their associations with mental health and job strain. Finally, qualitative interviews were used to gain a deeper understanding of police employees experiences of hazardous/harmful drinking or abstinence. The quantitative and qualitative findings were integrated through triangulation.

The meta-analysis identified gaps in the literature, with only two UK studies and no UK studies of police employees. Of the 40,000 UK police employees, 33% met criteria for hazardous drinking and 3% for harmful drinking. Those with poor mental health were more likely to drink harmfully and abstain (versus low-risk). High strain (versus low) was associated with reduced odds of hazardous drinking (though this was moderated by mental health). There were comparable levels of probable PTSD but higher levels of harmful drinking in military personnel compared to police employees (for both men and women). Police employees with poor mental health had double the odds of engaging in multiple health risk behaviours. The interviews developed an understanding of the motivations for drinking and abstaining, and the organisational culture of drinking.

The evidence indicated a J-shaped relationship, whereby poor mental health was linked with both abstinence and harmful drinking, in the UK Police Service. Critically, those with poor mental health were also more likely to engage in multiple health risk behaviours and may be at risk of harm. The triangulated findings have important theoretical implications, contributing to the self-medication hypothesis and sick quitter hypothesis, and practical implications, highlighting the need for accessible support for alcohol problems within the Police Service.

Contributor statement.

This thesis is submitted in fulfilment of the conditions for a PhD by published papers. In accordance with the University of Liverpool guidelines and regulations, this thesis conforms to an 'article format' in which Chapters 4, 5, and 6 are submitted as published papers. Chapters 7, 8 and 9 have been submitted for publication in peer reviewed journals and are currently under review. Each of these Chapters are discrete articles, meaning some statements are repeated. The first Chapter provides an overview of the literature, Chapter 2 outlines the aims of the thesis, and Chapter 3 details the methodology used. The findings from Chapters 5, 8 and 9 are triangulated in Chapter 10, and Chapter 11 provides a discussion of the research undertaken. Each empirical Chapter is preceded by a foreword, which states the justification of the research undertaken, including how the work links to the antecedent chapters.

Empirical work in peer reviewed publication form

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The author contributions are as follows:

PI conceptualised and designed the study protocol and pre-registered the review with Prospero. PI conducted the comprehensive literature search; screened all titles, abstracts, and full texts against eligibility criteria; extracted the data of the included studies; independently assessed each paper quality; conducted the meta-analyses, sub-

group analyses, and meta-regressions; and wrote the manuscript. PI approved and submitted the final manuscript. JAP screened 10% of all titles, abstracts, and full texts; and assessed the quality of 10% of all studies. LG, SHG, and VF contributed to the conceptualisation of the study protocol; critically reviewed the protocol; managed discrepancies during the screening; provided comments and edited the manuscript. All authors approved the final manuscript as submitted.

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PI and SAMS contributed equally to the conceptualisation of the study, and the design of the methodology. PI and SAMS also contributed equally to the formal analysis plan and data coding. PI conducted the statistical analysis and wrote the original manuscript, as well as the reviewing and editing. DP contributed to the resources and data curation. SHG, NG and SW contributed to reviewing and editing the manuscript and contributed to the development of the formal analysis. NTF and LG contributed equally to the supervision of the research, the conceptualisation of the study and both provided extensive feedback on the formal analysis and written manuscript. All authors approved the final manuscript as submitted.

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PI conceptualised and designed the study; created the topic guides and online Qualtrics screening questionnaire; and sought ethical approval. PI conducted all telephone interviews with participants; transcribed some of the interviews; analysed the qualitative data; and interpreted the findings. PI also wrote the initial manuscript; reviewed and revised the manuscript; and approved the final manuscript as submitted. LJ contributed to the qualitative analysis and the interpretation of the findings. SHG, SB, RP, and LJ contributed to the study design, such as the development of the topic guides, and reviewed and revised the manuscript. VF and LG contributed equally to the supervision of the research; the conceptualisation of the study; and provided extensive feedback on the qualitative analysis, interpretation of the findings, and written manuscript. All authors approved the final manuscript as submitted.

Chapter 1: Introduction to the thesis.

1.1 Foreword

What is the aim for each Chapter?

- Chapter 1 provides an overview of the background literature and relevant theories.

- Chapter 2 outlines the aims of this thesis, which were informed by the background literature, and Chapter 3 describes the broader methodological approaches used throughout this thesis, to address those aims (with additional information on the methods provided in each empirical chapter).

- A formal systematic review is reported in Chapter 4, to determine the international prevalence of hazardous and harmful alcohol use across occupational groups at risk of frequent trauma-exposure.

- Chapter 5 identifies the prevalence of hazardous and harmful alcohol use in the UK Police Service and examine their co-occurrence with mental health and job strain.

- Chapters 6 and 7 compare the level of alcohol use and poor mental health in the UK Police Service and the UK Armed Forces, analysing men (Chapter 6) and women separately (Chapter 7).

- Chapter 8 examines how health (risk) behaviours cluster together in police employees, and whether certain clusters are associated with poor mental health and job strain.

- A qualitative interview study is reported in Chapter 9, to explore UK police employees' experiences of either hazardous/harmful drinking or abstinence.

- In Chapter 10, the quantitative findings from Chapter 5 and Chapter 8 are triangulated with the qualitative findings from Chapter 9.

- Chapter 11 discusses the key findings, the theoretical and practical implications, strengths and limitations, and recommendations for policy and future research.

What do the findings of this Chapter add?

- This Chapter provides an overview of the structure and roles of the UK Police Service, followed by a summary of the international and UK literature on alcohol use, including data on the prevalence of hazardous and harmful use, binge drinking and abstinence from alcohol.

- This Chapter reports the evidence on alcohol use in police employees, as well as the literature surrounding job strain and poor mental health in police employees.

- Finally, this Chapter outlines the literature on the relationship between alcohol use and mental health, both in the general population and in police employees.

1.2 Overview of the UK Police Service

Police employees are responsible for most law enforcement activities within the United Kingdom (UK) (UK Statutory Instruments, 1999), though each of the nation's legal systems (i.e., England, Wales, Northern Ireland, Scotland) separately organises their own law enforcement (Dempsey & Forst, 2013). Police employees serve in regional police forces, also known as territorial police forces, which are governed by the Home Office (Home Office, 2019). There are 45 territorial police forces in the UK (Home Office, 2019). Of those, 43 territorial police forces are in England and Wales, with one force in Scotland (Police Scotland) and one force in Northern Ireland (Police

Service of Northern Ireland). In addition, there are four special police forces in the UK: British Transport Police, Civil Nuclear Constabulary, Ministry of Defence Police, and National Police Air Service (UK Statutory Instruments, 1999). The special police forces are managed by governing departments other than the Home Office, with responsibilities relating to specific legal or illegal activities, as opposed to being responsible for specific geographical areas, where territorial police forces are responsible (Police.UK, 2020).

Police employees can be separated into two broad groups: police officers and police staff. Police officers duties include protection of life and property, preservation of peace, prevention and detection of criminal offences (UK Statutory Instruments, 1999). Types of police officers include territorial police constables, other constables (such as special constables, i.e., volunteers, or members of the four special forces) and parks constables (who have the powers of a constable, to deal with by-laws relating to parks and open spaces in their area) (UK Local Acts, 1967). Police staff perform duties to assist police officers, with some of their occupations including Police Community Support Officers (PCSOs), police call handlers, investigating officers, detention officers and escort officers (Statute Law Database, 2002).

The term police constable is often used to refer to any officer with the powers of a police officer (UK Public General Acts, 1984; UK Statutory Instruments, 1999). However, police constable also refers to the lowest ranking police officer (Britain & Woods, 2015). The standardised set of ranks for police officers in the UK are outlined in Table 1.1. Across most territorial police forces, the highest level of seniority is chief constable (Britain & Woods, 2015). However, the most senior ranks in the Metropolitan police service and the city of London police service differ (UK Public General Acts, 1829, 1984) (Table 1.1).

Table 1.1 Police officer ranks of the UK.

Metropolitan Police Service	City of London Police	Police
Commissioner	Commissioner	-
Deputy Commissioner	-	-
Assistant Commissioner	-	Chief Constable
Deputy Assistant Commissioner	Assistant Commissioner	Deputy Chief Constable
Commander	Commander	Assistance Chief Constable
Chief Superintendent	Chief Superintendent	Chief Superintendent
Superintendent	Superintendent	Superintendent
Chief Inspector	Chief Inspector	Chief Inspector
Inspector	Inspector	Inspector
Sergeant	Sergeant	Sergeant
Constable	Constable	Constable

As of March 2020, there were 129,100 police officers and 72,300 police staff (as well as 9,180 PCSOs) in England and Wales (Allen & Audickas, 2020). This is an increase from 123,171 police officers and 70,737 police staff in March 2019 due to a national campaign by the UK government, to recruit an additional 20,000 police officers by 2023 (Home Office, 2020b). However, the number of police officers and staff had declined over the past decade and 2020 was the first year in which the number of police employees had increased, since 2010 (Allen & Audickas, 2020). Across all UK nations there were a total 155,000 officers in 2003, which increased to 171,600 in 2010. Following this, the number of police officers across all nations has declined each year, until 2020 (Allen & Audickas, 2020). In 2017, the number of police officers and

staff in England and Wales was the lowest since records began (in 1996) with only 121,929 police officers and 64,785 police staff (Home Office, 2019). The decline in police employees was a result of a 16% decrease in funding as part of austerity measures brought in by the Conservative and coalition governments, from 2010 to 2019, which also resulted in the closure of over 400 police stations (Institute for Government, 2019; Loveday, 2015).

The UK Police Service has become more diverse in recent years. In March 2020, a total of 31% of police officers were female (Allen & Audickas, 2020). For comparison, only 23% of police officers were female in 2007. However, women make up a large proportion (62%) of police staff in England and Wales, and 43% of PCSOs are female (Allen & Audickas, 2020). Further, the proportion of police officers from minority ethnic backgrounds has increased by 4% since 2007, to 7% of all police officers and staff in 2020 (10% of all PSCOs were from minority ethnic backgrounds) (Allen & Audickas, 2020). The proportion of police officers from minority ethnic backgrounds is still much lower than the proportion of the general population from minority ethnic backgrounds, which is 16% (Office for National Statistics, 2019). However, the proportion of police officers from minority ethnic backgrounds ranges across the territorial police forces, with the Metropolitan Police Service having the largest proportion of minority ethnic police officers, which is similar to the general population (16%) (Allen & Audickas, 2020).

1.2.1 Demand and capacity

The Police Federation for England and Wales was set up in 1919 by the Police Act, following police officer strikes over poor pay and working conditions (Home Office, 2016; King, 1988). Police officers are not technically employees, they are servants of the Crown (Home Office, 2016), and so, are not protected under employment laws

(police staff are considered employees). Moreover, under section 91 of the Police Act, it is a criminal offence for police officers to take strike action (UK Public General Acts, 1964). The Police Federation, therefore, exists to represent the interests of police officers, to protect their welfare and efficiency of the police service (Home Office, 2016).

The Police Federation conducted two surveys, in 2016 and 2018, to explore demand and capacity (Elliott-Davies, 2019; Houdmont & Elliot-Davies, 2016). The most recent survey (2018) included responses from 18,100 police officers (Elliott-Davies, 2019), representing 15% of all police officers in England and Wales at the time (Home Office, 2019). The sample was representative in terms of rank, role, gender, ethnicity, and region. Almost 90% of the sample reported that there were not enough officers to manage demands, or to do their job properly (Elliott-Davies, 2019; Houdmont & Elliot-Davies, 2016). Further, 76% of police officers reported that they were often or always single-crewed (the deployment of unaccompanied officers). Worryingly, single-crewing is significantly associated with work-related violent victimisation and injuries (Houdmont, Elliott-Davies, & Donnelly, 2019), with 67% of police officers being attacked in the 12 months prior to the Police Federation survey (Elliott-Davies, 2019). Although the Police Federation survey reports were not peer-reviewed, they still provide an insight into the increasing demands faced by UK police employees, which may relate to the budget cuts which have reduced officer numbers over the past decade.

The intensive demands faced by police employees, alongside the frequent exposure to traumatic incidents, can have adverse impacts on health behaviours and mental health. Due to the nature of their work, police employees may find ways to cope with their experiences. These coping responses could be proactive, such as keeping active,

or they could be maladaptive, such as engaging in health risk behaviours, such as smoking, or problematic alcohol use. This thesis will primarily focus on alcohol use, with Chapter 8 also examining additional health (risk) behaviours, given that there is evidence to suggest that some health risk behaviours, particularly heavy drinking and smoking, often occur together (McAloney, Graham, Law, & Platt, 2013; Meader et al., 2016b). The following sections will provide an overview of the existing literature surrounding alcohol use, job strain, and mental health, in police employees.

1.3 Alcohol use

The main outcome of interest for this thesis is alcohol use. Specifically, this thesis will focus on hazardous and harmful alcohol use (which can include probable dependent use). This thesis will also explore binge drinking and abstinence from alcohol. Throughout the existing literature, different measures and criteria are used to determine the specified outcomes of interest. Therefore, when discussing key literature, the measures and criteria used will be described.

1.3.1 Hazardous and harmful alcohol use

Hazardous alcohol use increases the risk of alcohol-related harm, and harmful alcohol use causes alcohol-related harm. Globally, 5.9% of all deaths and 5.1% of all disease and injury are attributable to alcohol (WHO, 2019). Not all alcohol-related harms are physical, as alcohol is linked with social harms such as relationship problems, financial problems, and violence. Alcohol-related physical harm can be measured using 'alcohol-attributable fractions', which denotes the proportion of a health outcome that is caused by alcohol (Public Health England, 2020). Alcohol-related physical harm is a consequence of its ethanol (also known as ethyl alcohol) content, which has toxic properties affecting almost every organ in the body (Rusyn &

Bataller, 2013). Alcohol is wholly or partially responsible for over 200 different diseases (WHO, 2019). Wholly alcohol-attributable conditions occur where alcohol is the sole cause, such as alcoholic liver disease (alcohol-attributable fraction is 1.0, i.e., 100%) (Jones & Bellis, 2013), whereas partially alcohol-attributable conditions have a known relationship with alcohol but there are additional causes, such as heart problems (Jones & Bellis, 2013). In the past decade, alcohol-related hospital admissions have risen by 19%, and wholly alcohol-attributable deaths by 7% (NHS Digital, 2020). Concerningly, provisional figures show that wholly alcohol-attributable deaths have risen by 16% from 2019 to 2020, and are the highest since records began in 2001 (Limb, 2021). The overall cost of hazardous and harmful alcohol use on the NHS and society is estimated to be £21 billion per year (Williams et al., 2020). These figures highlight that alcohol-related harm is rising in the UK and demonstrates the economic burden of hazardous and harmful alcohol use.

1.3.2 Prevalence of hazardous and harmful alcohol use

Recent statistics from the UK, obtained from the 2017 Health Survey for England (N = 7,997), showed that 85% of men and 79% of women consume any alcohol (NHS Digital, 2018b). The same survey identified that 24% of men and 11% of women (aged 16 and over) drank to hazardous levels, which equates to 17% of all adults in the UK. A total of 4% of the UK general population (4% of men and 3% of women) reported drinking to harmful levels. Hazardous drinking was defined as weekly consumption between 14 to 35/50 units for women/men (NHS Digital, 2018b), in line with the updated drinking guidelines from the UK Chief Medical Officer (CMO) (consuming less than 14 units per week keeps the risk of alcohol-related harm low) (Department of Health and Social Care, 2016). Harmful drinking was defined as weekly consumption above 35/50 units for women/men (meaning this may also include

dependent drinking), which was based on the CMO's guidelines at the time of the survey (Department of Health and Social Care, 2016). However, the CMO's guidelines were recently altered, removing the distinct category for harmful drinking, due to concerns that those drinking to hazardous levels may not perceive that they are at risk of alcohol-related harm (Department of Health, 2016). Nevertheless, these criteria are in line with the National Institute for Care and Excellence (NICE) definitions for harmful drinking (National Institute for Health Care Excellence (NICE), 2010).

Every seven years, the Adult Psychiatric Morbidity Survey (APMS) is conducted to monitor the level of mental health problems, alcohol and substance use and self-harm behaviours, in state population in England (McManus, Bebbington, Jenkins, & Brugha, 2016). The surveys began in 1993 and the most recent survey was conducted in 2014. Comparable methods have been used across all four of the existing surveys, meaning patterns and trends can be observed. In the most recent data collection, using the Alcohol Use Disorder Identification Test (AUDIT) (Saunders, Aasland, Babor, De la Fuente, & Grant, 1993), 16.6% of adults met criteria for hazardous drinking (AUDIT scores of 8 to 15), 1.9% for harmful drinking (AUDIT scores of 16 to 19), and 1.2% for probable alcohol dependence (AUDIT scores above 20) (McManus et al., 2016). In line with previous APMS surveys, and the Health Survey for England, men were more likely to drink hazardously than women (21.9% of men and 11.6% of women), and more likely to drink harmfully (4.4% of men and 1.8% of women) (McManus, Meltzer, Brugha, Bebbington, & Jenkins, 2009; NHS Digital, 2018a). Since 2000, the APMS survey also found a substantial decrease in the proportion of men meeting criteria for hazardous drinking, but the level of harmful or dependent alcohol use has remained relatively stable, as has the proportion of women meeting criteria for any category (McManus et al., 2016; McManus et al., 2009).

The World Health Organisation's (WHO) global status report on alcohol and health (WHO, 2019), measured global levels of alcohol consumption, in 2016, using the prevalence of current drinkers (those aged 15 years and older who had consumed alcohol in the past 12 months) and total alcohol per capita consumption (APC). APC was defined as the total alcohol per capita consumption within a year, in litres of pure alcohol (adjusted for tourist consumption), and has increased, globally, from 5.5 litres in 2005 to 6.4 litres in 2016 (WHO, 2019). Approximately 43% of the global population were current drinkers (WHO, 2019). However, alcohol was only consumed by more than half of the population in three regions: European Region (59.9%), the Americas (54.1%), and the Western Pacific Region (53.8%). The total APC can be used to estimate higher levels of consumption, with the highest total APC being observed in the European Region (10 or more litres of pure alcohol per person per year) (WHO, 2019).

This section provides an overview of the international prevalence of hazardous and harmful alcohol use in the general population, which links with the meta-analysis presented in Chapter 4, where the international prevalence of hazardous and harmful alcohol use across trauma-exposed occupations is determined. This section also demonstrates the range of different tools and criteria that are used to measure hazardous and harmful alcohol use, which complicates comparisons across studies, and this was a limitation throughout this thesis.

1.3.3 Binge drinking

One pattern of alcohol use is binge drinking. In research, binge drinking is often defined as 4/5 drinks on one occasion, or 6/8 units on one occasion, and is usually gender-specific, such as 6 units for women and 8 units for men. Binge drinking is associated with several physical health consequences, as high blood alcohol levels

achieved through binge drinking can affect almost all bodily tissues, leading to alterations in organ function (Molina & Nelson, 2018). The Office for National Statistics survey of UK adult drinking habits classed 27% of current drinkers (28% of men and 26% of women) as binge drinkers, defined as consuming 8 or more units for men and 6 or more units for women, on their heaviest drinking day, in the week prior to the survey (Office for National Statistics, 2018). Although a 2017 survey found that young people (aged 16 to 24 years old) were less likely to consume alcohol, they were more likely than any other age group to binge drink on their heaviest drinking day (37.3% compared with 10.3% of those aged above 65 years old) (Office for National Statistics, 2018). A longitudinal study of UK adults found that the prevalence of binge drinking (>10 units for men, >7 units for women, in a single session) decreased from 36.2% in men aged 23 years to 30.8% in men aged 42 years, and from 17.8% in women aged 23 years to 13.7% in women aged 42 years (Jefferis, Manor, & Power, 2007). Global statistics for binge drinking (>60g of alcohol on one day, in the past 30 days) estimate that 18% of adult population meet criteria, with the highest levels in Europe and the lowest levels in North Africa and the Middle East (Peacock et al., 2018).

1.3.4 Abstinence

Abstinence is the complete avoidance of alcohol consumption. The 2017 Health Survey for England found that 16% of men and 21% of women had abstained from drinking alcohol in the past 12 months (NHS Digital, 2018a). This data also showed the highest proportions of non-drinkers in the youngest age group (aged 16 to 24 years old) and the oldest age group (aged over 75 years old). Research suggests that rates of alcohol abstinence have increased in young people (aged 16 to 24 years old) in the UK, increasing from 18% in 2005 to 29% in 2015 (Fat, Shelton, & Cable, 2018). When looking at global statistics, in 2016, 57% of people over 15 years old reported

abstaining from alcohol in the past 12 months (44.5% were lifetime abstainers) (WHO, 2019). The global proportion of abstainers has increased by 5% since 2000, due to an increase in former drinkers becoming abstainers, rather than an increase in lifetime abstainers (WHO, 2019). There are a multitude of factors which impact the prevalence of alcohol abstinence across countries, including the wealth of the country, religion and cultural norms – with some countries having a complete ban on alcohol (WHO, 2019). The regions with the lowest prevalence of abstinence (less than 40% abstaining) tend to be high-income countries in Western Europe, and USA and Australia (WHO, 2019). In comparison to other countries around the world, the UK has considerably low rates of alcohol abstinence.

It is also important to consider differences in lifetime abstainers and abstainers who have formerly drank alcohol. This is particularly paramount in research, as the reasons for abstaining are likely to differ, and lifetime abstainers and former drinkers may have different health outcomes. Evidence shows that abstainers have poorer health outcomes than low-risk drinkers (Fat, Cable, Marmot, & Shelton, 2014; Liang & Chikritzhs, 2013). This relationship has been referred to as "U-shaped" or "J-shaped", due to evidence showing that abstinence and hazardous/harmful drinking were associated with adverse health outcomes, but low risk drinking was not (Leong, 2019; Marmot, Shipley, Rose, & Thomas, 1981; Shaper, Wannamethee, & Walker, 1988). However, it has been argued that this may relate to the misclassification of abstainers, by not differentiating between lifetime and former abstainers (Rehm et al., 2008). For example, a meta-analysis identified that, compared to lifetime abstainers, the all-cause mortality risk for former drinkers was 44% higher in women and 21% higher in men (Gmel, Gutjahr, & Rehm, 2003; Roerecke & Rehm, 2011). The "sick-quitter" hypothesis proposes that former drinkers may stop drinking because they have

developed a physical health problem, or because they have developed an alcohol problem, causing alcohol-attributable harm (Fillmore, Kerr, Stockwell, Chikritzhs, & Bostrom, 2006; Shaper et al., 1988).

1.3.5 Sociodemographic associations with alcohol use

The previous sections condensed the literature relating to hazardous and harmful alcohol use, binge drinking, and abstinence. Certain sociodemographic characteristics are associated with differences in these drinking behaviours, and these characteristics will be explored throughout this thesis. As previously outlined in the findings from the Health Survey for England and the APMS survey, men are more likely to meet criteria for hazardous and harmful drinking (McManus et al., 2016; NHS Digital, 2018a). Literature across Westernised countries has consistently shown higher levels of alcohol consumption, and higher prevalence estimates for hazardous and harmful drinking, in men, compared with women (Nolen-Hoeksema, 2004; Nolen-Hoeksema & Hilt, 2006). Recent evidence suggests that, although men do still generally consume more alcohol than women, the gender gap has narrowed (Bratberg et al., 2016; Keyes, Martins, Blanco, & Hasin, 2010; White, 2020). The convergence of men and women's drinking behaviours are thought to be influenced by cultural and societal changes, such as greater gender equality and changing roles (Kuntsche et al., 2006)

Another sociodemographic factor contributing to differences in alcohol consumption, is age. In a 2017 survey of UK adult drinking habits, the highest level of alcohol consumption was found in those aged 45 to 64 years old (65% reported drinking alcohol in the past week) and the lowest level was found in those aged 16 to 24 years old (48%). The proportion of young people who report being abstinent has also increased from 12% in 2011, to 24% in 2017 (NHS Digital, 2018a). However, people in the youngest age group (aged 16 to 24) were more likely to binge drink on

their heaviest drinking days and the oldest age group (aged over 65) were the least likely to binge drink (Office for National Statistics, 2018). Compared to the previous APMS survey, the most recent statistics show that the prevalence of harmful drinking has decreased in 16 to 24 year olds (from 6.2% in 2007, to 4.2% in 2014), but increased in 55 to 64 year olds (from 1.4% in 2007, to 2.8% in 2014) (McManus et al., 2016).

In the UK, people from ethnic minority backgrounds (excluding White Irish) typically drink less alcohol and are more likely to abstain compared to those from White British background (Institute of Alcohol Studies (IAS), 2020), however, there is a dearth of research in this area. For example, the Scottish Health Survey found that individuals from African, Caribbean, Pakistani and Chinese backgrounds were less likely to drink above the 'low-risk' limits, compared to White British respondents (Whybrow, Ramsay, & MacNee, 2012). The APMS survey also identified that 30.8% of White men met criteria for hazardous drinking (AUDIT score of 8 or more), compared to 6.6% of Black men and 4.7% of Asian men. Likewise, 14.8% of White women met criteria for hazardous drinking, compared to 7.4% of Black women and 2.6% of Asian women (McManus et al., 2016). However, the APMS survey can be criticised for using broad ethnic groupings, which does not allow for the exploration of differences across specific ethnicities. Ethnic differences in alcohol use are largely influenced by cultural or religious norms, and there is evidence that second-generation ethnic minority individuals (particularly people from Indian, Pakistani and Black Caribbean backgrounds), in the UK, show much higher levels alcohol use than their first-generation counterparts (Wang & Li, 2019).

Socioeconomic status (SES, the social class of an individual) is often measured using indicators such as education, income and occupational grade (Baker, 2014), and has known associations with alcohol consumption. Alcohol-related harm is much

higher in socioeconomically disadvantaged populations, compared to those living in more advantaged areas, despite similar levels of consumption (Katikireddi, Whitley, Lewsey, Gray, & Leyland, 2017). This is known as the alcohol harm paradox. There is some evidence to suggest that low SES is associated with an increased likelihood of binge drinking, but a reduced likelihood of drinking above recommended weekly limits (Beard et al., 2016; Lewer, Meier, Beard, Boniface, & Kaner, 2016). However, recent evidence shows that the greater levels of alcohol-related harms in socioeconomically disadvantaged populations remain even after accounting for differences in drinking patterns, obesity, and smoking status (Katikireddi et al., 2017). Similarly, there are also inequalities in mental health, as individuals from socioeconomically disadvantaged backgrounds are more likely to experience depression and anxiety (Lorant et al., 2003), and may be more likely to drink to cope (Boniface, Lewer, Hatch, & Goodwin, 2020). In terms of occupational grade, participants in routine or manual occupations were more likely to binge drink, compared to those in higher managerial occupations, but were less likely to drink above the recommended weekly limits (Lewer et al., 2016).

1.4 Alcohol use in police employees

The focus of this thesis is the level of hazardous and harmful alcohol use (and abstinence from alcohol) in police employees. This section will summarise the existing literature regarding alcohol use in police employees. There are some historic accounts of a heavy drinking culture within police employees, for example, police stations in the UK previously had bars - hence the colloquial reference to a "canteen culture" within policing (Waddington, 1999). Alcohol is thought to have benefits for social bonding, particularly as compensation for the lack of peers outside of the police service (resulting from shift work and the nature of experiences that civilians cannot relate to)

(Richmond, Kehoe, Hailstone, Wodak, & Uebel-Yan, 1999). In addition, drinking with colleagues is thought to provide an opportunity for occupational deviance, and symbolises loyalty and trustworthiness needed in social bonding (Abdollahi, 2002; Waddington, 1999). However, police employees in the UK now face strict regulations relating to alcohol use, as they are deemed unfit for duty if they have a blood alcohol concentration level of 29mg (the legal limit for driving is 80mg) (Home Office, 2012). Very few studies have examined alcohol use in UK police employees, with most research being conducted in Australia and the US.

A recent meta-analysis determined the global prevalence of mental health problems (including hazardous and harmful/dependent drinking) in police employees (Syed et al., 2020). The authors identified 60 eligible cross-sectional studies and seven longitudinal studies, involving almost 300,000 police employees from 24 countries. Of these studies, 16 examined hazardous or harmful drinking. The pooled prevalence of hazardous drinking was 25.7% (95% Confidence Intervals [CIs]: 19.6% to 32.4%) and the pooled prevalence of harmful/dependent drinking was 5.0% (95% CIs: 3.5% to 6.7%). Using a meta-regression, they found that being male was significantly associated with hazardous drinking (Syed et al., 2020). No UK studies were identified as eligible. A recent UK biobank study compared levels of mental health problems and hazardous, harmful or dependent alcohol use (AUDIT scores above 8), in emergency service personnel (including police employees) and the general working population (Stevelink, Pernet, et al., 2020). The level of hazardous, harmful or dependent alcohol use was 32.8% in emergency services personnel and 29.2% in the general working population, but this was not a statistically significant difference (Stevelink, Pernet, et al., 2020). Further, the results were not separated by specific occupational group, meaning differences between them could not be determined.

Some Australian and US studies have examined hazardous and harmful alcohol consumption in police employees. Davey, Obst and Sheehan determined the prevalence of hazardous and harmful alcohol use in a representative sample of police officers from an Australian state police service (Davey, Obst, & Sheehan, 2000a). The sample included 4,193 police officers (87.9% male), which represented 67% of that police force. Hazardous and harmful alcohol use was measured using the 10-item AUDIT, with scores of 8-13 indicating hazardous use and scores above 13 indicating harmful alcohol use (Davey, Obst, et al., 2000a). In total, 30% of police employees met criteria for hazardous drinking (31.5% of men and 22.6% of women) and 3% met criteria for harmful drinking (2.8% of men and 2.4% of women). They also explored sociodemographic and occupational associations with hazardous and harmful drinking. Males, those aged 18 to 35, those divorced or separated (compared to those married or single), police constables (compared to commissioned officers and sergeants) and those who had served between 4 and 10 years (compared to newer recruits and those who had served more than 10 years), were more likely to meet criteria for hazardous drinking. Similar factors were associated with harmful drinking, except males and females had similar rates of harmful drinking (Davey, Obst, et al., 2000a). The authors also compared the frequency and quantity of consumption with the Australian general population, using the National Household Survey, finding that both male and female police employees drank a greater number of drinks than males and females in the general population, and were less likely to abstain from drinking (9% of police sample vs 24% of the general population) (Davey, Obst, et al., 2000a).

Davey, Obst and Sheehan have published several additional studies using the same database. One study explored readiness to change in police employees who met criteria for hazardous drinking (Davey, Obst, & Sheehan, 2000b). Of those participants, 72.5%

stated that they did not have a drinking problem and 57.8% reported that it would be easy to stop drinking. A further study, using a subsample of 749 police employees, obtained from the larger study, explored factors that participants felt contributed to their drinking (Davey, Obst, & Sheehan, 2001). Participants rated social factors, e.g. celebrations, as the most important contributors to their alcohol consumption, but factors relating to stress were the strongest predictors of higher AUDIT scores. An additional longitudinal analysis of drinking behaviours, using a sample of 177 new police recruits, measured their drinking behaviour from the first day in training, 6 months into training and one year into training (Obst, Davey, & Sheehan, 2001). There were significant increases in mean AUDIT scores at 6 months and at 12 months, compared with the first day of training (Obst et al., 2001). The authors attributed the increase in AUDIT scores to a culture of drinking which is ingrained in the Australian police service and training process. However, although the mean AUDIT scores were significantly different, they only increased from 5.8 at the first day of training, to 6.8 at 6 months and 6.9 at 12 months, both of which would be categorised as "low risk" drinking (Saunders et al., 1993). These studies are further limited as they are over 20 years old and may not reflect current drinking behaviours, and the findings cannot be generalised to the UK as there may be cultural differences in drinking behaviours.

The US studies have smaller sample sizes (N below 1000) and may not be as representative. Ballenger and colleagues identified lower levels of hazardous alcohol consumption (NIAAA recommendation of 14 drinkers per week for men and 7 drinks per week for women), compared to the Australian data, with 11% of males and 16% of females meeting criteria (Ballenger et al., 2011). The Michigan Alcoholism Screening Test (MAST) was also used to screen for probable alcohol dependence, finding that 7.8% of the sample met criteria (Ballenger et al., 2011). The only

significant association with hazardous drinking was lower educational attainment (compared with higher educational attainment). Interestingly, women were more likely to meet criteria for hazardous drinking than men, opposing findings from Australian police and the UK general population (Davey, Obst, et al., 2000a; NHS Digital, 2018a; Office for National Statistics, 2018), which likely reflects the substantial gender differences in the cut-offs used. An additional study of 663 Mississippi police employees found that 16.8% met criteria for hazardous use and 1.4% met criteria for harmful use or possible dependence (using AUDIT scores) (Lindsay, 2008). White police employees were more likely to be hazardous or harmful drinkers than other ethnic groups, which is consistent with Australian data (Davey, Obst, et al., 2000a). Police employees who were single were more likely to be hazardous or harmful drinkers than those in a relationship, but education and rank were not significantly associated (Lindsay, 2008). Violanti and colleagues have conducted several studies exploring alcohol consumption in US police employees, mainly focussing on the associations with stress. A study of 115 randomly selected police officers from a US police department (with a total of 934 officers) found that 38.5% of men and 17.5% of women met criteria for hazardous drinking, using an AUDIT cut-off of 8 (Violanti et al., 2011). This study found no significant sociodemographic or occupational associations with alcohol use.

There have been some attempts to compare the level of alcohol consumption in police employees, cross-culturally. One study used a sample of 1,286 police employees (79% male and 21% female) from five countries: UK, USA, Canada, Australia and New Zealand (Ménard, Arter, & Khan, 2016). Using mean AUDIT scores, they observed the highest scores in Australia (7.16) and lowest in the US (4.18), with a mean score of 5.95 for UK police employees. Across the whole sample, 25% met

criteria for hazardous drinking (AUDIT cut-off of 8). Younger age, being male and the use of negative coping, were significantly associated with higher AUDIT scores across the whole sample (Ménard et al., 2016). However, the prevalence estimates for hazardous alcohol use are not reported separately by country, and the sample sizes are small for some countries (e.g. N = 102 for UK and N = 57 for New Zealand).

To summarise the existing literature (which is systematically reviewed in Chapter 4), there are a few publications stemming from a single large Australian dataset, and several US studies with smaller samples. However, the Australian data is 20 years old and may not reflect current drinking behaviours in police employees, the US studies are not representative, and there are large occupational differences between US and UK policing. Further, there is a clear lack of UK literature. Chapter 5 addresses these limitations, by using a representative sample of UK police employees to determine the prevalence of hazardous and harmful drinking, and abstinence.

1.4.1 Similar occupational groups and alcohol use

There are professions that have occupational similarities with police employees, such as other emergency services, which are also characterised by intensive job demands, shift work, frequent trauma exposure, and being male-dominated (which may encourage risk-taking behaviours like binge drinking (Roche et al., 2015)). Some studies have examined the prevalence of hazardous or harmful alcohol use across the emergency services. A study of 5,813 emergency services personnel, including police employees, paramedics and firefighters, found that 3.9% of Royal Canadian Mounted police and 5.8% of municipal/provincial police met criteria for harmful alcohol use (AUDIT cut-off of 15) (Carleton et al., 2018). This was lower than estimates for firefighters (8.0%), paramedics (6.1%) and call centre operators (7.2%). A study of 1,099 South African emergency services personnel used the CAGE alcohol

questionnaire to determine levels of harmful alcohol use across ambulance services, fire services, sea rescue and traffic police, with approximately 19% of traffic police meeting criteria for the lifetime likelihood of harmful alcohol use (Ward, Lombard, & Gwebushe, 2006). However, because the CAGE measures the likelihood of harmful drinking over one's lifetime, rather than current alcohol consumption, this estimate may be inflated (Volk, Cantor, Steinbauer, & Cass, 1997). As these studies compared alcohol use across multiple occupations, the sample sizes for each group were small and not representative.

Another occupational group frequently exposed to trauma is healthcare workers, such as doctors and nurses. There is evidence to suggest that alcohol is often used by healthcare workers to cope with work-related stress, frequent exposure to illness and death, and disrupted sleep and social life (Bennett & O'Donovan, 2001). Longitudinal research examined alcohol consumption in UK medical students, and again four years later when they were doctors, finding that alcohol consumption increased in both men and women (Newbury-Birch, Walshaw, & Kamali, 2001). Additional longitudinal research showed that poor mental health and drinking to cope were associated with hazardous drinking at follow up, in a sample of nearly 1,000 doctors (Mahmood, Grotmol, Tesli, Vaglum, & Tyssen, 2017). Given the occupational similarities with policing, police employees may also use alcohol to cope and show high levels of hazardous or harmful drinking.

One of the most obvious occupations with an increased risk of trauma exposure is the Armed Forces, which is characterised by periods of deployment and combat. Alcohol has historically been used by military personnel to assist in group bonding during training, to provide confidence during combat, and to aide with stress and sleep following combat (Jones & Fear, 2011). Evidence from both the UK and US shows

that the level of harmful alcohol use is almost three times greater in military personnel, compared to the general population (Fear et al., 2007; Jacobson et al., 2008). Mental health problems are also more common in UK military personnel, compared to the UK general population (Goodwin et al., 2015). In addition, military personnel with a mental health problem are more likely to drink harmfully, or abstain from drinking (Goodwin et al., 2017), which is in line with general population evidence, regarding a J-shaped relationship between alcohol and mental health (El-Guebaly, 2007; Puddephatt et al., 2021). Moreover, military personnel who report coping motivations for drinking are more likely to meet criteria for mental health problems and harmful drinking (Irizar et al., 2020).

1.4.2 Theories relevant to alcohol use in occupational settings

There are theories which can be useful for understanding alcohol consumption in occupational settings. One theory is social norms theory, which posits that behaviour is influenced by misperceptions of others' behaviours, suggesting that the overestimation of others' alcohol consumption leads to an increase in one's own alcohol consumption (Berkowitz, 2003; Perkins, 2003). This is known as pluralistic ignorance, whereby individuals incorrectly perceive that the attitudes or behaviours of others are different from their own, when they are similar (Miller & McFarland, 1991; Toch & Klofas, 1984). Though this theory was originally developed in college or university students, there is evidence to suggest that it is applicable to work-places (Barrientos-Gutierrez, Gimeno, Mangione, Harrist, & Amick, 2007). An additional theory that is relevant to understanding alcohol use in occupational settings is social practice theory. Social practice theory suggests that practices are routinised human activities that involve the intertwining of several elements (Nicolini, 2016). For example, in the UK, alcohol is often embedded within multiple social practices, such

as drinking when going out for a meal, or in an occupational context, after-work drinks with colleagues (Meier, Warde, & Holmes, 2018).

The social norms theory and social practice theory could be useful in understanding alcohol consumption and drinking cultures within police employees. For example, longitudinal Australian data showed that new police recruits increased their consumption after one year in service, with the authors theorising that this was related to the drinking culture (Obst et al., 2001). Similarly, the military drinking culture (e.g., use of alcohol to encourage unit cohesion and heavy drinking episodes following 'dry periods' during deployment) has been linked to the high levels of harmful alcohol use in military personnel (Ames, Cunradi, Moore, & Stern, 2007; Jones & Fear, 2011). In line with social norms theory, it could be that occupational drinking cultures create a misperception that heavy drinking is the norm, leading to increased consumption. In terms of social practice theory, individuals working in these occupations may be influenced by social practices relating to drinking, such as drinking with colleagues after work. These theories informed the topic guides used in the interview study described in Chapter 9.

1.5 Job strain in police employees

Section 1.2 highlighted that UK police employees are facing increasing demands, and this section will summarise the evidence regarding the types of strain that they experience, and the associations between strain and alcohol use. The reports on police officer strength showed that the number of UK police officers declined every year since 2010, with 2017 having the lowest number of officers since records began, in 1996 (Allen & Audickas, 2020). Though there has been a slight increase in the number of officers between 2019 and 2020, this is still much lower than a decade ago. These unprecedented cuts to the police service, leading to fewer officers and resources, have

led to increasing demands and strain (Elliott-Davies, 2019; Houdmont & Elliot-Davies, 2016). Within policing literature, there are two prominent types of stressors – operational stressors and organisational stressors. Organisational stress relates to strain caused by the harmful aspects of the work environment, whereas operational stress relates to distress caused by operational duties. Throughout this thesis, the term 'job strain' will be used in reference to organisational stress.

1.5.1 Organisational stressors

Organisational stress is caused by strain from working in an environment that poses a perceived threat to wellbeing (Cooper & Marshall, 1976; Cullen, Link, Wolfe, & Frank, 1985). This is thought to be related to a mismatch between 'costs' and 'gains', with Siegrist's effort-reward imbalance (ERI) model suggesting that imbalances in effort (e.g., high job demands) and rewards (e.g., promotion, recognition) leads to organisational stress (i.e., job strain) (Siegrist, 1996). Moreover, ERI has been linked to adverse physical and mental health outcomes (Rugulies, Aust, & Madsen, 2017; Siegrist & Li, 2016). Similarly, Karasek's Job Demand Control (JDC) model indicates that a combination of high job demands (e.g. time pressure, high amounts of effort and difficulty) and low job control (e.g. low freedom to control and organise own work, lack of decision-making authority) creates job strain (Karasek Jr, 1979). The JDC model suggests that high demands alone do not always lead to strain, but if the element of control lessens or disappears, the workload feels heavier, leading to strain (Karasek Jr, 1979).

The literature surrounding stressors in police employees generally concludes that organisational stressors are more commonly reported as a source of strain (Alexander & Wells, 1991; Biggam, Power, & MacDonald, 1997; Biggam, Power, Macdonald, Carcary, & Moodie, 1997; Houdmont, Jachens, Randall, & Colwell, 2020; Purba &

Demou, 2019; Shane, 2010). US literature suggests that organisational stressors, such as excessive or unfair discipline rates, are major sources of strain for police officers (Violanti et al., 2011). Although there are considerable cultural differences between the US and UK, the few existing UK studies show similar findings. One study of 1,206 UK police employees found that the most commonly reported sources of strain were organisational stressors, such as job demands affecting home life (e.g., cancelled annual leave, working overtime), lack of communication, lack of control over workload, inadequate support and excessive workloads (Collins & Gibbs, 2003). Further, an additional study found an association between higher reports of organisational stressors and higher scores on the General Health Questionnaire (GHQ; measures psychological distress) (Collins & Gibbs, 2003; Goldberg & Hillier, 1979). Additional literature suggests that organisational stressors have the strongest impact on job satisfaction (Burke, 2006), and contribute to the mental health consequences of operational stressors (Chan & Andersen, 2020).

1.5.2 Operational stressors

Operational stress is caused by distress from operational duties. Due to the nature of policing, police employees are frequently exposed to potentially traumatic incidents during their operational duties. A traumatic incident is defined as an experience involving actual or threatened death/serious injury, witnessing or learning about an event that involves actual or threatened death/serious injury (American Psychiatric Association, 2013). Police employees are often the first response to traumatic incidents, such as road traffic accidents or homicides, and sometimes for major incidents, such as the Manchester Arena Bombing (BBC News, 2017), or the Hillsborough football stadium disaster (BBC News, 2019), which do not occur frequently but can cause distress. In addition, police employees also face routine, daily

stressors, such as arresting people or helping victims of domestic violence. A UK Police Federation survey measured trauma exposure with a list of 20 traumatic incidents and participants reported whether they had experienced each one or not (Elliott-Davies, 2019). Worryingly, 99.6% of police officers reported experiencing one or more incident, with 96% reporting that they had witnessed the body of someone who had died a violent or unnatural death (Elliott-Davies, 2019). Police employees who are frequently exposed to traumatic incidents are more likely to suffer from post-traumatic stress disorder (PTSD) (Brewin, Miller, Soffia, Peart, & Burchell, 2020; Syed et al., 2020). Research into the mental health of police employees will be discussed in the following section (1.6).

1.5.3 Job strain and alcohol use in police employees

There is evidence to suggest that organisational stress (or job strain) impacts health behaviours (Dollard, Winefield, & Winefield, 2003). For example, high job strain (high demands and low control) is linked with heavy drinking and smoking (Lallukka et al., 2008; Lallukka et al., 2004), which may be related to the use of maladaptive coping strategies. Though conversely, health behaviours such as physical activity and a healthy diet are sometimes used as a form of proactive coping (Aspinwall & Taylor, 1997). However, there is a lack of research into the relationship between job strain and alcohol use (or other health behaviours), in police employees. One cross-sectional study explored coping behaviours in 105 older police employees (over the age of 50), finding that high job strain was associated with problematic alcohol use, and adverse health outcomes (e.g., chronic pain) (Gershon, Lin, & Li, 2002). An additional cross-sectional study found the relationship between job strain and problematic alcohol use (measured using 3-items relating to guilt, losing memory and drinking more than planned) was mediated by symptoms of depression and anxiety (Swatt, Gibson, &

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Piquero, 2007). Australian research also found that low job satisfaction and low perceived control within that job were significantly associated with hazardous alcohol use in police employees (Davey, Obst, & Sheehan, 2000c). It is important to understand the impact of organisational stressors on health risk behaviours, as a review of the literature identified that organisational stressors, along with problematic alcohol use, are associated with suicidal ideation in police employees (Chae & Boyle, 2013).

Operational stressors may result in coping-related drinking motives (Dixon, Leen-Feldner, Ham, Feldner, & Lewis, 2009). US research identified that alcohol was cited as one of the primary coping strategies to deal with operational stressors (Violanti et al., 2011). A cross-sectional study of 4,193 Australian operational police officers identified a significant positive relationship between dealing with alcohol-related incidents whilst on duty and higher AUDIT scores (Davey, Obst, Zinkiewicz, & Sheehan, 2000). Similar findings have been observed in Finnish police officers (N = 1,734), showing an association between work-related violence and increased alcohol consumption (Leino, Eskelinen, Summala, & Virtanen, 2011). However, a large study of 2,372 police employees and 1,096 ambulance personnel found no relationship between operational stressors and alcohol use, but did identify a significant positive association between drinking to cope and higher AUDIT scores (Sterud, Hem, Ekeberg, & Lau, 2007b). Menard and Arter (2014) examined gender differences in coping responses and alcohol consumption in 1,582 police employees from 13 countries. In men, reporting high levels of both operational stressors and negative coping (interaction of continuous measures) was significantly associated with higher AUDIT scores, reporting high levels of both operational stressors and negative coping was significantly associated with lower AUDIT scores in women (Ménard & Arter, 2014).

The adverse consequences of both organisational and operational stressors are well-evidenced (Bishopp, Leeper Piquero, Worrall, & Piquero, 2018). It has been theorised that a combination of both organisational and operational stressors leads to worse consequences in police employees, as evidence suggests that a good organisational climate, e.g., adequate support, can be protective against the adverse outcomes associated with operational stressors (Chan & Andersen, 2020). However, the existing literature surrounding the relationship between organisational and operational stressors with alcohol use is mixed, with some studies finding significant associations with problematic alcohol use in police employees, whereas others have not.

1.6 Mental health in police employees

Frequent and sustained exposure to traumatic incidents and extensive job demands may place police employees at an increased risk of poor mental health. The previous section described the organisational and operational stressors experienced by police employees and highlighted that these stressors have known associations with adverse mental health consequences. The mental health charity, Mind, set up a service specifically to support the wellbeing of emergency services personnel, between 2015 to 2019, called the Blue Light Project (Mind, 2019). Between December 2018 and January 2019, Mind conducted a survey to explore the mental health and wellbeing of emergency service personnel, with a final sample of 5,081 participants - 41% of which were police officers (Mind, 2019). Across the whole sample, 67% of participants reported having lived experience of mental health problems, with 48% of participants reporting depression, 48% reporting anxiety, and 21% reporting PTSD (Mind, 2019). It was not possible to compare estimates across the different occupational groups. When participants were asked what they thought were the causes of their mental health problems, the most cited reasons were excessive workload, trauma exposure (i.e.,

operational stressors), pressure from management, and long hours (Mind, 2019). Police officers were the occupational group most likely to cite excessive workload as the main reason for poor mental health (Mind, 2019). However, these findings were based on self-reported experiences, rather than validated questionnaires or clinician diagnosis. This section will present the existing literature regarding post-traumatic stress disorder (PTSD), depression, and anxiety in police employees.

1.6.1 Post-traumatic stress disorder

PTSD can occur in those who have experienced stressful, frightening, or distressing events (American Psychiatric Association, 2013). Symptoms include reliving the traumatic event through nightmares and flashbacks, problems sleeping, difficulty concentrating (American Psychiatric Association, 2013), and can develop immediately after the event, or weeks, months, or years later (though a diagnosis of PTSD would not be made immediately after the event, as this would be diagnosed as adjustment disorder). The symptoms of PTSD fall within four main clusters: re-experiencing trauma, deliberate avoidance, negative cognitions and mood, and arousal (American Psychiatric Association, 2013). The most recent prevalence estimates of PTSD in the UK general population are estimated to be 4.4%, measured using PCL-C (with items corresponding to the three DSM-IV symptom clusters: re-experiencing, avoidance, and arousal) (McManus et al., 2016). Individuals who have experienced repeated or prolonged traumatic situations can develop complex PTSD (CPTSD), which is includes similar symptoms to PTSD but also includes additional symptoms, such as disturbances of affect regulation, negative self-concept and difficulties in relationships (Cloitre, Garvert, Brewin, Bryant, & Maercker, 2013; Van der Kolk, 2002).

Police employees are an occupational group at risk of PTSD because they face high and sustained levels of trauma exposure. One review, including 360 studies, found that

emergency service workers, health care workers, train drivers and journalists were occupational groups at increased risk of work-related PTSD (Skogstad et al., 2013). They estimated the prevalence of PTSD to be 10% in police employees, which was lower than other emergency service personnel (e.g. firefighters and ambulance personnel, with an estimated prevalence of 20%) (Skogstad et al., 2013). Few studies have explored the prevalence of PTSD in UK police employees, with most existing research using small, non-representative samples (Foley & Massey, 2019). However, two very recent studies have used large samples to determine the prevalence of PTSD in UK police employees. One study used data from 40,299 police employees, obtained from the Airwave Health Monitoring Study (the database used throughout this thesis), reporting of prevalence of 3.9% for PTSD (9.8% for depression and 8.5% for anxiety) (Stevelink, Opie, et al., 2020). The other study used data from 10,401 police officers recruited from an online advertisement via Police Care UK, a police welfare charity, finding a prevalence of 8.0% for PTSD and 12.6% for CPTSD (Brewin et al., 2020). However, the latter study is not a representative estimate as participants had to have experienced trauma to participate, and this may explain the unusually high levels of complex PTSD, which is typically much rarer (Cloitre et al., 2019).

Besides from the two recent studies with large samples, only one other study exploring PTSD in UK police officers could be identified, which had a small sample of 31 police officers and 72 civilians (Green, 2004). Clinical interviews assessed DSM-IV criteria for PTSD, finding no difference in symptom severity between police employees and civilians, though police employees were more likely to develop PTSD after experiencing assault or threat to life (Green, 2004). A study of 157 Brazilian police officers estimated the prevalence of PTSD to be 8.9%, and PTSD was more likely in participants who were divorced or had worse physical health (Maia et al.,

2007). A larger cross-sectional study of 3,817 South Korean police officers found that 41% met criteria for probable PTSD (this extremely high estimate is theorised to be related to the greater workload of South Korean officers, compared to police officers in other advanced countries) (Lee, Kim, Won, & Roh, 2016). Due to cultural differences, these estimates may not be comparable with UK estimates (Yun, Kim, Jung, & Borhanian, 2013). Gender is important in the prevalence of PTSD, as most civilian studies show higher rates of PTSD in women, compared to men, but studies of police employees show no gender differences (Lilly, Pole, Best, Metzler, & Marmar, 2009), which may reflect resilience in police women.

1.6.2 Depression and anxiety

Symptoms of depression are feeling sad or hopeless, uninterested, tired, and can lead to insomnia or sleeping too much, reduced or increased appetite, and suicidal thoughts or ideation (American Psychiatric Association, 2013). Symptoms of anxiety include feeling a sense of dread, feeling on edge, restlessness, difficulty concentrating and irritability, and symptoms of anxiety can sometimes be physical (e.g., dizziness, heart palpitations, dry mouth) (American Psychiatric Association, 2013). Within the general population, the prevalence of depression (major depressive disorder) is estimated to be 3.3% and the prevalence of anxiety (generalised anxiety disorder) is estimated to be 5.9%, measured using the Clinical Interview Schedule-Revised (CIS-R), which is a validated diagnostic instrument (Lewis, Pelosi, Araya, & Dunn, 1992; McManus et al., 2016). Self-report questionnaire measures of depression and anxiety show higher prevalence estimates, with approximately 15.7% of the population reporting symptoms of common mental disorders (McManus et al., 2016).

Few studies have examined levels of depression and anxiety in police employees, with most of the available literature focussing on PTSD. A recent meta-analysis

identified 22 studies which screened for depression and 10 studies which screened for anxiety in police employees, finding a pooled prevalence of 14.6% for depression and 9.6% for anxiety (Syed et al., 2020). A recent paper compared the prevalence of common mental health problems in emergency service personnel (N = 842) and the general population (N = 5,052) (Stevelink, Pernet, et al., 2020), finding slightly higher rates of depression in emergency service personnel compared with the general population (6.8% vs 5.1%, respectively), and similar rates of anxiety (3.9% vs 3.6%, respectively). However, this study was not representative of the general population as the sample was over-represented by women and those of an older age. Further, all emergency service personnel were grouped together, meaning prevalence estimates for each occupation could not be obtained.

Of the existing research, one survey of 631 Australian police officers mapped items from the GHQ-12 (Goldberg & Williams, 1988), K10 (Kessler et al., 2002) and Centre for Epidemiologic Studies of Depression Scale (CES-Depression Scale) (Lewinsohn, Seeley, Roberts, & Allen, 1997), finding that 37% met the criteria for depression (Lawson, Rodwell, & Noblet, 2012). A longitudinal study, following-up 119 US police recruits after one year, found that 5.9% met the criteria for depression at baseline, and reported that 77.3% reported symptoms of depression at the one year follow-up (Wang et al., 2010). Nonetheless, the authors used different measures to assess depression at baseline (Symptom Checklist Revised (SCL-90-R)) and at the follow up (Beck Depression Inventory), reducing the comparability. One study compared mental health (using the SCL-90-R) in police officers and other occupational groups, including bank employees, supermarket workers, and soldiers before and after deployments, finding lower levels of anxiety and depression in police officers than other occupations (Van der Velden et al., 2013). Nevertheless, there is a lack of UK literature, despite police

employees being at risk of poor mental health due to the operational and organisational stressors which characterise their work.

1.7 Alcohol associations with mental health in the police

The previous section summarised the evidence surrounding the mental health of police employees. There is strong evidence showing the co-occurrence of poor mental health with harmful alcohol use (Bell & Britton, 2014; Conway, Swendsen, Husky, He, & Merikangas, 2016; Lai, Cleary, Sitharthan, & Hunt, 2015; Puddephatt et al., 2021). The co-occurrence of two problems is often referred to as 'comorbidity', within the literature. Comorbidity refers to the presence of an additional condition in an individual with an index condition, whereas co-occurrence refers to two conditions occurring simultaneously without knowing which existed first. It is important to examine the level of co-occurring problems, as those with both conditions have poorer outcomes than those with one condition (McCarthy & Petrakis, 2010), and experience complications in treatment (McManus et al., 2009). Emerging evidence has also identified a link between poor mental health and abstinence from alcohol (El-Guebaly, 2007; Goodwin et al., 2017; Puddephatt et al., 2021). Therefore, this thesis will explore the relationship between poor mental health with abstinence, as well as with hazardous/harmful alcohol use, in UK police employees. This section will describe the existing literature regarding co-occurring mental health problems and harmful alcohol use, in both the general population and police employees. In addition, this section will outline the evidence surrounding poor mental health and abstinence.

1.7.1 Post-traumatic stress disorder

There is an abundance of evidence showing a relationship between PTSD and harmful alcohol use. A large systematic review and meta-analysis identified 42 papers

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showing the comorbidity of PTSD and harmful alcohol use (Debell et al., 2014b). The prevalence of harmful alcohol use in those with PTSD ranged from 10% to 61% and the prevalence of PTSD in those with harmful alcohol use ranged from 2% to 63% (Debell et al., 2014b). For comparison, in the UK general population, the prevalence of both PTSD and harmful alcohol use, as separate conditions, are estimated to be approximately 4% (McManus et al., 2016). This review also found that avoidance PTSD symptoms were most strongly associated with harmful alcohol use (Debell et al., 2014b), suggesting that alcohol may be used as a form of avoidance coping. Recent evidence from the Adult Psychiatric Morbidity Survey found that individuals with probable PTSD had three times greater odds of meeting criteria for harmful alcohol use, compared to those without PTSD, even after controlling for a range of sociodemographic covariates (Puddephatt et al., 2021).

There is a surprising lack of literature regarding the relationship between PTSD and alcohol use in police employees. A small UK study by Green found that police officers (N = 31) were more likely to use alcohol to cope with PTSD, than civilians (N = 72) (Green, 2004). However, this study found no difference in the level of PTSD between police officers and civilians and is limited by the small sample. A study of 193 US police employees estimated the level of harmful alcohol use to be 3.5% and the level of dependent alcohol use to be 0.6%, measured using validated AUDIT cut-offs, findings that all PTSD symptom clusters (i.e., re-experiencing, hyperarousal, and avoidance) were associated with harmful drinking and dependence (Chopko, Palmieri, & Adams, 2013). An additional study of 750 US police employees found an association between operational stressors and both PTSD and alcohol use, which was mediated by coping (Ménard & Arter, 2014). Contrarily, a study of 747 US police employees found no association between PTSD or trauma exposure with alcohol

dependence (Ballenger et al., 2011), as did another US study (Violanti et al., 2011), though the latter found an association between external life events (e.g. divorce) with alcohol use.

1.7.2 Depression and anxiety

Within general population samples, the prevalence of depression and anxiety is much higher in those with harmful/dependent alcohol use, compared to those without (Grant et al., 2004; Kessler, 1994; Regier et al., 1990). For example, the Epidemiological Catchment Area study (ECA) interviewed over 20,000 US participants, finding that 16.5% of those with depression also met criteria for alcohol dependence, and 27% of those with alcohol dependence also met criteria for depression (Regier et al., 1990). Further, 17.9% of individuals with anxiety experienced comorbid alcohol dependence and 19.4% of those with alcohol dependence had comorbid anxiety. Similarly, both the National Comorbidity Study (NCS) and National Epidemiological Survey on Alcohol and Related Conditions (NESARC) found that individuals who met criteria for alcohol dependence were almost four times more likely to have depression, compared to those who did not (Grant et al., 2004; Kessler, 1994). A recent meta-analysis of 22 epidemiological surveys determined the co-occurrence of depression or anxiety with harmful or dependent alcohol use (Lai et al., 2015). This review showed that individuals with depression had at least one and half greater odds of also reporting harmful or dependent alcohol use, with similar pooled odds ratios for co-occurring anxiety and harmful or dependent alcohol use (Lai et al., 2015).

Research into the relationship between depression or anxiety and alcohol use in police employees is scarce. One small study examined the association between depression and hazardous alcohol use in 115 US police employees, and found no

significant relationship (Violanti et al., 2011). This study did find that external life events, such as divorce, were significantly associated with hazardous alcohol use. An additional study of 1,104 US police employees observed that those with higher levels of anxiety and/or depression were more likely to drink (any amount, versus does not drink at all) compared to those who had lower levels (Swatt et al., 2007). There is a clear dearth of literature regarding the relationship between depression or anxiety and alcohol use in police employees.

1.7.3 Abstinence

There is emerging evidence to suggest that poor mental health is linked with abstinence, compared to low-risk drinking. A recent study used APMS data to determine the relationship between various mental health problems with abstinence, hazardous and harmful/dependent alcohol use (Puddephatt et al., 2021). Those with a mental health problem showed much high levels of hazardous and harmful/dependent alcohol use, but also much higher levels of abstinence, compared to those without a mental health problem (Puddephatt et al., 2021). Other studies have also demonstrated this "U-shaped" or "J-shaped" relationship between alcohol and mental health, whereby both abstinence and hazardous or harmful drinking are associated with poor mental health, but low-risk drinking is not (Degenhardt, Hall, & Wayne, 2001; El-Guebaly, 2007; Rodgers et al., 2000). This literature review identified no existing research into the relationship between abstinence and mental health in police employees.

1.7.4 Theories relating to alcohol use and mental health

One theory which is useful for understanding the relationship between alcohol use and mental health is the self-medication hypothesis. The self-medication hypothesis

was first developed by Duncan in 1974, who took a behavioural approach, suggesting that substances offer positive reinforcement (feeling "high"), negative reinforcement (reducing negative affect), and the avoidance of withdrawal symptoms (Duncan, 1974). It was argued that harmful substance use is maintained through negative reinforcement, more so than positive reinforcement. A decade later, Khantzian took a psychodynamic approach to the self-medication hypothesis, after finding evidence that those who misuse substances experience worse mental health than those who do not misuse substances, suggesting that substances compensate for deficient ego function (Khantzian, 1987). In 1997, Khantzian revisited the self-medication hypothesis, after finding more evidence to suggest that symptoms of mental health problems, rather than deficient ego function, underly substance misuse, suggesting that substances are used as a relief from psychological suffering (Khantzian, 1997). Khantzian's self-medication hypothesis also proposed that different substances are used to self-medicate different symptoms, depending on the properties of that substance. However, individuals may be more likely to used alcohol than other substances, regardless of their properties, because of the acceptability and availability of alcohol. Longitudinal evidence supports this hypothesis, finding strong evidence between worsened mental health and increased alcohol use (Bell & Britton, 2014), suggesting that alcohol was used to self-medicate.

One way of investigating whether individuals are self-medicating with alcohol, is to explore their motivations for drinking. Cooper's Drinking Motives Questionnaire (DMQ) was developed for use in adolescents but is a reliable measure of drinking motivations across age groups and cultures (M. L. Cooper, Russell, Skinner, & Windle, 1992; Kuntsche, Knibbe, Gmel, & Engels, 2005, 2006; Martens, Rocha, Martin, & Serrao, 2008). The DMQ identified a four-factor structure, with the following drinking

motivations: social (to be sociable and to celebrate), coping (to reduce negative affect), enhancement (to feel better), and social pressure or conformity (to fit in). Research suggests that drinking to cope mediates the relationship between mental health and alcohol use (Gonzalez, Bradizza, & Collins, 2009). A recent survey of 6,184 adults in the UK general population found that coping motives showed the strongest associations with harmful drinking (Appleton, James, & Larsen, 2018). Several additional studies have shown that drinking to cope is associated with adverse outcomes, including alcohol dependence, obesity, poor sleep, low self-esteem, chronic fatigue, and poor performance at work (Kenney, Paves, Grimaldi, & LaBrie, 2014; Laitinen, Ek, & Sovio, 2002; Peele, 1991; Rice & Van Arsdale, 2010). In sum, understanding the relationship between mental health and alcohol consumption, as well as the reasons for this relationship, is vital for preventing adverse consequences.

One theory that may be helpful in understanding the relationship between abstinence and poor mental health is the sick quitter hypothesis (Shaper et al., 1988). The sick hypothesis was developed in response to evidence showing that former drinkers were more likely to report poor mental health, or physical health, compared to lifetime abstainers (Ng Fat, 2014; Shaper et al., 1988). This theory proposes that former drinkers may have stopped drinking because they experienced adverse mental or physical health consequences as a result of their alcohol use, or because they were using alcohol to cope with an existing mental health problem and this led to problematic alcohol use (Degenhardt & Hall, 2003; Goldman & Najman, 1984). Another possible explanation is that alcohol can interact with some prescribed medications for mental health problems, and abstinence is often advised. However, there is a lack of empirical evidence exploring the reasons for the association between abstinence and poor mental health.

Chapter 2: Aims of the thesis.

2.1 Aim one: review of the existing literature

This thesis first aims to conduct a systematic review of the literature, to collate the existing evidence on the prevalence of hazardous and harmful alcohol consumption in police employees. Chapter 4 aims (i) to determine the international prevalence of hazardous and harmful alcohol use across occupational groups at risk of trauma exposure; (ii) to compare the prevalence of hazardous and harmful alcohol use across the different occupational groups; (iii) to examine the impact of the type of measure of hazardous or harmful alcohol use, and geographical location on prevalence estimates; and (iv) to explore the impact of sociodemographic factors, mental health, and study characteristics, on prevalence estimates. The review is pre-registered with PROPSERO (CRD42019120106).

2.2 Aim two: estimating the level of the problem

This thesis will estimate the level of alcohol use in the UK Police Service, and the relationship with mental health problems and job strain, using a large and representative sample. Chapter 5 aims (i) to determine the prevalence of hazardous and harmful alcohol use, frequent binge drinking, and abstinence, in UK police employees; (ii) to explore the associations between probable mental health problems (depression, anxiety, and PTSD) and job strain (high, low, active, passive), with alcohol use; and (iii) to examine whether the associations between job strain and alcohol use differ by the level of job support or mental health status. The aims are pre-registered with Open Science Framework (DOI 10.17605/OSF.IO/T8EKJ).

2.3 Aim three: comparing occupational groups

Two chapters of this thesis will compare the level of alcohol use and mental health problems in the UK Police Service and the UK Armed Forces. Chapter 6 aims (i) to compare the levels of harmful alcohol use, probable PTSD, and their comorbidity, in a sample of male police employees and a sample of male military personnel; (ii) to explore the associations between sociodemographic, occupational, or health variables with harmful alcohol use and probable PTSD (separately for each sample). Similarly, Chapter 7 aims to (i) compare the levels of hazardous and harmful alcohol use, probable PTSD, and their comorbidity, in female police employees and female military personnel. However, due to the small number of female military personnel, this thesis was unable to explore the associations between sociodemographic, occupational, or health variables, with alcohol use or probable PTSD, in women. The aims are pre-registered with Open Science Framework (DOI 10.17605/OSF.IO/7PTWX).

2.4 Aim four: exploring clusters of health behaviours

After identifying the level of hazardous and harmful alcohol use, the final quantitative chapter of this thesis will explore how health (risk) behaviours cluster in the UK Police Service. Chapter 8 aims (i) to identify classes of health (risk) behaviours (alcohol use, smoking, physical activity, fruit and vegetable intake, red meat consumption) in UK police employees; (ii) to determine the associations between poor mental health (depression, anxiety, PTSD) and job strain (high, low, active, passive) with the identified classes; and (iii) to determine the sociodemographic and occupational characteristics of the identified classes. The aims for this chapter are pre-registered with Open Science Framework (DOI 10.17605/OSF.IO/K2CGU).

2.5 Aim five: understanding experiences

The final empirical chapter of this thesis is a qualitative exploration of UK serving police employees' experiences of either hazardous/harmful alcohol use or abstaining from alcohol. Specifically, Chapter 9 aims to qualitatively explore (i) police employees' motivations for alcohol use or abstinence; and (ii) the organisational culture or social environment of drinking, and attitudes towards those who abstain, within the UK Police Service.

2.6 Aim six: triangulation

This thesis takes a multi-method approach (Hanson, Creswell, Clark, Petska, & Creswell, 2005) (outlined in Chapter 3), using multiple methods of data collection to study the phenomenon, and then integrating the findings to make inferences. The aim of Chapter 10 is to integrate the quantitative findings from Chapter 5 and 8 with the qualitative findings from Chapter 9, determining the complementary and dissonant findings.

Chapter 3: General Methodology.

3.1 Methodological approach

This Chapter outlines the methodological approach and theoretical approach taken throughout this thesis, followed by an overview of the quantitative and qualitative methods and analyses used. This Chapter also details the quantitative datasets used in this thesis (describing the study procedures, methods of data collection, and study samples), the measures used, potential covariates, and missing data. Finally, the methodological and ethical considerations are presented.

A multi-method approach was used throughout this thesis, drawing on the strengths of both quantitative and qualitative research (Hanson et al., 2005). Multi-methods can be distinguished from mixed methods, as multi-methods use multiple methods of data collection or multiple related studies and integrate the findings when making inferences, whereas mixed methods specifically integrate the qualitative and quantitative data and/or study designs in a study or multiple related studies (Anguera, Blanco-Villaseñor, Losada, Sánchez-Algarra, & Onwuegbuzie, 2018). Multi-method approaches are becoming frequent in public health research (Kaur, 2016), and are viewed as the third methodological movement, emerging in response to the limitations of solely using a quantitative approach or qualitative approach (Noble & Heale, 2019). By taking a multi-method approach, a variety of methods can be used to answer multifaceted research questions, enabling the understanding of findings in ways that one form of data collection does not allow (Greene & Caracelli, 1997; Tashakkori & Teddlie, 1998).

When taking a multi-method approach, researchers must decide whether to collect the quantitative and qualitative data concurrently or sequentially (Clark & Creswell,

2008). Concurrent designs collect quantitative and qualitative data simultaneously (Clark & Creswell, 2008). Sequential designs collect one form of data first and this informs the following data collection (Clark & Creswell, 2008). In this thesis, a sequential design was utilised. The findings of the first quantitative study (Chapter 5), which determined the prevalence of hazardous and harmful alcohol use (and abstinence) in UK police employees, informed a subsequent quantitative study (Chapter 8), which examined how health risk behaviours cluster together in the same sample of police employees. The findings from Chapter 5 and Chapter 8 then informed the development of the qualitative study (Chapter 9). The order of which the research was conducted is outlined in Figure 3.1.

A key aspect of a multi-method approach is the integration of the quantitative and qualitative findings at an appropriate stage in the research (Tashakkori & Teddlie, 1998). In a multi-method approach, the integration of findings occurs by analysing the quantitative and qualitative data separately (in distinct publications) and then connecting them in some way (Tashakkori & Teddlie, 2003), such as with triangulation. Triangulation refers to the use of multiple data sources or multiple methods to enhance the credibility of findings, enrich the understanding the research question, corroborate evidence, and provide multiple perspectives (Noble & Heale, 2019). There are several types of triangulation, including data source triangulation, theory triangulation, investigatory triangulation, and methodological triangulation (Denzin, 1978; Patton, 1999). Methodological triangulation was used in this thesis, which refers to the use of several data collection methods, i.e., multi-methods (Denzin, 1978). The quantitative and qualitative findings are integrated in Chapter 10.
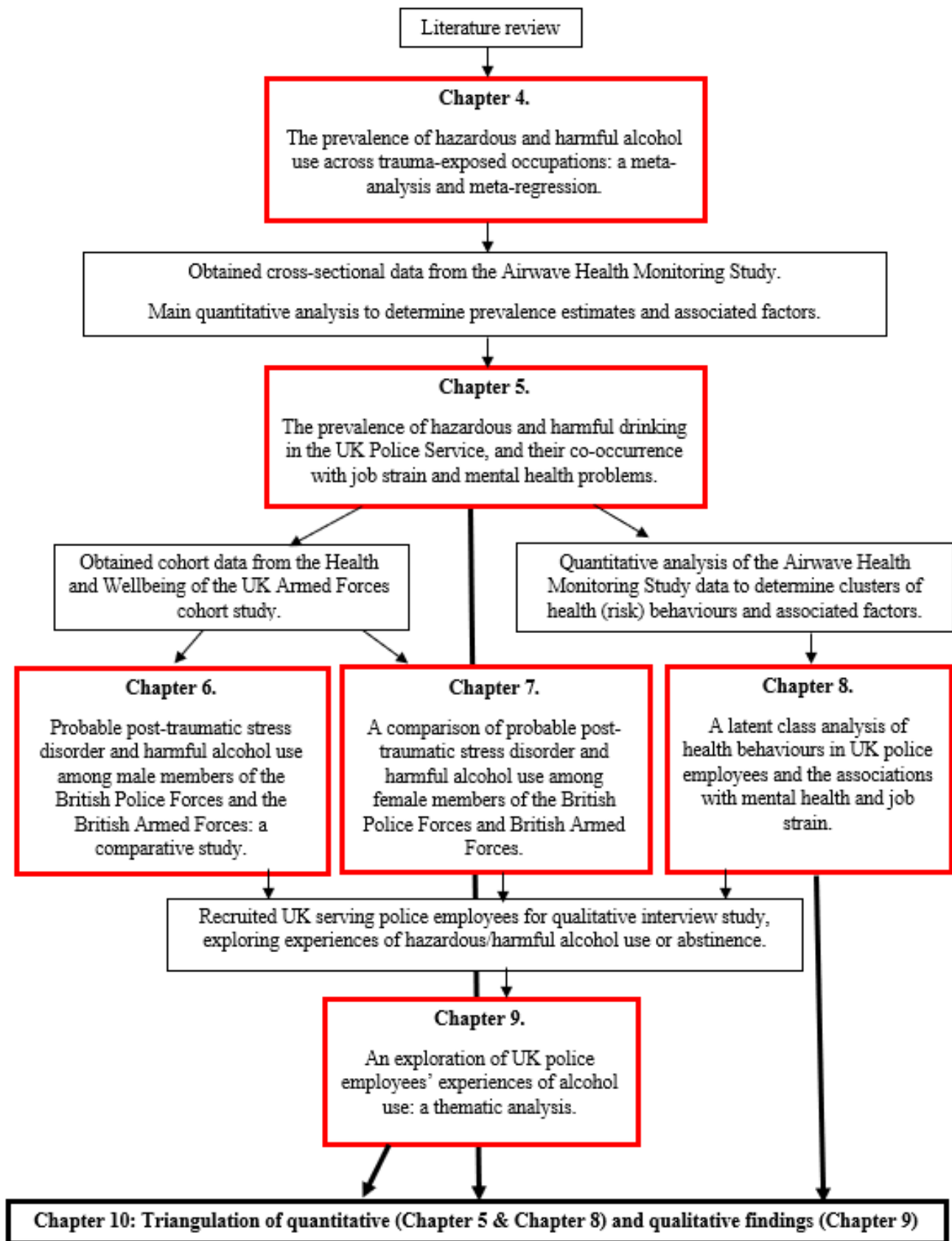
Figure 3.1. Flow diagram representing the order of the conducted research (black boxes linked with thin black arrows) and the manuscripts (red boxes) which were produced. The thick black arrows represent the triangulated findings.

3.2 Theoretical approach

The theoretical framework guiding this thesis, was pragmatism (Florczak, 2014). Pragmatism is an approach to research which involves using methods which are the most suitable to answer the research question (Florczak, 2014). Pragmatism values both objective and subjective knowledge (Biesta, 2010), rejecting traditional philosophical dualism, instead drawing on diverse approaches, which can and should be integrated in research (Rossman & Wilson, 1985). By taking a pragmatic approach, researchers are free to use any method of quantitative or qualitative research, but also recognise that each method has its limitations, and the use of multiple methods can counterbalance such limitations (Tashakkori & Teddlie, 1998).

Epistemology refers to the nature of knowledge and ways of knowing about reality. According to pragmatist epistemology, knowledge is always based on experience and one's knowledge is unique, as it is created by their own unique experiences. However, because we often share experiences, socially, much knowledge is shared knowledge (Morgan, 2014). In pragmatist epistemology, knowledge is not viewed as reality, and instead is viewed as being constructed to manage existence (Goldkuhl, 2012). A pragmatist epistemological perspective requires researchers to consider the consequences of various methods and study designs when evaluating the most appropriate way to answer the research question (Creswell, Klassen, Plano Clark, & Smith, 2011; Morgan, 2014). Therefore, in pragmatism, the research question is more important than the philosophy (Tashakkori & Teddlie, 2008). This thesis took a pragmatist epistemological approach, as multiple methods are required to understand the complex phenomenon of alcohol consumption in the UK Police Service, and the relationship with mental health and job strain.

3.3 Quantitative methods

This section provides an overview of quantitative methods that are relevant to this thesis, focussing on observational and occupational epidemiology. Quantitative methods are used to examine patterns in populations, by collecting data from a sample of the population of interest and analysing data to explore associations between variables. Associations can result from a range of possibilities, including chance, bias, covariates, causation, or reverse causation. Chance associations are also known as sample variation or random error, whereby variables appear to be associated, but occur by chance (Hennekens & Buring, 1987). Bias occurs when certain aspects of the study design, analysis or sample create a systematic error (bias), leading to incorrect associations (Cochran & Rubin, 1973; Rosenbaum, 2002). Covariates are additional variables which can influence the associations between explanatory variables and the outcome (Psaty et al., 1999), and must be controlled for, to minimise their influence on the relationship between the variables of interest (Grimes & Schulz, 2002). Causation is when the explanatory variable alters the likelihood of the outcome variable (e.g., depression causing harmful drinking) and reverse causation is when the outcome variable alters the likelihood of the explanatory variable (e.g., harmful drinking causing depression).

Certain methods provide more compelling evidence for causal associations, whereas others are not able to provide evidence for causal associations (Stovitz, Verhagen, & Shrier, 2019). Randomised controlled trials (RCTs) are used to determine causal associations, usually by comparing the outcomes between a group of participants who receive an intervention, and a control group of participants who do not receive an intervention (Akobeng, 2005; Kendall, 2003). However, there are circumstances when RCTs are not ethical or practical (Nichol, Bailey, & Cooper,

2010; Ovosi, Ibrahim, & Bello-Ovosi, 2017). For example, it would be unethical to conduct an RCT where the intervention or absence of the intervention may be particularly harmful. Further, it would not be practical to conduct an RCT where the intervention of interest has a long-term effect which would require running the RCT for several years before any data could be collected. Such methods would be costly and add further risk of bias as it would be difficult to control for covariates and would require prolonged compliance.

3.3.1 Observational epidemiology

Where RCTs are not ethical or practical, observational epidemiology studies are used to obtain evidence of associations, without intervening. Unlike experimental research in controlled laboratory settings, observational studies involve the collection of data in natural contexts (Song & Chung, 2010). Observational epidemiology studies include cohort studies and cross-sectional studies (Kelsey & Gold, 2016).

3.3.1.1 Cohort studies

After RCTs, cohort studies provide the strongest evidence for causal associations (Mhaskar et al., 2009). Cohort studies collect longitudinal (follow up) data from a cohort (a sample of the population with a shared characteristic) at cross-sectional intersects over time. A cohort can be a sample of individuals with a common demographic, such as those born in the same year, or from the same occupation (Barrett & Noble, 2019). Cohort studies are advantageous as they can examine associations between explanatory variables at baseline with the outcome at follow up (Setia, 2016a). However, cohort studies have limitations, as they are sensitive to bias from attrition (participants dropping out from the study), they are time consuming, and costly (Setia, 2016a).

3.3.1.2 Cross-sectional studies

Cross-sectional studies are observational studies which measure the outcome and explanatory variables in a sample at a single timepoint (Setia, 2016b). Unlike cohort studies, where the sample is selected based on outcome status or based on a shared characteristic, the sample of a cross-sectional study is selected based on inclusion and exclusion criteria of the set study (Setia, 2016b). Cross-sectional data from a single wave of a cohort study are sometimes used in research, particularly when the follow up data is not yet available. Cross-sectional studies are useful to determine the prevalence of outcomes and to examine associations. However, causal associations cannot be determined as there is no sequence of events (Setia, 2016b). Nevertheless, cross-sectional studies are advantageous as they are not as costly or time consuming as cohort studies (Levin, 2006).

3.3.2 Occupational epidemiology

Occupational epidemiology refers to research which collects data from a sample within a specific occupation. Occupational epidemiology is important for determining health risks which may occur more frequently in specific occupations (Ahrens, Behrens, Mester, & Schmeißer, 2008). Historically, occupational health risks have been identified through case-series reports, whereby diseases occurred in clusters within specific occupations, such as cases of silicosis in metal miners in the 1980s (Corn, 1980). Over the years, occupational epidemiology has been essential for understanding disease prevalence and risk, with several UK studies identifying increased cancer risks in occupations relating to gas works (Doll, 1952) and asbestos (Doll, 1955). Occupational epidemiology is vital for understanding whether certain occupations are at an increased risk of adverse physical or mental health outcomes, to develop interventions within occupational settings.

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3.3.2.1 Biases in occupational epidemiology studies

There are several potential biases to be aware of in occupational epidemiology, and studies should be designed to minimise random error (chance) and systematic error (bias), to increase the validity of the findings (Pearce, Checkoway, & Kriebel, 2007). Random error can be reduced by increasing sample size, whereas systematic error can only be reduced through alterations to the study design (Pearce et al., 2007).

Selection bias is a significant cause of systematic error in occupational epidemiology studies (Pearce et al., 2007), arising from the procedures by which the study sample is selected, or self-select themselves to participate (Henderson & Page, 2007). This is particularly pertinent in cohort studies, as selection bias can lead to incomplete follow up data, and participants may leave due to reasons associated with the outcome or explanatory variables (Checkoway, Pearce, & Kriebel, 2004). Generally, selection bias will only occur when the response rates are related to both the outcome and the explanatory factor (Pearce et al., 2007). Large samples which recruit participants through stratified sampling methods, with high response rates can minimise selection bias (Checkoway et al., 2004; Pearce et al., 2007).

The healthy worker effect (HWE) is a specific type of selection bias in occupational epidemiology, characterised by lower levels of mortality or disease incidence in an occupational sample, when compared with a sample from the general population (Li & Sung, 1999). There are two key sources of the HWE. The first is the initial selection of healthy individuals who are able to spend longer in employment (Choi, 1992). The second is the tendency for those who are unhealthy to leave employment early (Arrighi & Hertz-Picciotto, 1994). For these reasons, occupational studies generally tend to observe better levels of health than general population studies (Herbig, Dragano, &

Angerer, 2013; Schmitz, 2011; Shah, 2009). Cross-sectional studies are particularly prone to bias from the HWE, as the effects of explanatory variables on the outcome are often underestimated if the explanatory variable leads to individuals leaving employment (Pearce et al., 2007; Punnett, 1996).

A meta-analysis identified that the prevalence of mental health problems were much higher in UK occupational studies, compared to UK general population studies (Goodwin et al., 2013). The difference was reduced after limiting studies by response rate and sampling method, to account for systematic errors. Nevertheless, these findings have important implications and are inconsistent with the HWE, which would suggest better mental health in individuals who are in employment (Ford et al., 2010; Li & Sung, 1999). These findings may be indicative of contextual or framing effects, whereby occupational studies, directed at the mental health or "stress levels" of employees, and an emphasis on work-related questions, may be viewed as an opportunity for employees to vent their frustrations or report dissatisfaction (Tversky & Kahneman, 1981). Therefore, careful consideration should be given to how occupational surveys are framed.

3.4 Qualitative methods

This sections outlines the qualitative methods relevant to this thesis, focussing on interviews, sampling methods, biases in qualitative methods, and methodological rigour. Qualitative methods involve the collection of non-numerical data and are used to gain a deeper understanding of experiences, opinions, or concepts. In contrast to quantitative methods, which tend to answer the research question of 'what', qualitative methods often answer the questions of 'why' or 'how' (Dongre, Deshmukh, Kalaiselvan, & Upadhyaya, 2010). In public health research, qualitative methods can provide an additional understanding of a subject area, which may not have been

uncovered through quantitative methods. Therefore, qualitative methods can enhance and compliment quantitative methods, which is why it is common for both methodologies (multi-methods) to be used in public health research (Dongre et al., 2010).

3.4.1 Interviews

There are a range of qualitative methods for collecting non-numerical data, such as observations, analysing content, interviews, or focus groups (Silverman, 2020). In public health research, interviews or focus groups are the most common methods used (Lewis, Ritchie, & Ormston, 2003). Focus groups (group interviews) are useful for exploring a range of opinions and encouraging group interactions (Liamputtong & Ezzy, 2005), but confidentiality can be compromised (Kitzinger, 1995). One-to-one interviews enable more detail regarding an individual's experiences and participants may be more willing to share sensitive information (Broussard, 2006). To obtain in-depth qualitative data on UK police employees' experiences of drinking or abstaining, one-to-one interviews were used in Chapter 9.

Interviews can be structured, semi-structured, and unstructured. Structured interviews are like verbally administered questionnaires, using a specified list of questions which do not allow for follow-up questions or elaboration (Gill, Stewart, Treasure, & Chadwick, 2008). Unstructured interviews typically involve a vague opening question, which then progresses based on the participants response (Gill et al., 2008), but participants can find the lack of questions confusing (Gill et al., 2008). Semi-structured interviews were used in Chapter 9, and they involve the use of several prespecified open-ended questions which guide the interview, whilst also allowing follow-up questions and elaboration (Gill et al., 2008). In this thesis, telephone interviews were conducted, as they allow data collection over a wide geographical

area, create a greater sense of anonymity, and are more cost-effective and easier to conduct than face-to-face interviews, whilst still obtaining similar quality data (Opdenakker, 2006).

3.4.2 Sampling in qualitative methods

Qualitative studies have small sample sizes compared to quantitative research, as statistical power is not a concern. The sampling strategy in qualitative research is often purposive non-probability sampling and is not meant to obtain a random or representative sample from a population, unlike quantitative research. Instead, participants are selected based on specific characteristics which are relevant to the research question (Liamputtong & Ezzy, 2005; Mays & Pope, 1995). Homogenous or group sampling involves purposively selecting individuals who share similar characteristics (Ulin, Robinson, & Tolley, 2004). A type of purposive sampling is snowball (or chain) sampling, whereby existing participants refer the researcher to other potential participants (Ulin et al., 2004), which is often used for hard to research populations. When deciding an appropriate sample size in qualitative methods, there is no set criteria (Patton, 1999). In public health research, a minimum sample size is often set based on the purpose of the study and expected coverage (Patton, 1999). Then, as the qualitative data is being collected, if little new information emerges, it can be considered as achieving data saturation (Guest, Bunce, & Johnson, 2006; Vasileiou, Barnett, Thorpe, & Young, 2018).

3.4.3 Bias in qualitative methods

The subjectivity of qualitative methods is often equated with bias and viewed as a threat to credibility (Mehra, 2002). Being aware of potential biases in research is critical for determining the impact of the findings. In qualitative methods, there are

two broad types of bias: participant bias and researcher bias. Participant bias generally refers to a social desirability bias, whereby participants tend to answer in a way that they believe is more socially acceptable, rather than their true responses (Bergen & Labonté, 2020). Social desirability bias can be limited in qualitative research, by establishing rapport and asking open questions, whilst also being aware of social desirability tendencies (Bergen & Labonté, 2020). Researcher bias can occur through leading questions, which can be resolved by using clear and open questions, and having an independent individual or group review the interview schedule (Allen, 2017).

3.4.4 Methodological rigour

In quantitative research, methodological rigour is assessed through validity, reliability, and objectivity, whereas in qualitative research, methodological rigour is established through credibility, dependability, transferability, and confirmability (Lincoln & Guba, 1985). The purpose of credibility is to establish confidence that the findings truly reflect the perspectives of the participants. Credibility can be enhanced through the use of skilled researchers and techniques such as triangulation (Lincoln & Guba, 1985). Dependability refers to the replicability of the qualitative findings if the same methods were used within the same participants, coders, and context, which can be demonstrated through detailed descriptions of methodology (Tobin & Begley, 2004). Transferability relates to the degree in which the results can be transferred to other contexts or settings, which can be achieved through purposive sampling techniques. In addition, achieving data saturation, where no new information is discovered in analyses, can enhance the transferability of the findings (Fusch & Ness, 2015). The purpose of confirmability is to increase the confidence that the findings would be confirmed by other researchers, which can be achieved through reflexivity,

whereby the researcher demonstrates an awareness of their own background and position, and how this may influence the research (Alvesson & Sköldberg, 2017).

3.5 Quantitative analyses

This section outlines the quantitative analyses used throughout this thesis, including regression analyses, meta-analyses, entropy balancing, and latent class analysis.

3.5.1 Statistical inference

Quantitative analyses involve statistical tests which estimate the relationship between an explanatory variable and an outcome variable, typically controlling for other variables which are thought to influence the relationship (i.e., covariates). Statistical tests are used to infer whether associations between an explanatory variable and an outcome variable occur by chance.

One measure of statistical inference is a P value, which is a measure of probability that an observed difference could have occurred by random chance (Fisher, 1922). P values range from 0 to 1 and are used to determine the significance of results, in relation to the null hypothesis (i.e., no relationship and results are due to chance). Typically, a P value < 0.05 is used, indicating that there is a 5% probability that the results occurred by chance (Neyman & Pearson, 1933). More stringent cut-offs can also be used, such as $P < 0.01$ or $P < 0.001$.

Odds Ratios (OR) show the probability of an outcome occurring given a particular explanatory variable, over the probability of the outcome occurring in the absence of that explanatory variable (Bland & Altman, 2000). An OR below 1 indicates an increased occurrence and an OR below 1 indicates a decreased occurrence, whereas an OR of 1 indicates no difference (Szumilas, 2010). The larger/smaller the OR, the stronger the strength of the relationship. Confidence Intervals (CIs) are often provided

alongside ORs, and are estimated from the observed data to give a range of population values for an unknown parameter, with a certain degree of confidence that the true value lies within the range of values (Neyman & Pearson, 1933). Typically, 95% CIs are used. The range of interval values within a 95% CI becomes smaller as the sample size becomes larger, giving a more accurate result.

3.5.2 Regression analyses

Throughout this thesis, regression analyses were used to determine associations between explanatory variables and the outcomes, whilst controlling for covariates. Throughout this thesis the outcome variables were either binary or nominal. Where the outcome is binary (two values), logistic regressions are used. The equation for a logistic regression is outlined below. A logit model is used to determine the probability of an outcome (Y). The outcome Y is transformed to log odds (the logarithm of the odds), using the following logit function (P is the probability of the outcome):

$$\text{Logit (P)} = \log (P / 1 - P)$$

Nominal variables have two or more categories but are not in an intrinsic order. When the outcome is nominal, multinomial logistic regressions, an extension of logistic regressions, are used. A multinomial logistic regression predicts the probabilities of multiple categories, compared to a baseline category. These probabilities are presented as Multinomial Odds Ratios (MOR).

3.5.3 Meta-analyses

Chapter 4 of this thesis reports a systematic review, meta-analyses, and meta-regressions. A systematic review uses a replicable approach to identify and critically evaluate all relevant existing evidence to answer a research question (Aromataris & Pearson, 2014). Systematic reviews can collate qualitative or quantitative evidence, or

multiple types of evidence in a 'mixed-methods' review (Aromataris & Pearson, 2014). When the evidence is quantitative, and a consistent outcome can be obtained, a meta-analysis can be conducted, merging the findings of multiple independent studies to determine an overall 'pooled' estimate (Crombie & Davies, 2009). Meta-analyses account for differences in sample sizes across the independent studies, and for variability in outcomes (heterogeneity) (Crombie & Davies, 2009). Sub-group analyses can be conducted, by splitting the independent studies into sub-groups, to make comparisons (Thompson & Higgins, 2002). Meta-regressions are an extension of sub-group analyses and can be used to explore factors which are associated with the variability in the outcome (Thompson & Higgins, 2002).

3.5.4 Entropy balancing

Chapters 6 and 7 utilise a statistical reweighting technique, known as entropy balancing, to increase the comparability of the samples (Hainmueller, 2012). Entropy balancing is a data pre-processing method, used to balance two groups on a range of pre-determined covariates (Hainmueller, 2012). Entropy balancing creates a weight value for participants in the larger group, based on the characteristics of the smaller group, whereby participants in the larger group with similar characteristics to the smaller group, are given more weight. Entropy balancing has advantages over other matching methods, such as propensity score matching (selecting participants from the larger group who share similar characteristics with the smaller group), as no data is lost (Hainmueller, 2012). However, Chapter 7 compared entropy balancing with covariate-adjustment (of the same pre-specified covariates) in a regression, finding that both statistical techniques produced the same ORs and p-values.

3.5.5 Latent class analysis

Chapter 8 makes use of Latent Class Analysis (LCA), which is a statistical technique used to identify unmeasured constructs (classes) in a sample, using their responses to observed categorical or continuous variables (Lazarsfeld, 1950). The purpose of LCA is to identify the optimal number of classes to categorise the sample, where the individuals within each class are similar (homogeneity), but distinct from the other classes (heterogeneity). LCA involves estimating a series of models with an incrementally greater number of classes, beginning with a 2-class model, and then evaluating each model using a range of model fit criteria (described in detail in Chapter 8), to determine the ideal number of classes. If there are multiple groups within a sample, an observed grouping variable can be added. For example, gender can be added as a grouping variable, to explore the class descriptions and probability of class membership separately for men and women.

3.6 Qualitative analyses

The qualitative analyses used in this thesis are described in this section. Qualitative analysis involves 'sense making' or understanding a phenomenon, instead of statistically making inferences or testing associations as with quantitative analysis. Unlike quantitative research, qualitative analysis is largely dependent on the researcher's analytic and interpretative skills, as well as their contextual knowledge.

3.6.1 Thematic analysis

For Chapter 9, thematic analysis was the most appropriate method, as it is suitable for investigating under-researched areas, whilst still providing high research rigour (Braun & Clarke, 2006; Clarke, Braun, & Hayfield, 2015). Thematic analysis involves the identification, analysis, and interpretation of patterns within qualitative data.

Thematic analysis identifies themes which have relevance to specific research questions, allowing the data to be both described and interpreted (Roberts, Dowell, & Nie, 2019). An inductive approach was taken when conducting the thematic analysis (Braun & Clarke, 2006), beginning with initial observations from the quantitative data and then collecting qualitative data, allowing the codes and themes to arise from the qualitative data itself. Inductive thematic analysis involves six steps: familiarisation; data coding; generating initial themes; reviewing and developing themes; refining; defining and naming themes; and writing the report (Braun & Clarke, 2006, 2019). This analytic approach fits with the underpinning pragmatic epistemology, as this method was chosen as the most appropriate for answering the research question.

3.6.2 Alternative considerations

Interpretative phenomenological analysis (IPA) (Smith, 1996) was considered. IPA is a participant-oriented qualitative approach which aims to provide a detailed examination of each participants' experience and how they make sense of their experiences. There has been an increase in the use of IPA in public health research, but this rise in popularity has been criticised for creating poor quality research, which is mainly descriptive, rather than an in-depth interpretation (Hefferon & Gil-Rodriguez, 2011). In addition, IPA tends to focus on the experiences of a small number of individuals (Smith, 1996), making it difficult to extend the findings to existing research. Framework analysis was also considered, which is a qualitative method used for applied policy research (Ritchie, Spencer, Bryman, & Burgess, 1994). However, framework analysis is best suited to research which specifically aims to inform policy.

3.7 Quantitative datasets

This section describes the epidemiological datasets used throughout this thesis, i.e., the Airwave Health Monitoring Study (used in Chapters 5, 6, 7, and 8) and the Health and Wellbeing of the UK Armed Forces Cohort Study (used in Chapter 6 and 7). Though the datasets are described in each study Chapter, this section will detail the study procedures, data collection, follow up data, and study samples.

3.7.1 Airwave Health Monitoring Study

The Airwave Health Monitoring Study (AHMS), conducted by Imperial College London (Elliott et al., 2014), is an occupational epidemiology cohort study of UK police employees and the main dataset used in this thesis. The AHMS was conducted to determine the health impact of Terrestrial Trunked Radio (TETRA) usage, used by UK police forces and other emergency services since 2001. In 2000, the Stewart Report suggested that signals at or around 16 Hz may have adverse health effects and TETRA transmission is around 17.6 Hz (IEGMP, 2000). In response, the Home Office appointed Imperial College London to determine the feasibility of creating a cohort study of approximately 60,000 UK police employees, to obtain sufficient power to detect a wide range of health outcomes (Elliott et al., 2014).

A pilot study was launched in June 2004, recruiting participants from one police force, and this was completed in 2006 (Elliott et al., 2014). The pilot study found that a health screen boosted recruitment as it was an additional incentive. The health screen collected wide-ranging data, allowing investigations of research questions beyond the primary aim of the study. After the pilot study was completed, the study was rolled out nationally, to all 54 police forces. A total of 28 police forces agreed to participate, with the response rate averaging 50% (Table 3.1).

Table 3.1. Response rate and comparison of participant age and sex distributions with the original target population by force, adapted from Elliott et al. (2014).

	Start date	End date	Force characteristics			Participant characteristics			
			Total N employees [a]	% of men [b]	Average age [b]	Total N participants	% of men	Average age	Response rate %
Forces completed [c]									
Cheshire Constabulary	Jun-06	Apr-08	3,606	60	40	1,945	62	39	54
Devon & Cornwall Police	Nov-09	Jul-12	6,728	75	41	3,222	61	42	48
Dyfed Powys Police	Mar-07	Jan-09	2,139	61	41	1,122	59	41	52
Essex Police	Sep-06	Mar-09	5,881	59	39	3,186	57	39	54
Gwent Police	Aug-06	Jun-08	2,430	59	41	1,471	61	40	61
Hertfordshire Constabulary	Nov-09	May-12	3,890	66	39	1706	56	40	44
Lancashire Constabulary	Apr-04	Dec-05	5,452	-	-	2,274	63	39	42
Leicestershire Constabulary	Dec-05	Mar-07	3,497	60	40	1,653	69	40	47
Lothian & Borders Police	Oct-07	Oct-10	4,473	65	40	2,259	66	40	51
Merseyside Police	Jul-08	Oct-11	7,298	60	39	3,233	61	40	44
Norfolk Constabulary	Feb-08	Aug-10	3,203	59	41	1,752	58	41	55
North Wales Police	Sep-07	Dec-09	2,590	57	41	1,455	58	40	56
South Wales Police	Nov-04	Jun-08	5,055	60	40	3,757	64	39	74
Staffordshire Police	May-06	Oct-07	3,940	59	40	1,877	61	40	48
Strathclyde Police	May-08	Nov-10	9,901	63	37	3,367	71	40	34
Suffolk Constabulary	May-07	Jul-10	2,288	59	40	1,207	61	41	53
Tayside Police	Jun-07	Jun-2011	1,823	-	-	926	64	41	51
Warwickshire Police	Apr-08	Aug-09	1,671	59	41	894	61	42	54
West Midlands Police [d]	Apr-04	Jan-06	11,939	-	-	698	71	37	6
Forces ongoing [e]									
Central Scotland Police	Jun-10	-	1,209	-	-	178	72	38	15
Dorset Police	Apr-12	-	2,566	-	-	721	57	42	28

Dumfries & Galloway Police	Sep-06	-	774	-	-	182	65	39	24
Fife Constabulary	Jan-09	-	1,639	-	-	131	71	39	8
Grampian Police	Jan-08	-	2,320	-	-	807	64	41	35
Lincolnshire Police	Jul-07	-	2,486	59	40	366	66	40	15
Metropolitan Police Service	Oct-11	-	53,196	-	-	980	69	42	2
Northern Constabulary	Oct-07	-	1,113	-	-	172	73	41	15
Serious organized crime agency [f]	Jan-07	-	-	-	-	292	87	42	-
Serious organized crime agency Scotland [f]	Jan-07	-	-	-	-	99	88	41	-
Other forces [g]	-	-	-	-	-	180	58	43	-

a Total number of police employees obtained from the police directories for the year that enrolment was completed.

b Statistics obtained from each force, where it was provided.

c Police forces where the recruitment was complete when the study protocol was published (Elliott et al., 2014).

d Force where pilot study was conducted.

e Police forces which only started data collection by 31/12/2012.

f Nation-wide police forces with open enrolment - unknown number of police employees.

g Force unknown or participants not enrolled through their own force.

3.7.1.1 Study procedure

The AHMS included two phases: an enrolment questionnaire and a health screen. In phase one, all employees from participating forces received an enrolment questionnaire which was provided through administration or occupational health services. In phase two, participants received a health screen which was conducted by trained nurses, who followed the protocol outlined in Figure 3.2 (Elliott et al., 2014). Recruitment for phase two was through force-wide publicity, such as emails and articles in newsletters, and direct contact if participants requested a health screen on their enrolment questionnaire. Participants could complete the health screen even if they did not complete the enrolment questionnaire (phase one). Police employees could still participate in the health screen even if they did not belong to one of the enrolled forces. Participants could complete the health screen during work hours, and this took approximately 40 to 50 minutes. Data from the health screen was then mailed to participants, and if they consented, to their general practitioner (GP), within two months (Elliott et al., 2014).
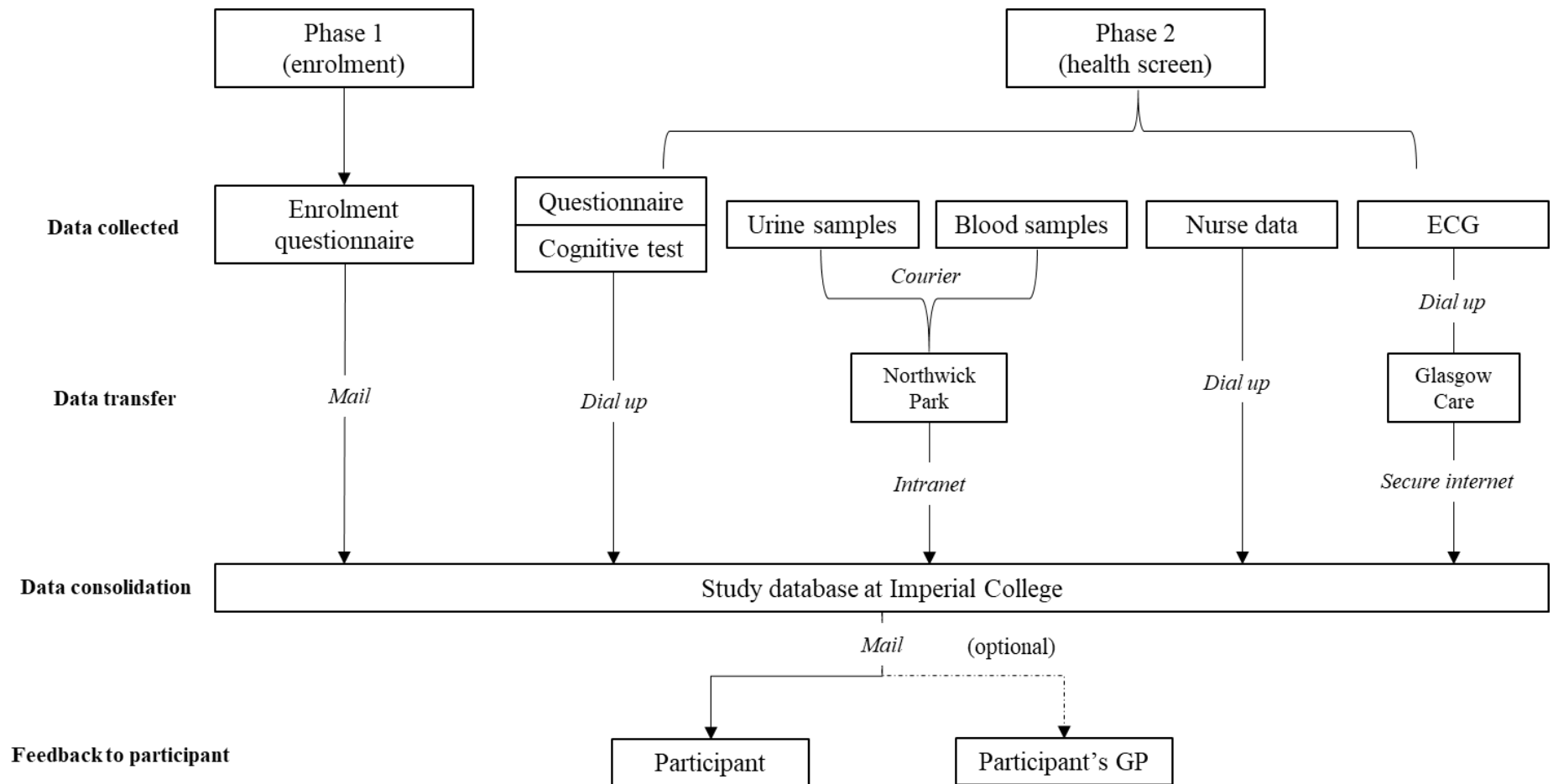
Figure 3.2. Airwave Health Monitoring Study Protocol, adapted from Elliott et al., (2014). CARE: Computer Assisted Reporting of Electrocardiograms. ECG: electrocardiogram.

3.7.1.2 Data collection

Table 3.2 lists the data collected during the Airwave Health Monitoring Study, which are relevant to the current thesis. In the enrolment questionnaire (phase one), participants completed a short questionnaire of demographic, health and lifestyle information. In the health screen (phase two), participants completed a longer questionnaire containing extensive questions relating to demographics, work environment, health and lifestyle information. Phase two also included the collection of anthropometric measures (e.g., weight and height). The completed enrolment questionnaires were returned to the study team for scanning into an electronic format. The health screen data was collected on a variety of devices and uploaded to the study team database. Participants each received a unique barcode which linked all data.

3.7.1.3 Follow up data

The AHMS is a cohort study and aimed to follow up participants for 15 to 20 years (Elliott et al., 2014), through both active (re-screening participants) and passive follow up (data collection through national records). Approximately 11,000 participants have been re-screened. This thesis aimed to use this data to conduct a longitudinal analysis, to determine whether mental health status at wave one, was associated with a change in alcohol consumption at follow up, or vice versa. However, this data was unavailable throughout the duration of the studentship, due to financial complications and COVID-19 (Imperial College London are leading the REACT study).

3.7.1.4 Study sample

A total of 53,114 UK police employees completed the first wave of the AHMS, with approximately 46,000 employees completing the health screen (Gao et al., 2019). To obtain the data for this thesis, an application was submitted to the study team,

outlining the aims of the proposed research and a list of variables required to investigate such aims. The datasets provided to researchers varied slightly, depending on the main variables of interest.

The dataset used in Chapters 5 and 8 included all participants who had complete data for the measures of alcohol consumption (N = 40,986). Chapters 6 and 7 were conducted in collaboration with researchers at King's College London, who also had access to an AHMS dataset (N = 41,038). Their dataset was used in Chapters 6 and 7 as it contained more detailed categories for job role (constables, sergeants, inspectors, and police staff).

Table 3.2. Relevant data collected during the Airwave Health Monitoring Study. Questionnaires refer to those which were asked in either the enrolment questionnaire (phase one) or the health screening (phase two).

Questionnaires		Health Screening	
Demographics	Gender Age Ethnicity Education Income Marital status Children under 18	Nurse interview	Gender Age Tobacco consumption Alcohol consumption
Work environment	Role Job strain	Anthropometrics	Weight Height
Health	Depression Anxiety PTSD Days of sickness absence		
Lifestyle	Tobacco consumption Alcohol consumption Physical activity Fruit and vegetable intake Red meat consumption		

PTSD: Post-traumatic stress disorder.

3.7.2 Health and Well Being of the UK Armed Forces

Chapters 6 and 7 compared the levels of alcohol consumption and mental health problems in UK police employees and UK military personnel, using data from the AHMS (police employees) and the Health and Wellbeing of UK Armed Forces cohort study (military personnel). The Health and Wellbeing of UK Armed Forces cohort study was established by King's Centre for Military Health Research (KCMHR) and will so forth be referred to as the KCMHR cohort study.

The KCMHR cohort study was initiated in 2003, with the initial aim of examining the mental and physical health of military personnel who had been deployed to Iraq (Operation TELIC) (phase one). The cohort study has since been expanded to explore the impact of deployment to Afghanistan (Operation HERRICK) (phase two) and followed up personnel to understand the long-term impact of deployment on health and wellbeing (phase three). The KCMHR cohort study collected data from regular or reservist personnel, those who have left service or who are still serving, and personnel from all three services (Royal Navy, British Army, Royal Air Force).

3.7.2.1 Study procedures

The study procedures, data collection, and samples, for each phase have been described in detail in separate publications: phase one (Hotopf et al., 2006), phase two (Fear et al., 2010), phase three (Stevelink et al., 2018). Phase one collected data from personnel who had deployed to Operation TELIC 1 between January 2003 and April 2003, and those who were serving but had not deployed, obtaining a random stratified sample of 10,272 personnel (59% response rate; June 2004-March 2006) (Hotopf et al., 2006). Phase two collected data from 6,429 personnel who had completed phase one (68% response rate) (Fear et al., 2010). Two additional samples were also recruited

for phase two: a random sample who had deployed to Afghanistan between April 2006 and April 2007 (N = 1,789; 50% response rate), and a randomly drawn replenishment sample who had joined the military between April 2003 to April 2007 (N = 2,665; 40% response rate) (Fear et al., 2010). The total sample size for phase two was 9,990 (56% response rate; November 2007-September 2009). Phase three included participants who consented to further contact in phases one or two (N = 6,346), and a replenishment sample of new recruits who had joined after June 2009 (N = 1,747). The total sample size for phase three was 8,093 (44% response rate; October 2014-December 2016) (Stevelink et al., 2018).

3.7.2.2 Data collection

Data from all three phases were collected via a self-administered questionnaire that was available in hard copy and, for phase three only, an electronic version (Fear et al., 2010; Hotopf et al., 2006; Stevelink et al., 2018). The questionnaire included seven sections: sociodemographics, service information (service branch, rank, deployment status), experiences during last deployment, experiences of transition from deployment, mental and physical health, relationships and lifestyle (e.g., marital status, smoking status, alcohol consumption). Potential participants were contacted via a range of strategies, including sending the questionnaire via post, assigning a visit from the research team, and tracing ex-service personnel through the electoral register or National Strategic Tracing Service (Fear et al., 2010; Hotopf et al., 2006; Stevelink et al., 2018).

3.7.2.3 Study sample

For this thesis, participants were selected from the KCMHR cohort study who were comparable with participants from the AHMS (Figure 3). Therefore, only serving

regular personnel were selected (the AHMS only included serving police employees). In the AHMS, the pilot study (2006) did not include a measure of PTSD. Therefore, for Chapters 6 and 7, police employees who completed the AHMS in 2006 and military personnel who only completed phase one of the KCMHR cohort study (2004-2006) were excluded. Military personnel who completed phase two and phase three data were assigned to only one phase, to prevent their data from being included twice (Figure 3). Participants in the AHMS were also assigned to a 'phase', as this was included as a covariate when creating the entropy balancing weight (section 3.4.4).

```
┌─────────────────────────┐
│   Full KCMHR Dataset    │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐
│ Drop those who completed│
│   phase 1 data only     │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐                      ┌─────────────────────────┐
│ Drop if were not a      │                      │   Full Airwave Dataset  │
│ serving regular in      │                      └─────────────────────────┘
│ either phase 2 or phase │                                   │
│ 3                       │                                   ▼
└─────────────────────────┘                      ┌─────────────────────────┐
            │                                     │ Drop those who completed│
            ▼                                     │    survey in 2006       │
┌─────────────────────────┐                      └─────────────────────────┘
│  Drop short questionnaire│                          │              │
└─────────────────────────┘                          ▼              ▼
      │            │                          ┌──────────┐   ┌──────────┐
      ▼            ▼                          │ Phase 2  │   │ Phase 3  │
┌──────────┐  ┌──────────┐                    └──────────┘   └──────────┘
│ Phase 2  │  │ Phase 3  │
└──────────┘  └──────────┘
```

Phase 2	**Phase 3**	**Phase 2**	**Phase 3**
Those who only completed phase 2 data assigned to phase 2	Completed both phases, but only serving regular in phase 3, assigned to phase 3	Data collected between January 2007 to June 2011 assigned to phase 2	Data collected between July 2011 and December 2015 assigned to phase 3
Completed both phases but were only serving regular in phase 2 assigned to phase 2	Serving regular in both phase 2 and phase 3 assigned to phase 3		

Figure 3.3. Selection process to obtain comparable samples of UK military personnel and UK police employees, using data from the KCMHR cohort study and AHMS.

3.8. Measures

This section provides an overview of the measures used throughout this thesis, beginning with the measures of alcohol consumption used in the AHMS, the KCMHR study, and in the interview study. Following this, the measures of mental health used in the AHMS and the KCMHR study are described. This section outlines the measure of job strain used in the AHMS, and the sociodemographic and occupational measures used in the AHMS and the KCMHR study. An overview of the validity and reliability of the measures used throughout this thesis are presented in a table in the appendices (Appendix 1).

3.8.1 Alcohol consumption

3.8.1.1 Airwave Health Monitoring Study

Participants in the AHMS were first asked whether they currently drink alcohol. Those who responded "no" to that item, skipped the items regarding current alcohol consumption and were asked if they ever drank alcohol. This variable was used to create the category of "non-drinkers" (N = 3,764), with an additional variable categorising "former drinkers" (N = 2,650) and "never drinkers" (N = 1,114), based on responses to the latter item.

Current drinkers were then asked two items, taken from the Alcohol Use Disorder Identification Test (AUDIT) (Saunders et al., 1993) / AUDIT-Consumption (AUDIT-C) (Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998): (1) "how often do you have a drink containing alcohol?" and (2) "how often do you have six or more drinks on one occasion? (One drink = half a pint of beer, a small glass of wine (125ml), or one measure of spirits)." The first item measures frequency of consumption, and the second

measures binge drinking. However, the response options provided in the AHMS differ slightly to the response options provided in the original AUDIT/AUDIT-C (Table 3).

Table 3.3. Comparing the response options from the AUDIT and the AHMS questionnaires. Numbers in brackets reflect how the response options are coded when the AUDIT or AUDIT-C is administered (Bush et al., 1998; Saunders et al., 1993).

Item	AHMS options	AUDIT / AUDIT C options
How often do you have a drink containing alcohol?	Monthly or less	Never (0)
	Two to four times a month	Monthly or less (1)
	Two or three times a week	Two to four times a month (2)
	Four or five times a week	Two to three times a week (3)
	Daily or almost daily	Four or more times a week (4)
How often do you have six or more drinks on one occasion?	Never	Never (0)
	Monthly or less	Less than monthly (1)
	Two to four times a month	Monthly (2)
	Two or three times a week	Weekly (3)
	Daily or almost daily	Daily or almost daily (4)
How many drinks do you have on a typical day when you are drinking?	-	1 or 2 drinks (0)
	-	3 or 4 drinks (1)
	-	5 or 6 drinks (2)
	-	7 to 9 drinks (3)
	-	10 or more drinks (4)

Current drinkers were also asked to record their past weekly alcohol consumption: "in the last seven days, how many drinks have you had of each of the following: red wine (125ml glass); white wine/champagne (125ml glass); fortified wine (includes sherry, port, vermouth) (125ml glass); spirits/liqueurs (includes whisky, gin, rum, vodka, brandy) (25ml pub measure); beer or cider (includes bitter, larger, stout, ale, Guinness) (pints). For this thesis, drinks were converted to units, using NHS guidance (NHS, 2018). A small glass of wine (125ml) equates to 1.5 units, a small glass of

fortified wine (125ml) equates to 2.5 units, a pub measure of spirits would remain as 1 unit, and a pint of beer can range from 2 to 3 units, depending on the strength (NHS, 2018). For the latter, the midpoint was used (2.5 units).

This thesis aimed to determine the prevalence of hazardous and harmful alcohol consumption in UK police employees. The prevalence of hazardous and harmful alcohol consumption could not be determined using the full 10-item AUDIT (Saunders et al., 1993) or even the three-item AUDIT-C (Bush et al., 1998). It was initially thought that past weekly alcohol consumption could be used to create the missing item of the AUDIT-C (typical drinks), by combining the measure of frequency (using the conservative estimate) with the number of drinks consumed in the past week. However, when conducting checks, there were some discrepancies in responses, with the computed typical drinks not being compatible with responses for the other two AUDIT-C items in some participants.

It was decided that prevalence estimates would be determined using the measure of past weekly alcohol consumption. This measure was also used by the Health Survey for England to determine the prevalence of hazardous and harmful alcohol consumption in the UK general population (NHS Digital, 2018a). Alcohol consumption was categorised using the UK Chief Medical Officer's guidelines for low-risk drinking, i.e., 0 to 14 units per week, for both men and women (Department of Health and Social Care, 2016). In line with the Health Survey for England (NHS Digital, 2018a) and NICE guidelines, hazardous drinking was defined as weekly consumption above 14 units to 35/50 units for women/men, and harmful drinking (which can include dependent drinking) was defined as weekly consumption above 35/50 units for women/men (NICE, 2014). These criteria are used in Chapters 5, 6, 7 and 8.

The data for the AHMS was collected between 2006 and 2015, which is before the UK Chief Medical Officer announced the amended guidelines for low-risk drinking, in 2016 (Department of Health and Social Care, 2016). Prior to this amendment, the recommended total weekly units for low-risk drinking were 0-14 units for women and 0-21 units for men. The prevalence estimates using these guidelines are presented in Table 3.4. However, evidence suggests that the change in guidelines did not alter consumption levels in the UK general population (Holmes et al., 2020), so it can be assumed that the AHMS participants did not change their consumption. Therefore, the most recent guidelines were used (categorising low-risk drinking using 0-14 units for both men and women) to be comparable with the Health Survey for England data (NHS Digital, 2018a) and to increase the relevance of the findings.

Table 3.4. Frequencies and percentages for low-risk, hazardous and harmful drinking, for men, using the old government guidelines (0-21 units).

	Total = 40,986		Males (N = 25,788)	
	N	% (95% CI)	N	% (95% CI)
Non-drinker	3,764	9.18 (8.91 to 9.47)	1,950	7.56 (7.25 to 7.89)
Low-risk (0-21 units)	26,860	65.53 (65.07 to 65.99)	16,806	65.17 (64.58 to 65.75)
Hazardous (21-50 units)	9,117	22.24 (21.84 to 22.64)	6,164	23.90 (23.39 to 24.43)
Harmful (50+ units)	1,245	3.04 (2.88 to 3.21)	868	3.37 (3.15 to 3.59)

3.8.1.2 Health and Wellbeing Cohort Study

In the KCMHR cohort study, alcohol consumption was measured using the 10-item AUDIT (Saunders et al., 1993). The first three items measure consumption (frequency of consumption, typical drinks/units on a drinking occasion, frequency of

binge drinking). The remaining seven items measure adverse consequences of alcohol use (e.g., feeling guilty, failing to meet expectations, being unable to remember the previous night) (Reinert & Allen, 2007). For the KCMHR cohort study, the response options for the second item of the AUDIT (how many units do you drink on a typical day of drinking) were extended to include additional options: 10 to 14 units, 15 to 19 units, 20 to 29 units, 30 units or more). Participants in the KCMHR cohort study were asked to report the number of units, rather than the number of drinks.

To increase comparability with the AHMS, only the first three items of the AUDIT were required from the KCMHR cohort study (Table 3.5). The first two items were used to create an estimate of average weekly unit consumption (to be compared with past weekly unit consumption). The conservative estimate for frequency of consumption was multiplied with the midpoint for typical units. For example, a participant who reported drinking two or three times a week (frequency = 2) and reported consumption seven to nine units on a typical day (typical units = 8), would have an average weekly unit consumption of 16. The third item measured binge drinking, as with the AHMS. However, the response options for the measure of binge drinking were not comparable across the two samples, except for "daily or almost daily". This was used to create a binary variable to reflect more harmful drinking behaviours ("binge drinking daily/almost daily" vs "does not binge drink daily/almost daily").

Table 3.5. Comparing the items and response options from the AUDIT items used in the AHMS and KCMHR questionnaires.

Item	AHMS options	KCMHR options
How often do you have a drink containing alcohol?	Monthly or less	Never
	Two to four times a month	Monthly or less
	Two or three times a week	Two to four times a month
	Four or five times a week	Two times a week
	Daily or almost daily	Three times a week
		Four or more times a week
How many units of alcohol do you have on a typical day when you are drinking?	-	1 or 2 drinks
	-	3 or 4 drinks
	-	5 or 6 drinks
	-	7 to 9 drinks
	-	10 to 14 drinks
	-	15 to 19 drinks
	-	20 to 29 drinks
	-	30 or more drinks
How often do you have six or more units/drinks on one occasion?	Never	Never
	Monthly or less	Less than monthly
	Two to four times a month	Monthly
	Two or three times a week	Weekly
	Daily or almost daily	Daily or almost daily

3.8.1.3 Qualitative study

The full 10-item AUDIT (Saunders et al., 1993) was used as a screening questionnaire for the interview study to identify hazardous/harmful drinkers and current abstainers (Chapter 9). Individuals who met criteria for probable alcohol dependence were not eligible to participate. The first item was adapted to include an additional statement to exclude those who have never drank alcohol (lifetime abstainers). The item asked: how often do you have a drink containing alcohol? (If you have never drunk alcohol, you are not eligible to participate).

3.8.2 Measures of mental health

3.8.2.1 Airwave Health Monitoring Study

Probable post-traumatic stress disorder (PTSD) was screened for using the 10-item Trauma Screening Questionnaire (TSQ) (Brewin et al., 2002). There TSQ includes five items measuring re-experiencing symptoms (e.g., recurrence of upsetting memories, upsetting dreams, feeling as though the event were happening) and five items measuring arousal symptoms (e.g., heightened awareness of potential threats, difficulty concentrating, irritability). The original TSQ asks whether symptoms have been experienced at least twice in the past week, with binary response options (yes or no). However, the AHMS instead asked whether symptoms had been endorsed following a traumatic event, with 5-point Likert scale response options ('not at all' to 'extremely'). To be consistent with the TSQ, and in line with an existing publication of the same sample (Stevelink, Opie, et al., 2020), 'not at all' was coded as 0 and all remaining options were coded as 1, using a validated cut-off of 6 to indicate probable PTSD (scores range from 0 to 10). Participants were guided to skip the TSQ items if they had not been bothered by a disturbing incident that had occurred in the past six months, meaning only 14% (N = 5,539) of the sample completed the TSQ items.

Probable depression was screened for using the self-administered 9-item Patient Health Questionnaire (PHQ-9) (Kroenke & Spitzer, 2002; Kroenke, Spitzer, & Williams, 2001). The nine items reflect symptoms of depression, including anhedonia (little interest or pleasure in things), sleeping difficulties, changes in appetite, feelings of guilt, trouble concentrating, psychomotor changes (moving more slowly or restlessness), and suicidal ideation. Participants were asked how often they had been bothered by symptoms over the past two weeks, with responses to each item being provided on a 4-point Likert scale ranging from 'not at all' (0) to 'nearly every day'

(3), using a validated cut-off of 10 (scores range from 0 to 27) to indicate probable depression (Kroenke et al., 2001). The PHQ-9 is a reliable and validated measure of probable depression in the general population (Martin, Rief, Klaiberg, & Braehler, 2006) and in occupational settings (Volker et al., 2016).

Probable anxiety was screened for using the anxiety subscale of the self-administered Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983). The well-validated scale ((Bjelland, Dahl, Haug, & Neckelmann, 2002) contains seven items measuring symptoms of anxiety and seven questions measuring symptoms of depression, with the AHMS only including the anxiety items. The anxiety items measured symptoms such as feeling tense, worrying thoughts, frightened feelings, restlessness, and feelings of panic. In the original HADS, the timeframe for symptoms is the past week, but the timeframe for the AHMS items was the past two weeks. The response options vary but are provided on a 4-point Likert scale, ranging from 0 ('not at all') to 3 (e.g., 'most of the time' or 'very much indeed'). A validated cut-off of 11 indicates moderate symptoms of anxiety (Zigmond & Snaith, 1983).

3.8.2.2 Health and Wellbeing Cohort Study

This thesis aimed to compare the level of mental health problems in UK police employees and UK military personnel. However, the KCMHR study used the 12-item General Health Questionnaire (GHQ-12) (Goldberg & Hillier, 1979), which could not be compared with the AHMS measures of probable depression (PHQ-9) and anxiety (HADS-A). It was thought that selected items from the GHQ-12 could be used to create the validated 2-item PHQ-2 (Kroenke, Spitzer, & Williams, 2003) and GAD-2 (Kroenke, Spitzer, Williams, Monahan, & Löwe, 2007). However, because of differences in the wording of items, response options, and timeframe for experiencing symptoms, it was not possible to compare depression or anxiety.

The 17-item National Centre for PTSD Checklist (PCL-C) (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996), civilian version, was used to screen for probable PTSD in the KCMHR cohort study. The civilian version was used in preference to the military version as it is less restrictive for populations exposed to trauma unrelated to combat (Hotopf et al., 2006). Responses are provided on a 5-point Likert scale, ranging from 'not at all' (1) to 'extremely' (5). It was originally proposed that 10 items from the PCL-C, which were most like the 10-item TSQ, would be selected to increase comparability. Table 3.6 shows the 10-item TSQ and the 10 similar items from the PCL-C. However, this method generated an inflated prevalence estimate for probable PTSD in military personnel (approximately 16%), which did not align with recent prevalence estimates from the full KCMHR cohort (Stevelink et al., 2018). Therefore, the full 17-item PCL-C was used, using a cut-off of 50 to indicate probable PTSD (scores range from 17 to 85) (Hotopf et al., 2006). However, a limitation of comparing these questionnaires is the difference in timeframes.

The differences in the alcohol and mental health measures used across the AHMS and KCHMR cohort study was a limitation as it reduced the reliability of the comparisons. Work is currently being completed to produce a core set of standardised outcomes that should be included in research (Shorter et al., 2021), but at the time of completing this thesis, this was not available. I refer to the reliability and validity of the individual measures in the appendices (Appendix 1).

Table 3.6. Selected items from the 17-item PCL-C (KCMHR) chosen to be comparable with the 10-item TSQ (AHMS)

10 items from 17-item PCL-C (KCMHR)	10-item TSQ (AHMS)
Timeframe: past month. *Response scale: not at all (1), a little (2),* *moderately (3), quite a bit (4), extremely (5)*	*Timeframe: following traumatic event.* *Response scale: not at all (1), a little (2),* *moderately (3), quite a bit (4), extremely (5)*
1. Repeated, disturbing memories, thoughts or images of a stressful experience	1. Bothered by recurrence of upsetting thoughts or memories
2. Repeated, disturbing dreams of a stressful experience	2. Bothered by upsetting dreams
3. Suddenly acting or feeling as if a stressful experience were happening again (as if you were re-living it)	3. Bothered by acting or feeling though the event were happening again
4. Feeling very upset when something reminded you of a stressful experience	4. Bothered by being upset by reminders of the event
5. Having physical reactions when something reminded you of a stressful experience	5. Bothered by bodily reactions when reminded of the event
6. Having trouble falling or staying asleep	6. Bothered by difficulty falling or staying asleep
7. Feeling irritable or having angry outbursts	7. Bothered by irritability or outbursts of anger
8. Having difficulty concentrating	8. Bothered by difficulty concentrating
9. Being super alert, watchful or on guard	9. Bothered by heightened awareness of potential dangers to self or others
10. Feeling jumpy or easily startled	10. Has been jumpy or startled at the unexpected

3.8.3 Measure of job strain

The AHMS included Karasek's Job Content Questionnaire (JCQ) which measures job strain, as proposed in the job-demand-control-support (JDCS) model (Karasek Jr, 1979; Karasek et al., 1998). The questionnaire includes three scales: demands, control, support. In the AHMS, 10-items were selected from the JCQ. Two items measured demands (in my normal day to day work, I have to work very hard / I have an excessive amount of work to do), four items measured control (in my normal day to day work, I have a lot of say about what happens on the job / I have a high level of skill / I have

the freedom to decide how I work / I have the chance to be creative), and four items measured support (when having difficulties at work, I get support from my colleagues / colleagues are willing to listen to work related problems / help and support from immediate superior / immediate superior willing to listen to work related problems). Responses were provided on a 4-point Likert scale, ranging from 'strongly agree/often' (1) to 'strongly disagree/never' (4).

Participants were categorised into one of four categories of job strain, proposed in the JDCS model, i.e., high strain (high demands, low control), low strain (low demands, high control), active strain (high demands, high control), and passive strain (low demands, low control), using a quadrant approach. Total scores for the demand items and control items were calculated and the sample medians were used to determine high/low demands (median = 5.65, range = 2 to 8) and control (median = 10.68, range = 4 to 16). This approach was used in a published study of the same sample (Gibson et al., 2018), and several other studies which have used items from the JCQ (Campo, Weiser, & Koenig, 2009; Useche, Montoro, Cendales, & Gómez, 2018). The support items were combined to create a total score, which remained continuous, as scores were positively skewed (median = 13.25, range = 4 to 16).

3.8.4. Sociodemographic, occupational and health measures

The AHMS included the following relevant sociodemographic measures which are described in detail in the study chapters: gender, age at enrolment, country of residence, marital status, educational attainment at time of enrolment, ethnicity, and number of children under 18. Several variables were recoded, either grouping categories to increase cell sizes, or transforming continuous variables into categorical variables.

The AHMS included the following relevant occupational measures, which are detailed in the study chapters: personal annual income before tax is deducted, police role (officer, staff, other), and the year participants joined the police service. 'Police officer' refers to warranted officers and 'police staff' refers to non-warranted officers, but the roles are varied (e.g., administrative roles, intelligence analysts, custody and detention staff). The AHMS study team were not able to provide any additional detail regarding which roles are included under 'other'.

In the AHMS, several health variables were measured. The health variables primarily used throughout this thesis were number of days of sickness absence taken in the past year, and current smoking status. Chapter 8 includes a detailed description of the following health variables, which were included in the LCA: physical activity; fruit and vegetable intake; red meat consumption; weight and height.

The KCMHR cohort study included several sociodemographic, occupational, and health variables which were comparable with the AHMS. For sociodemographic variables, this included gender, age, marital status, and educational attainment. Though not directly comparable to the AHMS role variable, the KCMHR included a measure of rank (commissioned officer, non-commissioned officer, other). The KCMHR study also included a measure of current smoking status.

3.9 Covariates

This section explains covariates and provides an overview of the covariates relevant to this thesis. Covariates are variables which are related to the explanatory and/or outcome variables (Salkind, 2010). Covariates can be determined by conducting statistical analyses to identify whether there is a statistically significant relationship between the potential covariate and explanatory/outcome variable (Salkind, 2010).

However, adding multiple covariates can reduce the overall sample size due to missing data, as missing data across variables are not always missing from the same participants. Further, controlling for multiple covariates can increase the risk of over-adjustment bias (Schisterman, Cole, & Platt, 2009), whereby controlling for covariates does not affect the *bias* of the relationship between an explanatory variable and an outcome variable, but affects the *precision* of the relationship (Schisterman et al., 2009). For these reasons, it is important to use evidence to inform covariate adjustments.

The sociodemographic variables hypothesised to be associated with alcohol consumption and/or mental health were gender, age, education, marital status, ethnicity, and number of children under 18 living at home. There are well-established gender differences in alcohol consumption, with men typically consuming more than women (Drummond, McBride, Fear, & Fuller, 2016; Nolen-Hoeksema, 2004; Wilsnack, Wilsnack, Gmel, & Kantor, 2018). Age is also associated with varying levels of alcohol consumption, with data from the general population showing a decline in harmful drinking in young people (aged 16-24 years old) but an increase in those aged 55-64 years old (Drummond et al., 2016). Higher education is thought to be a protective factor for hazardous/harmful alcohol consumption and for mental health (Beard et al., 2019; Iversen et al., 2008; Jones, Bates, McCoy, & Bellis, 2015). Those who are married have been found to consume lower levels of alcohol than those who are divorced or single, which is thought to also be related to mental health (Dinescu et al., 2016; Liang & Chikritzhs, 2012). People from ethnic minority backgrounds often report lower levels of alcohol consumption than those of White ethnicity, and are more likely to report abstinence (Hurcombe, Bayley, & Goodman,

2010). In addition, parenthood is thought to be protective against hazardous/ harmful alcohol consumption (Fergusson, Boden, & Horwood, 2012).

The potential occupational covariates were income, years in the police service, police role, and days of sickness absence in the past year. Evidence suggesting those with a higher income drink more heavily (Office for National Statistics, 2018). Australian data showed that officers who had served for longer (10+ years) drank more frequently than those who had served for less than 10 years (Davey, Obst, et al., 2000a). The same study identified that constables were more likely to report hazardous or harmful consumption than officers of a higher rank (Davey, Obst, et al., 2000a). The only health variable is smoking status, which has been found to be associated with an increased risk of harmful alcohol use in military personnel (Fear et al., 2007).

Using secondary data has its limitations, as it is not possible to measure all variables of interest. Further, when applying for the AHMS data, researchers must request a list of relevant variables and it is not possible to request additional variables once the data has been obtained. Because of these reasons, additional potential covariates, such as shift work and sleep duration, which have recently been shown to be associated with alcohol consumption and poor mental health (Britton, Fat, & Neligan, 2020; Richter et al., 2021), could not be included.

3.10 Missing data

It important to explore the patterns of, and reasons for, missing data in epidemiological research, as missing data can significantly influence the conclusions that can be drawn from the data (Kang, 2013). Therefore, this section highlights the types if missing data and describes the missing data in the AHMS.

3.10.1 Types of missing data

There are different types of missing data which have differential impacts on study findings: Missing Completely At Random (MCAR), Missing At Random (MAR), and Missing Not at Random (Salgado, Azevedo, Proença, & Vieira, 2016; Sterne et al., 2009). When data is MCAR, this means that the missingness of data is unrelated to any study variable and those with completely observed data are a random sample of all participants (Salgado et al., 2016). When data is MAR, missingness is not random and can be predicted using variables where there is complete information (Salgado et al., 2016). It is impossible to verify MAR assumptions statistically and one must rely on substantive reasonableness (Little & Rubin, 2019). For example, men being less likely to complete mental health surveys than women, for reasons unrelated to their mental health, but this can still result in biases. The final type of missing data is MNAR, whereby the value of the variable that is missing is related to the reason why it is missing (Salgado et al., 2016). For example, men being less likely to fill in a mental health survey because of poor mental health.

3.10.2 Dealing with missing data

There are numerous ways of accounting for missing data. Complete case analysis (listwise deletion) can be conducted, which uses only the observed data and takes a MCAR assumption, meaning participants with missing data for any variable included in the analysis are excluded (Salgado et al., 2016). Simple methods can also be used, such as replacing missing values with a type of 'predicted' value, such as the mean or median, resulting in a complete dataset. However, the imputed value is treated as the true value and does not reflect the uncertainty of the missing data and reduces variability (Soley-Bori, 2013). There are also imputation methods such as single imputation and multiple imputation. In single imputation, regression models are used

to predict the value of the missing data from the observed variables for that participant, but this is also limited by not accounting for the uncertainty of the missing data (Salgado et al., 2016; Soley-Bori, 2013). Multiple imputation is a Monte Carlo statistical technique, whereby regression models are used to estimate missing values based on observed values for that variable and other variables which are associated (Rubin, 1976). Then, multiple datasets are created with different plausible imputed values, replacing the missing values. This creates varying values assigned to the missing values, to reflect the uncertainty of predicting missing data (Rubin, 1976).

3.10.3 Missing data in the Airwave Health Monitoring Study

Table 3.7 outlines the frequencies and proportions of missing data for the AHMS variables which have been included in the analyses throughout this thesis, as well as the reasons for the missing data (as outlined by the contingency codes provided by the AHMS research team). Complete case analysis was used throughout this thesis (except for the LCA which used an estimation approach using all data), as the proportion of missing data for each variable was typically 1-2%, except for police role and the PTSD items. For police role, approximately 9% of the data was missing (N = 3,859), which was given the contingency code of 'not found'. Because it was not possible to determine why the data was missing, imputation methods were not appropriate. For the PTSD items, approximately 6% of the data was missing (N = 2,469), because they were not included in the pilot version of the study protocol (Elliott et al., 2014), which could be interpreted as MCAR. Further, as PTSD caseness is rare, it was not appropriate to use regression analyses to predict PTSD caseness based on the observed data, as this may have resulted in biased prevalence estimates.

Table 3.7. Frequency and proportion of missing data for the Airwave Health Monitoring Study dataset, with reasons.

Variable	N Missing	%	Reason for missing data
Sociodemographic/Occupational Variables			
Country enrolled	750	1.83	Unusable
Marital status	158	0.39	Ex-protocol
Education	158	0.39	Ex-protocol
Ethnicity	6	0.01	Not found
	155	0.38	Ex-protocol
	39	0.10	No mandatory question
Is smoker	30	0.07	Ex-protocol
	15	0.04	Not found
	7	0.02	Unusable
Role	3,852	9.40	Not found
	7	0.02	Ex-protocol
Salary	158	0.39	Ex-protocol
BMI	18	0.04	Unusable
	17	0.04	Not found
	1	0.07	Ex-protocol
Children under 18	158	0.39	Ex-protocol
Year of joining force	46	0.11	No mandatory question
	7	0.02	Ex-protocol
	1	0.00	Unusable
	1	0.00	Not found
Health Variables			
Days of sickness absence	58	0.14	Ex-protocol
All smoking items	44	0.11	Ex-protocol
Minutes spent doing vigorous activity	6	0.01	Not found
How many days did you do moderate activity	8	0.02	Not found
Minutes spent doing moderate activity	13	0.03	Not found
All diet items	110	0.88	Ex-protocol
Mental Health Variables			
All depression items	614	1.50	Ex-protocol
All anxiety items	614	1.50	Ex-protocol
All PTSD items	2,469	6.02	Ex-protocol
All job strain items	614	1.50	Ex-protocol

Ex-protocol: not included in the version of the protocol use at the time the participant was screened. Not found: no record of a result having been received and no clear explanation in the dataset to explain why. Unusable: one or more responses to the item are present but they are all deemed in some way unreliable or otherwise faulty. Data could also be missing because the question was not mandatory.

3.11 Methodological considerations

3.11.1 Self-report data

Self-report data is advantageous as it is cheap and easy to obtain, and much quicker than other methods of data collection, such as clinical diagnostic interviews (Demetriou, Ozer, & Essau, 2014). Because self-report data is relatively inexpensive, large quantities of data can be collected on a magnitude of measures (Demetriou et al., 2014). Further the anonymised nature of self-report data can promote more truthful responses (Warner et al., 2011). However, this is not always the case and there are several disadvantages to self-report data, which can lead to systematic errors (biases), reducing the validity of findings.

Response bias is a broad term for a range of ways in which participants inaccurately reply to self-report surveys or interviews (Furnham, 1986), potentially impacting the validity of study conclusions. Social desirability bias is a type of response bias whereby participants may consciously or unconsciously respond questions in a way that may be viewed more socially acceptable than their true answer (Paulhus, 1984). This can lead to the underreporting of less socially desirable behaviours and the overreporting of more socially desirable behaviours (Grimm, 2010; Krumpal, 2013). One theory of social desirability bias indicates that it is a result of impression management (presentation of self to please others) and self-deception (potentially unconscious motivation to have a positive self-view) (Paulhus, 1984). Evidence shows that individuals who score highly on measures of impression management and self-deception report lower alcohol consumption (Davis, Thake, & Vilhena, 2010; Devaux & Sassi, 2016).

Measurement error is a type of bias that occurs when the information collected is inaccurate (Bound, Brown, & Mathiowetz, 2001). This can be a result of poor instruments being used to measure the outcome or explanatory variables of interest. Alcohol consumption is often under-reported in research (Devaux & Sassi, 2016; Livingston & Callinan, 2015), with surveys only capturing between 40-60% of alcohol sales (Knibbe & Bloomfield, 2001). In the Airwave Health Monitoring Study (AHMS), alcohol consumption was measured by asking participants to recall their alcohol consumption. However, this can cause recall bias, and has been found to lead to lower levels of reported consumption compared to recall consumption of one day (Gmel & Daeppen, 2007). Further, heavy drinking and non-regular drinking patterns are associated with greater under-reporting of alcohol consumption in retrospective measures of consumption (Boniface, Kneale, & Shelton, 2014).

3.11.2 Sampling

Sampling bias, also referred to as ascertainment bias, is a type of bias whereby the sample is collected in a way that certain members of the population of interest have a lower or higher probability of completing the study than others (Spencer & Brassey, 2017). This can result in a non-random or biased sample, which is not representative of the population of interest (Spencer & Brassey, 2017). The terms sampling bias and selection bias are often used interchangeably, though they are distinct. Sampling bias reduces the external validity of findings (i.e., generalising the findings to the population of interest), whereas selection bias reduces the internal validity of findings (i.e., determining similarities and differences within the sample) (Fadem, 2012). One type of selection bias is self-selection bias, which occurs when self-selecting (or volunteer) sampling is used to recruit participants, instead of methods such as stratified random sampling (Heckman, 1990).

3.12 Ethical considerations

Ethical considerations are an important part of research methodology. There are several key principals of ethics in research: participants should not be subject to any harm (including psychological, financial, and social), participation should be voluntary, informed consent should be obtained, participants' dignity should be respected, the privacy of participants should be protected, participants' data should be adequately confidential, deception should be avoided, and study findings should be accurately reported and communicated (Coughlin, Beauchamp, & Weed, 2009). In addition, the recent EU General Data Protection Regulation (GDPR) and UK Data Protection Act 2018 now governs data processing, to ensure it is lawful, fair, and transparent (Cornock, 2018). Regarding research, the GDPR and UK Data Protection Act 2018 applies to the collection, storage, and use of any personal data which could be identifiable (including pseudoanonymised data). Research can be considered lawful if it is in public interest and is considered fair by respecting participants' rights and ensure that their data is use in line with their expectations (transparency is directly related to fairness) (Cornock, 2018).

The quantitative studies received ethical approval from relevant ethics committees. Fully informed consent was obtained, and data was fully anonymised, to prevent identification. When consenting to participate in the AHMS or KCMHR cohort study, participants consented to their data being available for use in future research, though this data is only available upon request, following an application process. The ethical considerations of the AHMS did create limitations in the current research, as data on region, specific police force, and specific roles, were not provided due to anonymity concerns, even though this data was collected.

For the qualitative study, UK serving police employees were recruited. Ethical approval was obtained from the University of Liverpool's ethics' committee. Several ethical considerations were in place, including fully informed consent. Regarding confidentiality, only the study team had access to the screening questionnaire data, which was collected via Qualtrics. After completing the interview, the recording was transcribed and any identifiable information was removed (e.g. names, unique experiences). The pseudo-anonymised transcript was then sent to participants for approval, and after approval, the recording and contact information were deleted, creating a fully anonymised transcript.

Chapter 4: The prevalence of hazardous and harmful alcohol use across trauma-exposed occupations: a meta-analysis and meta-regression.

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4.1 Foreword

What is already known from the previous Chapter (Chapter 1)?

- The introduction to the thesis provided an overview of the background literature and relevant theories, including a description of the UK Police Service, a summary of the broader literature surrounding the alcohol use outcomes, followed by the existing evidence regarding alcohol use within police employees. Research into job strain, mental health, and their links with alcohol use were also described.

What does the current Chapter aim to do?

- This Chapter aimed to determine the prevalence of hazardous and harmful alcohol use across trauma-exposed occupations (first responders, health care workers, Armed Forces personnel, train drivers, and war journalists).

- To address the aims, literature was searched from 2000 to March 2020, using Scopus, Web of Science, and PsycINFO. Studies were eligible for inclusion if they used a standardised measure of hazardous or harmful alcohol use, and

studies were excluded if they measured alcohol use following an isolated sentinel event or included student/retired/clinical samples.

- Meta-analyses were used to determine the pooled prevalence estimates across all studies. Sub-group analyses compared prevalence estimates across occupations, measures used, and geographical locations. Meta-regressions explored the impact of pre-defined covariates on the variance in prevalence estimates.

What new findings does this Chapter add?

- The review identified 55 eligible studies measuring the prevalence of hazardous and/or harmful alcohol use across trauma-exposed occupations. Across all studies, the pooled prevalence of hazardous alcohol use was 22% and 11% for harmful alcohol use.

- The pooled prevalence of both hazardous and harmful alcohol use was highest in studies of Armed Forces personnel (33% and 14%, respectively). The pooled prevalence of hazardous alcohol use was significantly lower in studies of health care workers, compared to studies of first responders and studies of Armed Forces personnel.

- Sub-group analyses observed higher prevalence estimates for hazardous alcohol use in studies using the AUDIT C (compared to the full AUDIT), and lower prevalence estimates for studies conducted in Asia.

- Meta-regressions identified that studies with a higher proportion of males and a younger mean age significantly predicted variation in the prevalence of hazardous and harmful alcohol use, respectively.

4.2 Introduction

A traumatic stressor is defined as an experience that involves actual or threatened death or serious injury, witnessing an event that involves death or serious injury, or learning about an unexpected death or serious injury of a close associate (American Psychiatric Association, 2013). Approximately 70% of adults experience a traumatic stressor at least once during their lifetime (Friedman, Keane, & Resick, 2007; Kessler et al., 2017). However, a review identified certain occupations who experience frequent trauma exposure and have an increased risk of post-traumatic stress disorder (PTSD), including first responders (i.e., police, firefighters, ambulance personnel and rescue workers), health care workers (i.e., doctors, nurses and mental health professionals), train drivers and journalists (Skogstad et al., 2013). There has been a focus in the literature on the Armed Forces, specifically relating to the risk of combat or stressful periods of deployment, away from the support of their families (Stevelink et al., 2018). Within the Armed Forces, trauma exposure is normalised and expected, which could lead to differential outcomes in response to a traumatic event, compared to occupations where trauma is not expected.

Trauma exposure, e.g. disasters, assault or combat, is associated with an increased risk of hazardous and/or harmful alcohol use (Boscarino, Adams, & Galea, 2006; Stewart, 1996), with a previous systematic review identifying high comorbidity of PTSD and harmful alcohol use (Debell et al., 2014b). Hazardous alcohol use is defined as a quantity or pattern of alcohol consumption that places you at risk of adverse health events, whilst harmful alcohol use is defined as alcohol consumption causing current health problems directly related to alcohol (Saunders et al., 1993). Globally, 6% of all deaths and 5% of all disease and injuries are attributable to alcohol (WHO, 2019). Trauma-exposed individuals often use substances as a form of avoidance coping to

alleviate negative affective states (Dixon et al., 2009). For example, witnesses of terrorist attacks or victims of interpersonal violence are more likely to engage in heavy episodic drinking, and this association is mediated by drinking to cope motivations (Boscarino et al., 2006; Kaysen et al., 2007). Moreover, recurrent work-related trauma also increases the likelihood of developing common mental health problems, such as depression and anxiety (Feinstein, Owen, & Blair, 2002; Gianni & Papadatou, 2016; Jones, 2017; Stevelink et al., 2018), and there is a known high co-occurrence of alcohol with common mental health problems (Debell et al., 2014b; Jacobsen, Southwick, & Kosten, 2001; Kessler, Chiu, Demler, & Walters, 2005). Individuals working in trauma-exposed occupations may be more likely to use alcohol in response to trauma and could have high rates of hazardous and harmful alcohol use, relating to mental ill-health.

There are currently no reviews examining the prevalence of hazardous and harmful alcohol use across trauma-exposed occupations, therefore it is not yet known which occupational groups are more at risk of alcohol harm. Identifying which occupational groups are more likely to report hazardous or harmful alcohol use, and determining any associated characteristics (such as sex, age or mental health status), is vital for the development of interventions tailored specifically for such occupational groups, to reduce alcohol harm (Khadjesari et al., 2015). The findings of this review could provide further support for the need to integrate alcohol and mental health services, which could be administered in an occupational setting. Moreover, a comprehensive review of the existing literature is needed to determine where there are gaps in the literature, to know where future research should be directed.

The present meta-analysis aims (i) to determine the international prevalence of hazardous and harmful alcohol use across occupational groups at risk of trauma

exposure; (ii) to compare the prevalence of hazardous and harmful alcohol use across the different occupational groups (i.e., first responders, health care workers, Armed Forces personnel, train drivers, journalists), to identify which occupational groups are more at risk of alcohol harm; (iii) to use sub-group analyses to determine the impact of the type of measure of hazardous or harmful alcohol use, and geographical location (continent) on prevalence estimates, (iv) to use meta-regressions to determine the impact of sociodemographic factors (proportion of males, mean age, proportion of participants of White ethnicity), mental health status, and study characteristics (e.g. year of data collection, response rate) on prevalence estimates.

4.3 Methods

Eligibility criteria (Table 4.1), a search strategy (Table 4.2), data extraction and quality assessment were developed in line with the Joanna Briggs Institute methodology for prevalence and incidence studies (Munn, Moola, Lisy, Riitano, & Tufanaru, 2015). This review is registered with the international prospective register of systematic reviews PROSPERO network (registration no. CRD42019120106). This study did not require ethical approval.

4.3.1 Eligibility criteria

The "CoCoPop" mnemonic for reviews assessing prevalence and incidence data was used to determine inclusion criteria (Munn et al., 2015). CoCoPop comprises of condition (the health condition, disease, symptom, or event), context (the environmental factors that impact on the prevalence of the condition) and population (the population characteristics). Inclusion and exclusion criteria are outlined in Table 4.1.

Studies were included if they used a standardised measure of hazardous and/or harmful alcohol use (e.g. Alcohol Use Disorder Identification Test (AUDIT) (Saunders et al., 1993)). Some standardised measures examine alcohol dependence or alcohol use disorders (e.g. CAGE Alcohol Questionnaire, Rapid Alcohol Problem Screen (RAPS), Diagnostic and Statistical Manual of Mental Disorders (DSM) and Substance Use Inventory (SUI)), therefore, we broadened the term "harmful alcohol use" to include alcohol dependence and alcohol use disorders. The secondary outcomes of interest were measures of mental health, including PTSD, anxiety, and depression. However, studies were included even if they did not include a measure of mental health.

Based on an existing review identifying trauma-exposed occupations with an increased risk of PTSD (Skogstad et al., 2013), the following occupations were included: first responders (i.e., police officers, firefighters and paramedics/emergency service technicians (EMTs), aid/disaster workers), health care professions (i.e., doctors, surgeons, nurses and mental health professionals), war journalists, train drivers, and Armed Forces personnel (i.e., Army, Royal Air Force, Navy and Marines). This review included observational studies, such as cross-sectional, longitudinal and cohort studies. Intervention studies and reviews were excluded. Where multiple papers were generated from the same data, with the same outcome, the most relevant paper was included.

Table 4.1. Inclusion and exclusion criteria

Inclusion Criteria	
Condition	• Studies measuring the prevalence of hazardous and/or harmful alcohol use, using a standardised measure.
Context	• Studies across all geographical locations were included.
Population	• Subjects who are currently working in occupations with an increased risk of trauma exposure identified from Skogstad (4) (i.e., first responders, health care professionals, war journalists, train drivers, and Armed Forces personnel). • Subjects must be of working age (i.e., >16 years old).

Exclusion Criteria	
Condition	• Studies examining drug and alcohol use together, or examining substance use without specifying alcohol use. • Studies examining hazardous and/or harmful alcohol use in a sub-group of the population with an existing physical or mental health problem.
Context	• Studies were not excluded on the basis of geographical location. • Studies which measured alcohol use following an isolated sentinel event (e.g. 9/11).
Population	• Studies with retired or student-only samples. • Subjects who have worked in multiple occupations.

4.3.2 Search strategy

A literature search was conducted using three article databases, Scopus, Web of Science, and PsycINFO, from 2000 to March 2020. Inclusion was restricted to this time frame due to global increases in alcohol use and alcohol-attributable harm since 2000 (Shield et al., 2020), meaning studies conducted before this time may

underestimate current prevalence estimates. The search strategy, outlined in Table 4.2, was developed in Scopus and adapted for Web of Science and PsycINFO. Search terms were used as free text terms and combined with Boolean operators. We also manually searched reference lists of studies that met the inclusion criteria and checked for further relevant cited articles. The search included peer-reviewed journal articles and grey literature, such as PhD theses and conference abstracts. References were managed in EndNote (Clarivate Analytics, Philadelphia), which assisted with the identification and removal of duplicate studies.

Table 4.2 CoCoPop search strategy.

#1 AND #2 AND #3. Limits: English, publication year >1999.

Search no.	CoCoPop Component	Search term (search function OR)
#1.	Condition	Alcohol misuse, alcohol dependence, alcohol use, alcoholism, hazardous alcohol, harmful alcohol, alcohol consumption
#2.	Condition	Stress, trauma
N/A	Context	[any study setting]
#3.	Population	Employee, worker, profession*, occupation

4.3.3 Data extraction

One researcher (PI) screened all titles and abstracts against inclusion and exclusion criteria. Full texts were obtained for the titles and abstracts which appeared to meet inclusion criteria. A second reviewer (JAP) screened 10% of titles, abstracts, and full texts. Any disagreements over the inclusion of studies were reviewed by a third researcher (LG) and resolved through discussion. Inter-rater agreement was >80%, with Cohen's kappa >0.60, indicating moderate agreement (McHugh, 2012), for all stages of screening.

The following data was extracted: title, aims/objectives, study design, study setting, occupational group (broad and specific), year of data collection, response rate, mean age, sampling method, proportion of males, proportion of participants identifying as White ethnicity, measure of hazardous or harmful alcohol consumption, prevalence (N and proportion) of hazardous or harmful alcohol consumption. If available, measures and prevalence estimates for mental health problems (e.g. depression, anxiety, PTSD) were also obtained. For cohort studies and longitudinal, prevalence estimates (N and proportion) from the most recent wave were extracted. PI contacted authors to obtain relevant information that was not available in text.

4.3.4 Quality assessment

Quality assessment was conducted following the Joanna Briggs Institute critical appraisal checklist (Appendix 3) for studies reporting prevalence data (Munn, Moola, Riitano, & Lisy, 2014) (Figure 4.1). The checklist assesses: representativeness, recruitment, adequate sample size, adequate description of setting, standard criteria used to measure condition, appropriate statistical analysis, and confounding factors, identified using objective criteria. Quality assessment scores were standardised as percentages and categorised into low (<33%), medium (33%-66%) and high quality (>66%). PI initially conducted the quality assessment and JAP reviewed 10% to determine inter-rater reliability. Agreement for the quality assessment was >80%, with Cohen's kappa >0.60 (McHugh, 2012).
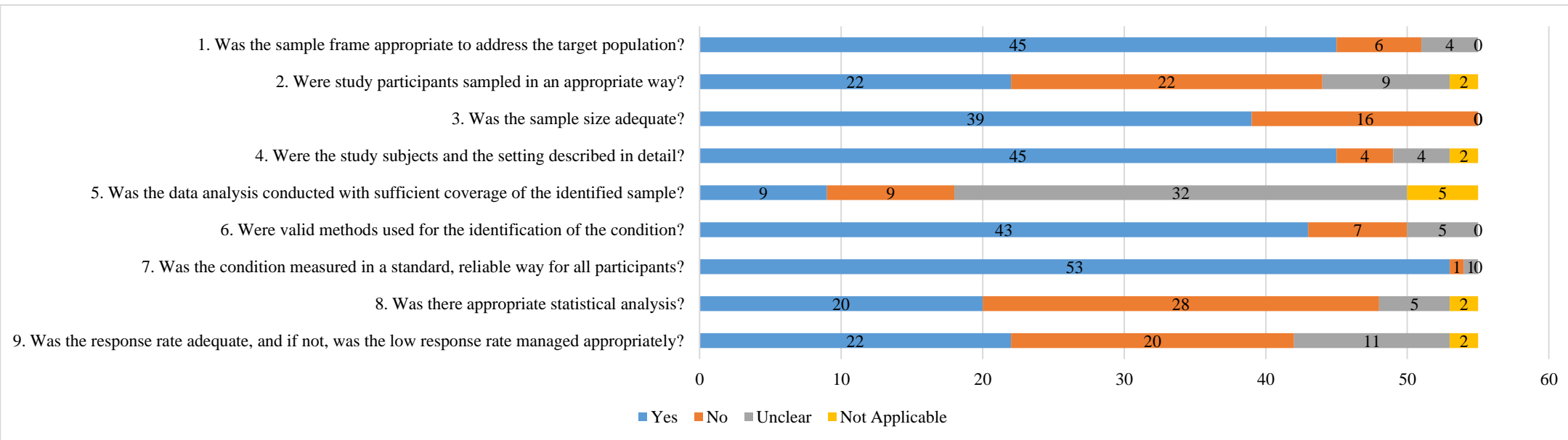
Figure 4.1. Joanna Briggs Institute critical appraisal summary

4.3.5 Data analysis

We decided *a priori* to conduct a random-effects meta-analyses to determine the pooled prevalence of hazardous and harmful alcohol use, first, using sub-group analyses of broad occupational groups (first responders, health care workers, Armed Forces, train drivers and journalists), and then using sub-group analyses of specific occupational groups (e.g. doctors, nurses, paramedics) in additional meta-analyses. Random-effects meta-analyses were selected because observational studies often have a high degree of heterogeneity, as true prevalence is likely to vary between studies due to both within- and between-study variation (DerSimonian & Kacker, 2007; Mueller et al., 2018). Further, the heterogeneity statistic (I^2) is calculated as the proportion of total variation which is attributable to between-study variation, meaning studies with large sample sizes and therefore, small within-study variation, are likely to show inflated heterogeneity (Coory, 2010). Separate meta-analyses were conducted, with the prevalence of hazardous alcohol use as the outcome, and then with harmful alcohol use as the outcome.

Additional sub-group analyses examined any difference in prevalence estimates of hazardous and harmful alcohol use, grouping the included studies by measure used (e.g. AUDIT and AUDIT C), geographical location (continent, e.g. Europe, North America) and study quality (low, medium and high). These sub-group analyses were grouped by the variable of interest, e.g. measure used, and not by occupational group. Separate meta-analyses were conducted for measure used, geographic location and study quality, first using hazardous alcohol use as the outcome, and then using harmful alcohol consumption as the outcome.

As prevalence estimates can range from 0 to 100, a meta-analysis can give undue weight to studies at either extreme of this range. Therefore, a Freeman-Tukey double

arcsine transformation method was applied, carrying out all the meta-analyses on the transformed proportions, using the inverse of the variance of the transformed proportions as the study weight (Barendregt, Doi, Lee, Norman, & Vos, 2013). Forest plots were generated for each meta-analysis, displaying the prevalence and 95% confidence intervals (CIs) for each estimate, and the overall pooled estimate and 95% CIs for each occupational group. Significant group differences were defined as no overlap in 95% CIs (Cumming & Finch, 2005).

Conventional funnel plots are inaccurate for assessing publication bias in meta-analyses of prevalence data (Hunter et al., 2014). Therefore, a sensitivity analysis was used instead, removing outliers. Outliers were defined as extremely large values which fall outside the confidence interval for the respective sub-group. The sensitivity analysis repeated the first meta-analyses (prevalence of hazardous alcohol use and prevalence of harmful alcohol use across broad occupational groups) with the outliers removed, to determine any changes in the pooled prevalence estimates.

Heterogeneity was assessed using I^2, with a cut-off of >50% suggesting high heterogeneity (Higgins & Thompson, 2002). Significance was determined using χ^2 for Cochrane's Q, with a conservative significance level (p<.01) being used due to increased heterogeneity associated with observational studies. To explore the association of sociodemographic and mental health variables on the variance in prevalence estimates (heterogeneity), random-effects meta-regressions, with Knapp-Hartung adjustment, were used (Harbord & Higgins, 2008). Variables were decided *a priori* and entered as univariate explanatory variables to determine the proportion of variance explained. If the data was sufficient ($n \geq 10$ for each univariate variable), the following variables were included: age, sex, ethnicity, and mental health (PTSD, depression and anxiety). We conducted exploratory meta-regressions using study

characteristics (study quality, response rate, and year study was conducted) as univariate explanatory variables. All statistical analyses were conducted using the computer software STATA SE 15 (StataCorp., 2017), using the *metaprop* and *metareg* commands.

4.4 Results

4.4.1 Study characteristics

The initial search identified 1882 unique articles. After screening titles and abstracts, 299 full texts were screened for eligibility. A total of 42 articles were identified as relevant. After searching reference lists and "cited by", 13 additional articles were identified, totalling 55 papers. Of these papers, three included data for multiple occupations, e.g. paramedics and firefighters (K = 62) (Figure 4.2). The characteristics of all included studies are provided in appendices (Appendix 4). Most studies were of high quality, with only three studies rated as low quality. The Joanna Briggs Institute critical appraisal items with the lowest positive scores reflected a lack of sampling weights, or lack of confidence intervals reported alongside prevalence estimates (Figure 4.1). There was a varied geographical distribution, with 45% (K = 28) of the studies being conducted in the North America and 24% (K = 15) in Europe (2 of which were in the United Kingdom (UK)). The search identified no relevant studies of journalists and one study of train drivers.
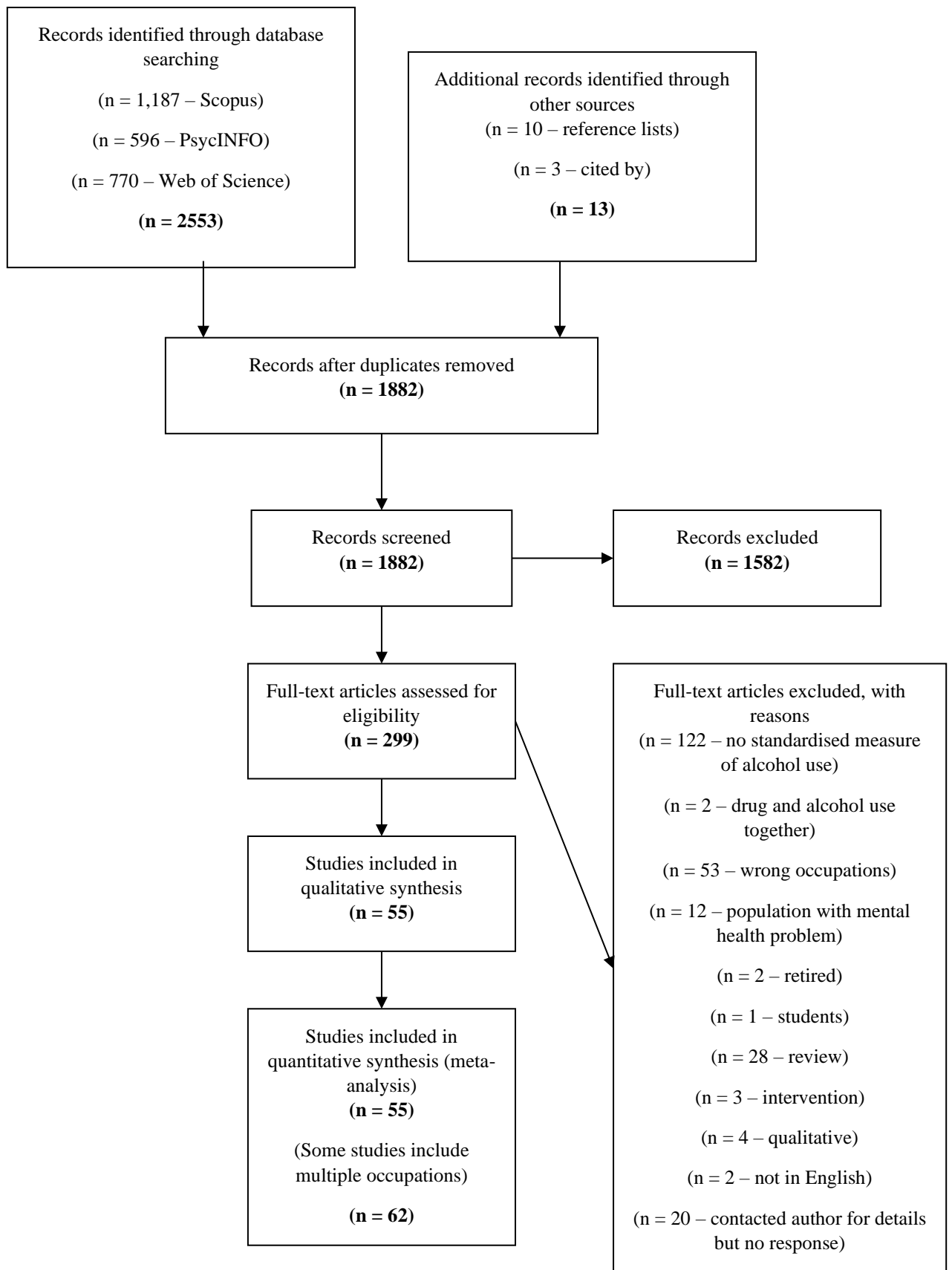
Figure 4.2. PRISMA flow diagram.

4.4.2 Meta-analyses of the prevalence of hazardous and harmful alcohol use: broad occupational groups

The pooled prevalence of hazardous alcohol use and the pooled prevalence of harmful alcohol use were determined using two meta-analyses. Some studies reported only hazardous use or harmful use so could only be included in the respective meta-analysis. Some studies included measures which only identify harmful use (i.e., CAGE Alcohol Questionnaire, DSM [Alcohol Use Disorder and Associated Disabilities Interview Schedule] and RAPS), or hazardous alcohol use (i.e., AUDIT C).

The overall pooled prevalence of hazardous alcohol use across trauma-exposed occupations was 21.60% (K = 50, 95% confidence intervals [CI]: 17.05% to 26.53%; I^2 = 99.59%) (Figure 3). The prevalence of hazardous alcohol use was significantly lower in health care workers (13.11%; K = 18; 95% CI: 10.05% to 16.49%; I^2 = 98.12%) compared with first responders (25.56%; K = 22; 95% CI: 19.91% to 31.64%; I^2 = 99.76%) and Armed Forces personnel (33.64%; K = 9; 95% CI: 17.81% to 51.63%; I^2 = 99.87%).

Hazardous alcohol use separated by broad occupational group

Study		ES (95% CI)
Health Care Workers		
Kuerer (2007)		7.10 (5.24, 9.56)
Sebo (2007)		30.01 (28.27, 31.81)
Rosta (2008)		17.58 (15.94, 19.35)
Hodgins (2009)		4.02 (3.14, 5.13)
Bazargan (2009)		5.64 (4.21, 7.51)
Toral-Villanueva (2009)		21.00 (16.85, 25.86)
Nash (2010)		15.01 (13.77, 16.33)
Oreskovich (2012)		15.41 (14.59, 16.26)
Rosta (2013)		6.57 (5.17, 8.32)
Wurst (2013)		13.60 (10.75, 17.05)
Sorensen (2015)		18.94 (17.26, 20.74)
Talih (2016)		5.93 (2.90, 11.74)
Lheureux (2016)		11.53 (10.17, 13.05)
Patel (2017)		27.78 (15.85, 43.99)
Mahmood (2017)		15.02 (12.99, 17.30)
Obadeji (2018)		4.30 (2.42, 7.53)
Kim (2018)		13.20 (9.56, 17.96)
Pforringer (2018)		23.04 (20.44, 25.87)
Subtotal (I^2 = 98.12%, p<0.001)		13.11 (10.05, 16.49)
First Responders		
Slaymaker (2000)		12.26 (7.99, 18.35)
Davey (2000)		32.01 (30.61, 33.43)
Davey (2001)		36.58 (33.21, 40.09)
Obst (2001)		22.60 (17.06, 29.30)
Sterud (2007)		13.62 (12.30, 15.06)
Sterud (2007)		15.24 (13.23, 17.49)
Lindsay (2008)		16.87 (14.95, 18.98)
Murtagh (2010)		28.13 (24.90, 31.61)
Ballenger (2010)		18.96 (16.25, 22.00)
Violanti (2011)		30.48 (22.49, 39.84)
De Barros (2013)		31.02 (26.08, 36.44)
Fjeldheim (2014)		24.43 (17.87, 32.44)
Mumford (2015)		82.07 (75.88, 86.93)
Donnelly (2015)		11.58 (9.33, 14.29)
Loo (2016)		4.92 (3.40, 7.06)
Carleton (2018)		25.25 (22.17, 28.59)
Gallyer (2018)		63.14 (60.01, 66.15)
Smith (2018)		23.47 (20.37, 26.87)
Carleton (2018)		20.23 (18.05, 22.60)
Carleton (2018)		18.80 (15.95, 22.03)
Strohmeier (2018)		35.74 (30.33, 41.54)
Carleton (2018)		19.84 (16.88, 23.17)
Subtotal (I^2 = 98.76%, p<0.001)		25.56 (19.91, 31.64)
Armed Forces		
Henderson (2009)		92.05 (90.47, 93.38)
Rona (2010)		49.29 (48.23, 50.35)
Orme (2011)		38.04 (31.34, 45.24)
Green (2014)		21.56 (19.22, 24.10)
Fuehrlein (2016)		25.92 (24.43, 27.47)
Hammer (2017)		21.30 (17.91, 25.13)
Holliday (2017)		35.69 (32.31, 39.23)
Bryan (2018)		13.15 (12.41, 13.93)
Hoopsick (2020)		10.56 (8.04, 13.76)
Subtotal (I^2 = 99.85%, p<0.001)		33.64 (17.81, 51.63)
Train Drivers		
Baek (2017)		4.84 (4.26, 5.50)
Heterogeneity between groups: p<0.001		
Overall (I^2 = 99.58%, p<0.001);		21.60 (17.05, 26.53)

Prevalence %

Figure 4.3. Forest plot showing the pooled prevalence estimates for hazardous alcohol use, separated by broad occupational groups.

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Harmful alcohol use separated by broad occupational group

Study		ES (95% CI)
Health Care Workers		
Unrath (2012)		18.86 (16.29, 21.74)
Sorensen (2015)		2.37 (1.78, 3.14)
Thrasher (2016)		9.04 (7.08, 11.46)
Patel (2017)		5.56 (1.54, 18.14)
Obadeji (2018)		1.56 (0.61, 3.95)
Subtotal (I^2 = 98.17%, p<0.001)		6.39 (1.24, 14.77)
First Responders		
Davey (2000)		3.01 (2.53, 3.57)
Davey (2001)		3.60 (2.49, 5.19)
Obst (2001)		14.12 (9.75, 20.02)
Ward (2006)		23.99 (21.36, 26.82)
Ward (2006)		18.76 (16.28, 21.51)
Ward (2006)		22.55 (19.80, 25.56)
Ward (2006)		16.67 (13.76, 20.04)
Lindsay (2008)		0.53 (0.26, 1.08)
Murtagh (2010)		1.02 (0.50, 2.09)
Ballenger (2010)		13.48 (11.17, 16.19)
Violanti (2011)		17.14 (11.13, 25.48)
Haddock (2012)		10.82 (8.67, 13.43)
Kaufmann (2013)		37.13 (32.90, 41.57)
De Barros (2013)		9.57 (6.75, 13.41)
Burnhams (2014)		19.69 (15.73, 24.36)
Fjeldheim (2014)		8.40 (4.75, 14.41)
Donnelly (2015)		14.24 (11.74, 17.16)
Loo (2016)		0.73 (0.28, 1.86)
Martin (2017)		31.19 (29.57, 32.86)
Carleton (2018)		8.99 (7.09, 11.33)
Smith (2018)		6.29 (4.67, 8.42)
Carleton (2018)		6.10 (4.88, 7.61)
Carleton (2018)		6.32 (4.67, 8.49)
Carleton (2018)		7.64 (5.80, 10.01)
Subtotal (I^2 = 99.08%, p<0.001)		10.88 (6.77, 15.80)
Armed Forces		
Rona (2010)		15.85 (15.09, 16.64)
Bartone (2012)		1.86 (1.21, 2.85)
Sekulic (2014)		54.79 (43.42, 65.69)
Green (2014)		13.76 (11.84, 15.93)
Hammer (2017)		5.68 (3.96, 8.09)
Subtotal (I^2 = 98.94%, p<0.001)		14.29 (6.54, 24.36)
Heterogeneity between groups: p = 0.404		
Overall (I^2 = 99.00%, p<0.001);		10.65 (7.54, 14.23)

Prevalence %

Figure 4.4. Forest plot showing the pooled prevalence estimates for harmful alcohol use, separated by broad occupational groups.

The pooled prevalence of harmful alcohol use was 10.65% (K = 34, 95% CI: 7.54% to 14.23%; I^2 = 99.00) (Figure 4.4). There were 5 studies measuring harmful alcohol use in health care workers, 24 in first responders and 5 in Armed Forces personnel.

Though there were no significant group differences, the highest prevalence of harmful alcohol use was found in Armed Forces personnel (14.29%; K = 5; 95% CI: 6.77% to 24.36%; I^2 = 98.94%), followed by first responders (10.88%; K = 24; 95% CI: 6.77% to 15.80%; I^2 = 99.08%), with the lowest prevalence in health care workers (6.39%; K = 5; 95% CI: 1.24% to 14.77%; I^2 = 98.17%).

4.4.3 Meta-analyses of the prevalence of hazardous and harmful alcohol use: specific occupational groups

Some studies grouped specific occupations together (e.g. prevalence of hazardous alcohol use in firefighters and paramedics) or did not specify the type of health care professional and were therefore not included in the sub-group analysis of specific occupational groups. The specific occupational groups included in the meta-analysis for hazardous and harmful alcohol use are shown in the Figures 4.5 and 4.6.

Hazardous alcohol use separated by specific occupational groups

Study	ES (95% CI)
Other Health Care Workers	
Hodgins (2009)	4.02 (3.14, 5.13)
Obadeji (2018)	4.30 (2.42, 7.53)
Kim (2018)	13.20 (9.56, 17.96)
Subtotal (I^2 = .%, p = .)	6.53 (2.44, 12.36)
Doctors (including surgeons)	
Kuerer (2007)	7.10 (5.24, 9.56)
Sebo (2007)	30.01 (28.27, 31.81)
Rosta (2008)	17.58 (15.94, 19.35)
Bazargan (2009)	5.64 (4.21, 7.51)
Toral-Villanueva (2009)	21.00 (16.85, 25.86)
Nash (2010)	15.01 (13.77, 16.33)
Oreskovich (2012)	15.41 (14.59, 16.26)
Rosta (2013)	6.57 (5.17, 8.32)
Wurst (2013)	13.60 (10.75, 17.05)
Sorensen (2015)	18.94 (17.26, 20.74)
Talih (2016)	5.93 (2.90, 11.74)
Lheureux (2016)	11.53 (10.17, 13.05)
Patel (2017)	27.78 (15.85, 43.99)
Mahmood (2017)	15.02 (12.99, 17.30)
Pforringer (2018)	23.04 (20.44, 25.87)
Subtotal (I^2 = 97.73%, p<0.001)	14.61 (11.53, 17.99)
Firefighters & Paramedics	
Slaymaker (2000)	12.26 (7.99, 18.35)
Firefighters	
De Barros (2013)	31.02 (26.08, 36.44)
Carleton (2018)	25.25 (22.17, 28.59)
Gallyer (2018)	63.14 (60.01, 66.15)
Smith (2018)	23.47 (20.37, 26.87)
Subtotal (I^2 = 99.18%, p<0.001)	35.25 (16.46, 56.78)
Police	
Davey (2000)	32.01 (30.61, 33.43)
Davey (2001)	36.58 (33.21, 40.09)
Obst (2001)	22.60 (17.06, 29.30)
Sterud (2007)	13.62 (12.30, 15.06)
Lindsay (2008)	16.87 (14.95, 18.98)
Murtagh (2010)	28.13 (24.90, 31.61)
Ballenger (2010)	18.96 (16.25, 22.00)
Violanti (2011)	30.48 (22.49, 39.84)
Mumford (2015)	82.07 (75.88, 86.93)
Donnelly (2015)	11.58 (9.33, 14.29)
Carleton (2018)	20.23 (18.05, 22.60)
Subtotal (I^2 = 98.72%, p<0.001)	27.36 (20.26, 35.09)
Paramedics	
Sterud (2007)	15.24 (13.23, 17.49)
Fjeldheim (2014)	24.43 (17.87, 32.44)
Carleton (2018)	18.80 (15.95, 22.03)
Subtotal (I^2 = .%, p = .)	18.41 (14.37, 22.82)
Aid Workers	
Loo (2016)	4.92 (3.40, 7.06)
Strohmeier (2018)	35.74 (30.33, 41.54)
Subtotal (I^2 = .%, p = .)	12.64 (10.45, 15.01)
Correctional Workers	
Carleton (2018)	19.84 (16.88, 23.17)
Military Personnel	
Rona (2010)	49.29 (48.23, 50.35)
Orme (2011)	38.04 (31.34, 45.24)
Green (2014)	21.56 (19.22, 24.10)
Fuehrlein (2016)	25.92 (24.43, 27.47)
Hammer (2017)	21.30 (17.91, 25.13)
Holliday (2017)	35.69 (32.31, 39.23)
Hoopsick (2020)	10.56 (8.04, 13.76)
Subtotal (I^2 = 99.44%, p<0.001)	28.11 (17.34, 40.33)
Air Force	
Bryan (2018)	13.15 (12.41, 13.93)
Navy	
Henderson (2009)	92.05 (90.47, 93.38)
Train Drivers	
Baek (2017)	4.84 (4.26, 5.50)
Heterogeneity between groups: p<0.001	
Overall (I^2 = 99.58%, p<0.001);	21.60 (17.05, 26.53)

Prevalence %

Figure 4.5. Forest plot showing the pooled prevalence estimates for hazardous alcohol use,

separated by specific occupational groups.

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The occupations with the highest prevalence estimates for hazardous alcohol use were military personnel (28.11%; K = 7; 95% CI: 17.34% to 40.33%; I^2 = 99.44%) and police officers (27.36%; K = 11; 95% CI: 20.26% to 35.09%; I^2 = 98.72%). Police officers had significantly higher prevalence estimates than doctors (14.61%; K = 15; 95% CI: 11.53% to 17.99%; I^2 = 97.73%) and aid workers (12.64%; K = 2; 95% CI; 10.45% to 15.01%). For harmful alcohol use, military personnel had the highest prevalence estimate (14.29%; K = 5; 95% CI: 6.54% to 24.36%; I^2 = 98.94%), though this was not significantly higher than any other group, due to wide confidence intervals.

Harmful alcohol use separated by specific occupational groups

Study	ES (95% CI)
Other Health Care Workers	
Thrasher (2016)	9.04 (7.08, 11.46)
Obadeji (2018)	1.56 (0.61, 3.95)
Subtotal (I^2 = .%, p = .)	6.39 (4.89, 8.08)
Doctors (including surgeons)	
Unrath (2012)	18.86 (16.29, 21.74)
Sorensen (2015)	2.37 (1.78, 3.14)
Patel (2017)	5.56 (1.54, 18.14)
Subtotal (I^2 = .%, p = .)	7.77 (0.01, 24.86)
Firefighters & Paramedics	
Martin (2017)	31.19 (29.57, 32.86)
Firefighters & Police	
Kaufmann (2013)	37.13 (32.90, 41.57)
Firefighters	
Ward (2006)	23.99 (21.36, 26.82)
Haddock (2012)	10.82 (8.67, 13.43)
De Barros (2013)	9.57 (6.75, 13.41)
Carleton (2018)	8.99 (7.09, 11.33)
Smith (2018)	6.29 (4.67, 8.42)
Subtotal (I^2 = 96.87%, p<0.001)	11.41 (5.90, 18.40)
Police	
Davey (2000)	3.01 (2.53, 3.57)
Davey (2001)	3.60 (2.49, 5.19)
Obst (2001)	14.12 (9.75, 20.02)
Ward (2006)	18.76 (16.28, 21.51)
Lindsay (2008)	0.53 (0.26, 1.08)
Murtagh (2010)	1.02 (0.50, 2.09)
Ballenger (2010)	13.48 (11.17, 16.19)
Violanti (2011)	17.14 (11.13, 25.48)
Burnhams (2014)	19.69 (15.73, 24.36)
Donnelly (2015)	14.24 (11.74, 17.16)
Carleton (2018)	6.10 (4.88, 7.61)
Subtotal (I^2 = 98.39%, p<0.001)	8.45 (4.55, 13.38)
Paramedics	
Ward (2006)	22.55 (19.80, 25.56)
Fjeldheim (2014)	8.40 (4.75, 14.41)
Carleton (2018)	6.32 (4.67, 8.49)
Subtotal (I^2 = .%, p = .)	11.71 (2.87, 25.26)
Aid Workers	
Loo (2016)	0.73 (0.28, 1.86)
Correctional Workers	
Carleton (2018)	7.64 (5.80, 10.01)
Rescue Workers	
Ward (2006)	16.67 (13.76, 20.04)
Military Personnel	
Rona (2010)	15.85 (15.09, 16.64)
Bartone (2012)	1.86 (1.21, 2.85)
Sekulic (2014)	54.79 (43.42, 65.69)
Green (2014)	13.76 (11.84, 15.93)
Hammer (2017)	5.68 (3.96, 8.09)
Subtotal (I^2 = 98.94%, p<0.001)	14.29 (6.54, 24.36)
Heterogeneity between groups: p<0.001	
Overall (I^2 = 99.00%, p<0.001);	10.65 (7.54, 14.23)

Prevalence %

Figure 4.6. Forest plot showing the pooled prevalence estimates for harmful alcohol use, separated by specific occupational groups.

4.4.4 Sub-group analyses: differences in prevalence depending on measure used, geographical location and study quality

Forest plots showing prevalence estimates for hazardous and harmful alcohol use, depending on measure used, can be found in the supplementary information (Appendices 5 and 6). The SUI, DSM and RAPS were not included, due to insufficient numbers of studies using them. Studies which used the AUDIT C obtained significantly higher prevalence estimates for hazardous alcohol use (36.46%; K = 11; 95% CI: 23.49% to 51=0.51%; I^2 = 99.81%) than studies using the full AUDIT (17.83%; K = 38; 95% CI: 13.23% to 22.95%; I^2 = 99.41%). The AUDIT and CAGE Alcohol Questionnaire showed no difference in prevalence estimates for harmful alcohol use. However, there were inconsistencies with cut-offs used for each measure.

A sub-group analysis was conducted to determine differences in the prevalence of hazardous and harmful alcohol use, depending on continent. For hazardous alcohol use, Asia had lower prevalence estimates than all other continents (though there were only 2 studies), with no other differences (Appendix 7). For harmful alcohol use, Oceania had lower prevalence estimates than Africa, but there were no other differences (Appendix 8). Heterogeneity was significantly high within each continent.

A further sub-group analysis showed that the low-quality studies obtained higher prevalence estimates for both hazardous (27.82%; K = 2; 95% CI: 23.88% to 31.93%) and harmful alcohol use (23.43%; K = 3; 95% CI: 6.07% to 47.23%), with particularly wide confidence intervals for harmful alcohol use. However, only 3 studies were classified as low quality.

4.4.5 Sensitivity analysis: removing outliers

Three outliers, with extremely large prevalence estimates for hazardous alcohol use, were removed for a sensitivity analysis. The overall pooled prevalence for remaining studies was reduced: 18.37% (K = 47; 95% CI: 14.84% to 22.18%; I^2 = 99.35%). The prevalence of hazardous alcohol use reduced in first responders (21.37%; 95% CI: 17.48% to 25.52%; I^2 = 97.46%) and Armed Forces personnel (26.00%; 95% CI: 14.23% to 39.86%; I^2 = 99.76%).

4.4.6 Meta-regression: impact of sex, age, ethnicity, mental health status, and study characteristics on prevalence estimates

Univariate meta-regression analyses were conducted with hazardous alcohol use as the outcome (Table 4.3) and harmful alcohol use as the outcome (Table 4.4), using mean age, proportion of males, proportion of participants of White ethnicity, prevalence of PTSD, prevalence of depression, quality score, response rate and year the study was conducted as explanatory variables. Anxiety was not included, as it breached the rules of data sparsity and would result in over-parameterization (i.e., N ≤ 10).

Meta-regression data from 49 prevalence estimates showed that the proportion of males significantly predicted 20.21% of the variation in the prevalence of hazardous alcohol use, indicating that the more males in the study, the higher the prevalence of hazardous alcohol use (Table 3). The mean proportion of males in Armed Forces personnel was 90% (standard deviation (SD) ± 7.92), 79% (SD ± 11.67) in first responders, and 61% (SD ± 17.31) in health care workers.

Meta-regression data from 20 prevalence estimates showed that response rate predicted 21.80% of the variance in harmful alcohol use, suggesting that the higher the

response rate, the higher the prevalence of harmful alcohol use (Table 4). When low quality studies were removed from the analysis, response rate no longer significantly predicted variation in harmful alcohol use and age became a statistically significant predictor 42.70% of variation in harmful alcohol use (K = 17; β = -0.77, p = .031, 95% CI: -0.15 to -0.07), suggesting that studies with younger samples have higher prevalence estimates of harmful alcohol use. The mean age in Armed Forces personnel was 38 years (SD ± 10.97), 37 years in first responders (SD ± 5.39), and 41 years (SD ± 10.14) in health care workers.

Table 4.3. Univariate random-effects meta-regression of study and participant characteristics on the prevalence of hazardous alcohol use across trauma exposed occupations

Overall pooled prevalence of hazardous alcohol use	Prevalence estimates (N)	Prevalence (%)	LCI	UCI	I^2 (%)		
	49	22	17	27	99.59		
	Prevalence estimates (N)	Beta	LCI	UCI	I^2 (%)	p-value	Adjusted R^2
Mean age of participants	28	-0.30	-1.06	0.47	94.79	0.432	-1.75
Proportion male	49	0.52	0.22	0.81	97.29	0.001*	20.21
Proportion with PTSD	17	-0.23	-0.76	0.30	97.87	0.372	-1.58
Proportion with depression	21	-0.02	-0.64	0.59	97.60	0.934	-6.07
Quality score	50	0.20	-0.14	0.54	96.51	0.248	1.23
Response rate	38	0.16	-0.12	0.43	97.98	0.255	0.89
Year study conducted	50	-0.23	-1.20	0.74	97.47	0.636	-1.58

[a] All covariates are continuous. PTSD; post-traumatic stress disorder. LCI; lower confidence interval. UCI; upper confidence interval. Adjusted R^2; the percentage of variation in prevalence explained by a particular covariate.

Table 4.4. Univariate random-effects meta-regression of study and participant characteristics on the prevalence of harmful alcohol use across trauma exposed occupations

Overall pooled prevalence of harmful alcohol use	Prevalence estimates (N)	Prevalence (%)	LCI	UCI	I^2 (%)		
	34	11	8	14	99.00		
	Prevalence estimates (N)	Beta	LCI	UCI	I^2 (%)	p-value	Adjusted R^2
Mean age of participants	18	-0.82	-1.69	0.03	67.49	0.059	44.49
Proportion male	34	0.16	-0.06	0.38	88.55	0.151	3.18
Proportion with PTSD	15	-0.15	-0.44	0.14	89.50	0.284	1.55
Proportion with depression	16	-0.03	-0.55	0.48	89.74	0.887	-8.43
Quality score	34	0.01	-0.22	0.26	89.78	0.872	-3.32
Response rate	20	0.30	0.02	0.57	91.80	0.034*	21.80
Year study conducted	34	-0.10	-0.80	0.59	89.32	0.770	-4.12

[a] All covariates are continuous. PTSD; post-traumatic stress disorder. LCI; lower confidence interval. UCI; upper confidence interval. Adjusted R^2; the percentage of variation in prevalence explained by a particular covariate.

4.5 Discussion

4.5.1 Key Findings

This is the first review of alcohol consumption across trauma-exposed occupations, with the meta-analysis identifying higher levels of hazardous drinking in Armed Forces personnel and first responders, specifically military personnel and police officers, compared with health care workers. The higher levels of hazardous drinking in Armed Forces personnel and first responders likely reflects gender composition, as these occupational groups had a higher proportion of males, and studies with more

males had higher levels of hazardous alcohol use, correlating with well-established gender differences in alcohol consumption (Wilsnack, Wilsnack, Kristjanson, Vogeltanz-Holm, & Gmel, 2009; Wilsnack, Greenfield, & Bloomfield, 2018). Studies conducted in Asia showed lower prevalence estimates than all other continents, which may relate to stricter regulations of alcohol, the diverse cultural and religious background, or biological factors which influence alcohol (e.g., deficiency of enzymes involved in breaking down alcohol) (Chen & Yin, 2008). Nevertheless, heterogeneity remained high, despite exhaustive attempts to explain the variance, through sub-group analyses, sensitivity analyses and meta-regressions. Though this is common in meta-analyses of prevalence data, it still limits the interpretation of the findings (Imrey, 2020).

Determining global prevalence estimates for hazardous and harmful alcohol use are difficult due to a lack of consistent evidence. However, prevalence estimates for heavy episodic drinking (>60g alcohol on one day, an indicator of hazardous use) in the past 30 days are available, with 18% of the global adult population meeting criteria (Peacock et al., 2018). The levels of heavy episodic drinking are highest in Europe and lowest in North Africa and the Middle East, with low levels also observed in South and Southeast Asia (Peacock et al., 2018). Individual studies show that the prevalence of hazardous drinking in the UK is 17% (and 3% for harmful drinking) (McManus et al., 2016), 10% in Japan (and 3% for harmful drinking) (Osaki et al., 2016), 10% in South Africa (hazardous and harmful grouped together) (Pengpid, Peltzer, & Ramlagan, 2021), and range from 4% to 29% in the US general population (1% to 10% for harmful drinking) (Reid, Fiellin, & O'Connor, 1999). The present findings show that the pooled levels of both hazardous and harmful drinking across all trauma-exposed occupations are higher than these general population estimates (and equal to

the highest US estimates). Across the globe, employees in these occupations (especially first responders and armed forces personnel) may have an increased risk of alcohol-related harm, and evidence-based interventions should target these groups.

Across several regions (US, UK, and Canada), studies have shown higher rates of alcohol problems in Armed Forces personnel, compared to the respective general populations (Debell et al., 2014b; Fear et al., 2007; Sirratt, Ozanian, & Traenkner, 2012; Taillieu et al., 2020). Suggested reasons for such high levels include periods of non-deployment which encourage alcohol use, frequent trauma exposure, male-dominated culture, and the use of alcohol to form social bonds and unit cohesion (Ames, Duke, Moore, & Cunradi, 2009; Breslau, Setodji, & Vaughan, 2016; Fear et al., 2010). There may be some occupational similarities between Armed Forces personnel and first responders, such as the "macho" culture, and shift-work or unsociable working hours, which are associated with risky drinking behaviours (Smith, Devine, Leggat, & Ishitake, 2005). The lower levels of hazardous alcohol use observed in health care workers is harmonious with recent evidence examining occupations associated with level of alcohol consumption, using the UK biobank (Thompson & Pirmohamed, 2021). Health care is less male-dominated (Fagan & Burchell, 2002), possibly contributing to the comparatively low levels of hazardous alcohol use in these occupations (Thompson & Pirmohamed, 2021). Further, there are varying degrees of trauma exposure across the occupational groups, and a wide range of occupations fall within health care, with even more varied levels of trauma exposure (e.g. a pharmacist will experience less trauma than an accident and emergency doctor). Armed Forces personnel and first responders may witness more direct trauma than health care workers, and combined with being male-dominated, could prevent help-

seeking for mental health problems and lead to coping mechanisms such as risky drinking (Probst, Roerecke, Behrendt, & Rehm, 2015; Roche et al., 2015).

We expected mental health problems to be significantly associated with the variation in hazardous or harmful alcohol use (Jacobsen et al., 2001; Kessler et al., 1997). Across all studies, there was a lack of research including a measure of any mental health problem, meaning that some occupations had no studies which measured mental health. For example, as not enough studies measured anxiety, we could not explore the relationship with hazardous and harmful alcohol consumption. Further, a wide range of measures and cut-offs were used for depression and PTSD across different studies, reducing the comparability of the prevalence estimates, leading to wide variation in prevalence estimates for depression and PTSD across the studies. There is evidence for a systematic bias in studies directed at mental health or alcohol use in occupational studies, compared to population studies (Goodwin et al., 2013). Some of the higher prevalence estimates for mental health problems may represent a self-reporting bias or a framing effect, whereby the emphasis on job related questions may be potentially seen as an opportunity to report dissatisfaction (Tversky & Kahneman, 1981). These biases could be heightened depending on the context of how the questionnaires were administered.

High heterogeneity is expected with observational research, due to variations in study design, contexts and research questions (Dekkers et al., 2019). Meta-regressions, sub-group analyses and sensitivity analyses were used to explore variation across methodological quality, measures used and study characteristics. The proportion of males and mean age (after removing low quality studies) were predictors of variance in heterogeneity. Younger age is a risk factor for harmful alcohol use, particularly in Armed Forces personnel (Jones & Fear, 2011). Higher prevalence rates were observed

when the AUDIT C was used to measure hazardous alcohol use, suggesting it could lead to inflated estimates (Rumpf, Hapke, Meyer, & John, 2002). However, several different cut-off scores for the AUDIT or AUDIT C were used, reducing the comparability of the studies. The remaining variance across studies could be due to a range of additional unmeasured contributors, such as variations in trauma-exposure across the countries; potential framing biases depending on how the questionnaires were administered or self-selecting sampling biases.

Low-quality studies obtained higher prevalence estimates for both hazardous and harmful alcohol use, compared with the medium and high-quality studies, with very wide confidence intervals for harmful alcohol use. When exploring the reasons why these studies were rated as low quality, it was mainly due to small sample sizes, non-generalisable samples (i.e., over 90% of participants being males), possible biases (e.g. self-selecting samples), and not using validated cut-offs. One of the low-quality studies obtained a prevalence of 55% for harmful alcohol use in military personnel, but used an AUDIT cut-off of 11, meaning the prevalence would be much lower if the validated cut-off of 16 was used (Saunders et al., 1993). Similarly, another low-quality study of police officers, identified a prevalence of 14% for harmful alcohol use, using an AUDIT cut-off of 13. These low-quality studies may be driving the high rates of hazardous alcohol use in military personnel or police officers, as the sensitivity analysis which removed these studies, substantially lowered the pooled prevalence estimates for these groups.

4.5.2 Strengths & Limitations

A strength of this study is that we followed robust methodological guidance, using the Joanne Briggs Institute guidance for systematic reviews of prevalence and incidence data (Munn et al., 2015), and pre-registered our study protocol. However,

the scope of the initial search was limited as several articles were identified through the reference lists of relevant studies. Further, only 10% of the records were double screened. We aimed to determine the prevalence only in trauma-exposed occupations, so we might not have captured other occupations with an increased risk of hazardous or harmful alcohol use (Thompson & Pirmohamed, 2021). Moreover, although the included occupations have high trauma exposure, many studies included in the review did not include a measure of mental health, making it difficult to determine the role of trauma-related mental health problems, known to be comorbid with alcohol misuse. Additionally, we were only able to explore the association with the proportion of participants of White ethnicity and could not explore differences across specific ethnic groups, due to the lack of available data. Further, some studies did not use the validated cut-offs for the measures of hazardous and harmful alcohol use, reducing comparability. A caveat of the included literature is that prevalence estimates were not often the primary aim of the study, meaning many of these papers did not use appropriate statistical methods for prevalence estimates (i.e., confidence intervals or weighting). Finally, the study findings have a limited impact on recommendations for clinical practice, as observational studies are deemed as 'low quality' evidence, when taking a GRADE approach (Grading of Recommendations, Assessment, Development and Evaluation) (Malmivaara, 2015).

4.5.3 Future Directions

This review highlighted several gaps in the literature, which should direct future research. Only one study of hazardous or harmful alcohol use in train drivers was identified, despite high rates of PTSD in train drivers (relating to the number of suicides witnessed) (Mehnert, Nanninga, Fauth, & Schäfer, 2012; Yum et al., 2006). Train driving is an isolated occupation, meaning drivers may be less likely to talk

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through a traumatic experience (Heath, Hindmarsh, & Luff, 1999), potentially using alcohol as a coping mechanism instead (Martin, Blum, & Roman, 1992). There were few studies of paramedics, who are often the first to witness traumatic accidents and fatalities (Regehr, Goldberg, & Hughes, 2002). Across all occupations, only two UK studies were identified. The UK has high rates of hazardous alcohol use in the general population, higher than many other developed countries (World Health Organization, 2016), and representative prevalence estimates for hazardous/harmful alcohol use in UK trauma-exposed occupations are needed. Finally, the search strategy was conducted before the COVID-19 pandemic and health care workers may have had greater trauma exposure since (Chen et al., 2020; Cucinotta & Vanelli, 2020), and additional research will be needed to determine the impact on alcohol consumption.

4.6 Conclusions & Implications

The findings of this meta-analysis indicate that studies of Armed Forces personnel and first responders, specifically military personnel and police officers, show higher rates of hazardous and harmful alcohol use, compared to health care workers. Several studies have identified this increased risk in military personnel and tailored interventions have been developed in both the UK (Leightley et al., 2018; Puddephatt et al., 2019) and the US (Pemberton et al., 2011). Future research should evaluate tailored interventions in other high-risk occupations, particularly those which are male-dominated. Given the amount of time spent working, the workplace is an opportunistic setting for alcohol-reduction interventions, with evidence indicating efficacy in reducing consumption in heavy drinkers (Yuvaraj, Eliyas, Gokul, & Manikandanesan, 2019). Those working in trauma-exposed occupations should be regularly informed of the harms of using alcohol to cope and routinely screened for alcohol problems and, if needed, support should be accessible.

Chapter 5: The prevalence of hazardous and harmful drinking in the UK Police Service, and their co-occurrence with job strain and mental health problems.

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5.1 Foreword

What is already known from the previous Chapter?

- The previous Chapter identified only two UK studies of hazardous and/or harmful alcohol use across trauma-exposed occupations, and no UK studies of police employees.

- Studies of police employees showed a pooled prevalence of 27% for hazardous alcohol use and 8% for harmful alcohol use.

- Studies with a higher proportion of males and a younger mean age, showed higher prevalence estimates for hazardous and harmful alcohol use, respectively.

What does the current Chapter aim to do?

- This Chapter aimed to determine the prevalence of hazardous and harmful alcohol use in the UK Police Service, and to explore the associations with poor mental health and job strain.

- This Chapter describes a cross-sectional analysis of representative data from the Airwave Health Monitoring Study, which measured alcohol consumption

(abstinence, low-risk, hazardous, harmful), mental health (depression, anxiety, PTSD), job strain (high, low, active, passive), and a range of sociodemographic and occupational variables in 40,986 UK serving police employees.

- Multinomial logistic regressions were used to examine the associations between mental health and job strain, with the categories of alcohol use, adjusting for potential confounders.

What new findings does the current Chapter add?

- A total of 33% of UK police employees met criteria for hazardous drinking, and 3% for harmful drinking. Compared to those without a mental health problem, police employees with probable depression, anxiety, or PTSD were twice as likely to be harmful drinkers and were also 1.3 times more likely to report abstinence.

- Those reporting low strain (versus high strain) were more likely to drink hazardously, but this was statistically moderated by mental health status. When the sample was stratified by mental health status, the association between low strain and hazardous drinking was significant only in those without a mental health problem.

- The following sociodemographic and occupational variables were associated with hazardous/harmful drinking: being male (vs female), aged 40-49 years old (vs all other age groups), being single (vs married), having served for more than 10 years (vs less than 10 years), holding a police officer role (vs police staff), being a current smoker.

5.2 Introduction

Policing is a stressful occupation, characterised by operational stressors such as frequent exposure to traumatic incidents (Tuckey, Winwood, & Dollard, 2012), and organisational stressors such as cuts to budgets, reducing officer numbers and increasing demands (Allen & Audickas, 2020; Elliott-Davies, 2019). UK Police Federation surveys identified that 67% of police employees reported an inability to meet demands and 60% reported low morale (Boag-Munroe, 2016; Elliott-Davies, 2019). However, the surveys' low response rates could indicate a sampling bias towards those experiencing problems, which is common in occupational studies (Goodwin et al., 2013). Nevertheless, exposure to operational and organisational stressors increases the risk of mental health problems (Houdmont & Randall, 2016; Van der Velden, Kleber, Grievink, & Yzermans, 2010), which could lead to maladaptive coping behaviours, such as hazardous drinking (a pattern of alcohol consumption that increases someone's risk of harm) or harmful drinking (a pattern of alcohol consumption that is causing mental or physical damage) (Brough, Chataway, & Biggs, 2016; Lindsay & Shelley, 2009).

Data from 4193 Australian police officers, two decades ago, found that 32% met the criteria for hazardous drinking and 3% for harmful drinking (Davey, Obst, et al., 2000a), compared to just 12.5% of the Australian general population drinking hazardously or harmfully (National Drug Strategy, 1996). Certain socio-demographic factors were associated with hazardous and harmful drinking: male gender, younger age, being single, lower education, smoking, and holding a lower job role (Davey, Obst, et al., 2000b; Obst & Davey, 2003). More recent evidence from the United States (US), estimated the prevalence of hazardous drinking to be 16% (similar to the US general population), though the sample size was relatively small (Ballenger et al.,

2011). Additional literature identified that traumatic stressors increased the likelihood of hazardous drinking in officers (Chopko et al., 2013; Violanti et al., 2011).

Alcohol and mental health problems often co-occur, with several population-based studies demonstrating this relationship (Burns & Teesson, 2002; Jane-Llopis, Jané-Llopis, Matytsina, Jané-Llopis, & Matytsina, 2006; Kessler et al., 1997; Regier et al., 1990). Within the UK general population, individuals with a mental health problem are twice as likely to have an alcohol problem, compared to those with no mental health problem (Davis et al., 2020; Farrell et al., 2001; Puddephatt et al., 2020). Contrarily, those with mental health problems are also more likely to abstain from alcohol (Goodwin et al., 2017), as they may avoid alcohol to prevent further mental health decline (Strid, Andersson, & Öjehagen, 2018). It is well established that UK military personnel have higher levels of alcohol problems compared to the general population (Fear et al., 2007), with high comorbidity with post-traumatic stress disorder (PTSD) (Head et al., 2016) and common mental disorders (Goodwin et al., 2017). Comparable levels of alcohol problems and comorbid mental health problems are predicted in UK police employees, due to occupational similarities, e.g. high-trauma exposure and a male-dominated culture which promotes risk-taking behaviours (Hales, May, Belur, & Hough, 2015).

Job strain is a further risk factor for heavy drinking (Crum, Muntaner, Eaton, & Anthony, 1995; Violanti et al., 2011), which may be exacerbated in UK police employees, given recent cuts (Allen & Zayed, 2019; Boag-Munroe, 2016). According to the strain hypothesis of job demand-control (JDC), those working in a high strain job (high demands and low control, i.e., an inability to set own goals and priorities) experience the lowest well-being (Karasek Jr, 1979). This model has been expanded to the JDC-Support model, translated to the iso-strain hypothesis, whereby workers in

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an iso-strain job (i.e., high demands, low control and low support) have the most negative outcomes (Häusser, Mojzisch, Niesel, & Schulz-Hardt, 2010; Van der Doef & Maes, 1999) as high support moderates the negative impact of high strain on well-being. In relation to alcohol use in police officers, early literature demonstrates a relationship between high strain and heavy drinking (Kohan & O'connor, 2002; Violanti, Marshall, & Howe, 1985; Violanti et al., 2011).

The present study aims to i) determine the prevalence of hazardous and harmful alcohol use and frequent binge drinking (6 or more drinks on one occasion (NHS, 2019), at least twice a month) in UK police employees; (ii) explore the associations between probable mental health (i.e., depression, anxiety and PTSD), and job strain, with alcohol use; (iii) examine whether the associations between job strain and alcohol use differ by level of support or mental health status. It is hypothesised that those with a probable mental health problem or high job strain will be more likely to drink hazardously/harmfully or abstain from alcohol. It is expected that the association between high job strain and hazardous/harmful drinking will be stronger in individuals with lower support or a probable mental health problem.

This study is pre-registered on Open Science Framework, where the *a priori* research questions and hypotheses are outlined in more detail: DOI 10.17605/OSF.IO/T8EKJ.

5.3 Methods

5.3.1 Study sample

The study sample is the Airwave Health Monitoring Study (Elliott et al., 2014), which was open to all police forces across the UK. Baseline data was collected between June 2006 and March 2015 and this analysis is based on a sample of 40,986

police employees. A pilot study was completed in 2006 in one force (representing 6% of the total sample) and this version of the protocol did not include a measure of PTSD. Recruitment was then rolled out across the 28 participating forces (out of 54), recruiting approximately 3,000-6,000 participants each year (except 2015, where only 1,674 participants were recruited). The response rate averaged 50% across participating forces (range: 6% to 74%). At the time of recruitment, there were a total of 259,283 police employees in the UK; the present sample represents approximately 16% of the target population (Hargreaves, Cooper, Woods, & McKee, 2016). The ethnicity of the sample is representative, as 95% of police employees were White in the overall Police Service and in the sample, and the gender composition of the sample is also representative (Allen & Audickas, 2020).

5.3.2 Data collection

The Airwave Health Monitoring Study was established to determine possible health risks associated with the use of Terrestrial Trunked Radio (TETRA), a digital communication system used by police forces since 2001 (Elliott et al., 2014), and wider health issues. Data were collected via an enrolment questionnaire through administration or occupational health services and health screens conducted by trained nurses. The study measured sociodemographics, occupational variables, TETRA usage, medical history, physical health, blood and urine samples, diet and alcohol use, and some mental health variables. The Airwave Health Monitoring Study design and protocol have been described in detail elsewhere (Elliott et al., 2014).

5.3.3 Measures

The outcome variable was categories of alcohol use, used by the Health Survey for England (NHS Digital, 2018a), based on the UK Chief Medical Officer's guidelines

for low-risk drinking (0 to 14 units) (Department of Health and Social Care, 2016) and National Institute for Health and Care Excellence (NICE) guidance for hazardous use (above 14 to 35/50 units for women/men), and harmful use (above 35/50 units for women/men) (NICE, 2014). Participants were asked if they drink alcohol, those who answered "no", were defined as "non-drinkers". Remaining participants completed a past weekly drinks diary, for the following: red wine, white wine, fortified wine, spirits, beer (converted into units). One item measured binge drinking (i.e., six or more drinks on one occasion). Participants who reported binge drinking at least two to four times a month were coded as "frequently binge drinks".

The explanatory variables were measures of mental health and job strain. Symptoms of depression were measured using the 9-item Patient Health Questionnaire (PHQ-9), with a validated cut-off of 10 indicating probable depression (range from 0 to 27) (Kroenke et al., 2001). Responses were given on a 4-point Likert scale ranging from "not at all" to "nearly every day". The PHQ-9 had good internal reliability (McDonald's omega $\omega = 0.93$) and has been shown to have a sensitivity of 0.88 and specificity of 0.88 (Saunders et al., 1993). Symptoms of anxiety were measured using the 7-item anxiety subscale of the Hospital Depression and Anxiety Score (HADS-A), with a validated cut-off of 11 indicating probable anxiety (scores range from 0 to 21) (Zigmond & Snaith, 1983). The HADS-A had good internal reliability ($\omega = 0.90$) and has high sensitivity of 0.90 and specificity of 0.78 (Bjelland et al., 2002). Probable PTSD was measured using the 10-item Trauma Screen Questionnaire (TSQ). Responses are usually binary (yes or no), but a 4-point Likert scale was used ("not at all" to "extremely"), therefore "not at all" was coded as 0 and remaining responses were coded as 1, using a cut-off of 6 (scores range from 0 to 10) (Brewin et al., 2002). The TSQ had excellent internal reliability ($\omega = 99$) and has good criterion validity

(sensitivity 0.86, specificity 0.93, Brewin et al., 2002). The TSQ was only administered if participants reported a traumatic experience in the past six months (N = 5,539), coding the remaining participants as "non-case" for PTSD.

Job strain was measured using 10 items of the Job Content Questionnaire (JCQ) (Karasek, 1985), with four items measuring support (e.g. when having difficulties at work, I get support from colleagues), four items measuring control (e.g. I have a lot of say about what I do) and two items measuring demand (e.g. I have an excessive amount of work to do). A quadrant approach (combining demand with control) was used and participants were grouped into high (high demand, low control), low (low demand, high control), active (high demand, high control) and passive (low demand, low control) strain, using the sample median scores (Gibson et al., 2018). Support was kept continuous (ranging from 4 to 16) as the data were skewed towards higher support (i.e., median = 14).

Sociodemographic measures included gender, age, country (England, Wales, Scotland), marital status, ethnicity, education, and number of children under 18. Occupational measures included years in the police force, police role (police officer, police staff, other – police officers are those who have completed a two-year probationary period and become a serving officer; police staff refers to a range of roles, such as intelligence analysts, administration, response call operators, custody and detention staff), and income. Health measures included days of sickness absence in the past year and smoking status.

5.3.4 Data analysis

Descriptive statistics (frequencies and percentages, with 95% confidence intervals (CIs)) were reported for sample characteristics and each category of alcohol

consumption, binge drinking, probable mental health problems and job strain. Median units with interquartile range (IQR) were reported for categories of alcohol consumption and binge drinking.

Unadjusted and adjusted logistic or multinomial logistic regressions determined the associations between probable depression, anxiety, and PTSD, with alcohol use (reference group: low risk) and binge drinking as outcomes. The regressions were adjusted for an *a priori* predefined list of potential confounders believed to be associated with alcohol use: age, gender, ethnicity, marital status, children under 18, income and smoking status.

Unadjusted and adjusted logistic or multinomial logistic regressions examined the associations between job strain and alcohol use or binge drinking, adjusting for the same potential confounders. Two interaction terms were created (job strain X job support, job strain X mental health), to determine whether job support and/or the presence of any mental health problem moderated the relationship between job strain and alcohol use.

Exploratory logistic regressions or multinomial logistic regressions, which adjusted for age and gender, examined the sociodemographic, occupational and health associations with alcohol use and binge drinking as the outcomes. Exploratory sensitivity analysis of non-drinkers examined mental health differences in never drinkers versus former drinkers, using unadjusted and adjusted logistic regression analyses. Exploratory descriptive statistics, presenting key explanatory variables and the outcome variable, separated by year of data collection, were conducted to explore cross-sectional trends over time, and are reported and discussed in the supplementary materials.

All statistical analyses were conducted in the statistical package STATA SE 15 (Stata Cooperation, 2017).

5.3.5 Missing data

The proportion of missing data for the variables of interest was less than 1%, except for PTSD (6%, N = 2,469) and police role (9%, N = 3,859). Police role was only included in supplementary analysis, exploring the demographic associations with alcohol use (Appendix 11). PTSD was only included as an explanatory variable when looking at the association between mental health and alcohol use, with a final sample size of 38,517 for this analysis.

5.3.6 Ethics

The Airwave Health Monitoring Study received ethical approval from the National Health Service multi-site research ethics committee (MREC/13/NW/0588). Written informed consent was obtained from all participants.

5.4 Results

5.4.1 Sample characteristics

The sample characteristics (N = 40,986) are described in Table 5.1. A total of 70.1% of the sample were police officers and 27.9% were police staff. Only 20.7% of the sample had served for less than 5 years, at the time of enrolment into the study, and 45.8% had been serving for more than 20 years. Few police employees reported an income above £60,000 (3.2%), with the majority earning between £26,000 and £37,999. Men made up 62.9% of the sample. Approximately 38.8% of the sample were aged 40 to 49, with the mean age being 40.55 (± 8.92). Almost 95% of the sample were White and 76.5% of the sample obtained qualifications higher than GSCEs or equivalent. Almost 10% were current smokers.

Table 5.1. Socio-demographic, occupational and health characteristics of participants (N = 40,986)

Characteristic	Complete N (% missing)	N	%	95% CI
Gender	40,986 (0.00)			
Men		25,788	62.92	62.45 to 63.39
Women		15,198	37.08	36.61 to 37.55
Age	40,986 (0.00)			
40 to 49		15,919	38.84	38.37 to 39.31
<29		5,653	13.79	13.46 to 14.12
30 to 39		13,547	33.05	32.60 to 33.51
50 to 59		5,207	12.70	12.39 to 13.03
>60		660	1.61	1.49 to 1.74
Marital status	40,828 (0.39)			
Married/Cohabiting		31,710	77.67	77.26 to 78.07
Divorced/Separated		3,317	8.12	7.86 to 8.39
Single		4,854	11.89	11.58 to 12.21
Other		947	2.32	2.18 to 2.47
Country	40,236 (1.83)			
England		28,465	70.75	70.30 to 71.19
Scotland		6,428	15.98	15.62 to 16.34
Wales		5,343	13.28	12.95 to 13.61
Education	40,828 (0.39)			
GSCE/O-Level or below		13,675	33.49	33.04 to 33.95
A levels / Highers or equivalent (NVQ3)		12,960	31.74	31.29 to 32.20
Bachelor Degree/Postgraduate Qualifications		11,326	27.74	27.31 to 28.18
Vocational qualifications (NVQ1+2)		2,867	7.02	6.78 to 7.27
Ethnicity	40,786 (0.49)			
White		38,643	94.75	94.52 to 94.96
Asian		690	1.69	1.57 to 1.82
Black		438	1.07	0.98 to 1.18
Mixed Race		456	1.12	1.02 to 1.22
Other		559	1.37	1.26 to 1.49
Children Under 18	40,828 (0.39)			
0		20,737	50.79	50.31 to 51.28
1		8,139	19.93	19.55 to 20.33
2		9,552	23.40	22.99 to 23.81
3 or more		2,400	5.88	5.65 to 6.11
Years in police force	40,931 (0.13)			
11 to 20		12,679	30.98	30.53 to 31.43
Less than 5		8,466	20.68	20.29 to 21.08
6 to 10		9,231	22.55	22.15 to 22.96
More than 20		10,555	25.79	25.37 to 26.21
Role	37,127 (9.42)			
Police Officer		26,031	70.11	69.65 to 70.58
Police Staff		10,361	27.91	27.45 to 28.37
Other Ranks		735	1.98	1.84 to 2.13
Income	40,828 (0.39)			
£26000 - £37999		16,820	41.20	40.72 to 41.68
Less than £25999		8,832	21.63	21.24 to 22.03
£38000 - £59999		13,869	33.97	33.51 to 34.43
More than £60000		1,307	3.20	3.03 to 3.38

Days of sickness	40,928 (0.14)			
None		18,956	46.32	45.83 to 46.80
1 to 5		13,504	32.99	32.54 to 33.45
6 to 10		3,703	9.05	8.77 to 9.33
More than 10		4,765	11.64	11.34 to 11.96
Smoking status	40,934 (0.13)			
Not smoker		36,902	90.15	89.86 to 90.43
Current smoker		4,032	9.85	9.57 to 10.14

5.4.2 Prevalence estimates

Prevalence estimates for the alcohol categories are outlined in Table 5.2. Most of the sample were low-risk drinkers (55.1%), with 32.6% meeting the criteria for hazardous use, and 3.0% for harmful use. When separated by gender, 19.4% of women and 40.4% of men were hazardous drinkers; 2.5% of women and 3.4% of men were harmful drinkers. A total of 9% reported abstinence (11.9% of women and 7.6% of men). For frequent binge drinking, 21.2% of women and 35.6% of men met criteria. Of the hazardous drinkers, 60.3% reported frequent binge drinking, with 88.9% of harmful drinkers frequently binge drinking (Appendix 9).

Table 5.2. Proportions and percentages for past week alcohol consumption, binge drinking, mental health and job strain.

	Median Units (IQR)	Total N	% (95% CI)	Men N	% (95% CI)	Women N	% (95% CI)
Summary of past week alcohol consumption *(N = 40,986)*							
Non-drinker	0	3,764	9.18 (8.91 to 9.47)	1,950	7.56 (7.25 to 7.89)	1,814	11.94 (11.43 to 12.46)
Up to 14 units (low risk)	5.5 (2.5 to 9.5)	22,612	55.17 (54.69 to 55.65)	12,558	48.70 (48.09 to 49.31)	10,054	66.15 (65.40 to 66.90)
Between 14 and 35/50 units (hazardous)	22.5 (18.0 to 29.5)	13,365	32.61 (32.16 to 33.06)	10,412	40.38 (39.78 to 40.98)	2,953	19.43 (18.80 to 20.07)
35+ units for women, 50+ units for men (harmful)	56.0 (50.5 to 66.0)	1,245	3.04 (2.88 to 3.21)	868	3.37 (3.15 to 3.59)	377	2.48 (2.24 to 2.74)
Binge drinking *(N = 40,986)*							
Does not binge drink	5.5 (0.0 to 12.0)	28,577	69.72 (69.28 to 70.17)	16,598	64.36 (63.78 to 64.95)	11,979	78.82 (78.16 to 79.46)
Frequent binge drinking [a]	21.5 (14.0 to 32.0)	12,409	30.28 (29.83 to 30.72)	9,190	35.64 (35.05 to 36.22)	3,219	21.18 (20.54 to 21.84)
Mental health *(N = 40,372)* [b]							
Depression caseness (PHQ-9)	-	3,958	9.80 (9.52 to 10.10)	2,090	8.24 (7.91 to 8.58)	1,868	12.45 (11.94 to 12.99)
Anxiety caseness (HADS)	-	3.407	8.44 (8.17 to 8.71)	1,578	6.22 (5.93 to (6.52)	1,829	12.19 (11.68 to 12.73)
PTSD caseness (BTS)	-	1,520	3.95 (3.75 to 4.15)	979	4.05 (3.81 to 4.31)	541	3.76 (3.47 to 4.09)
Job strain (JCQ) *(N = 40,372)*							
Low	-	11,015	27.28 (26.85 to 27.72)	7,515	29.62 (29.06 to 30.18)	3,500	23.33 (22.66 to 24.02)
High	-	9,722	24.08 (23.67 to 24.50)	5,799	22.86 (22.34 to 23.38)	3,923	26.16 (25.46 to 26.86)
Active	-	11,246	27.86 (27.42 to 28.30)	7,454	29.38 (28.82 to 29.94)	3,792	25.28 (24.59 to 25.98)
Passive	-	8,389	20.78 (20.39 to 21.18)	4,605	18.15 (17.68 to 18.62)	3,784	25.23 (24.53 to 25.92)

[a] Frequent binge drinking defined as 6 or more units, at least 2 to 4 times a month

[b] Total N for PTSD = 38,517

IQR; interquartile range. PHQ-9; Patient Health Questionaire-9 (Kroenke, Spitzer, & Williams, 2001). HADS; Hospital Anxiety and Depression Scale (anxiety sub-scale only) (Spitzer, Kroenke, Williams, & Löwe, 2006). BTS; Brief Trauma Screen (Brewin et al., 2002). JCQ; 6 items from Job Content Questionnaire (Karasek, 1985).

The mental health and job strain characteristics of the sample are described in Table 5.2. In total, 9.8% met the criteria for probable depression, 8.4% for anxiety and 4% for PTSD. Around 27% were categorised as having low job strain, 24% as high job strain, 28% as active job strain, and 21% were categorised as having passive job strain.

The prevalence estimates for the categories of alcohol consumption, probable mental health problems, job strain, and key demographic variables (mean age, ethnicity and gender composition), separated by year of data collection (in 3-4 year bands), are presented and discussed in the supplementary materials (Appendix 13). As the data was collected over a long period of time, these descriptive statistics can be used to cautiously observe cross-sectional trends. The limitations of this approach are outlined in the supplementary materials (Appendix 13).

5.4.3 Associations between mental health, job strain and alcohol use

Compared to those without a mental health problem, police employees with probable depression and anxiety were 1.3 times as likely to abstain from alcohol, with a weak association between PTSD and abstinence (Table 5.3). Those with depression, anxiety and PTSD were also twice as likely to drink harmfully and frequently binge drink (Table 5.4). All associations remained after adjusting for potential confounders, with the associations between anxiety and depression with harmful drinking/binge drinking, stronger after adjustments. Those with PTSD and anxiety were 1.3 times more likely to report hazardous drinking, with anxiety only becoming statistically significant after adjustments. After adjustment, police employees reporting low strain were significantly more likely to drink hazardously, or frequently binge drink, compared to those who reported high strain.

Table 5.3. Unadjusted and adjusted multinomial logistic regression analysis showing the associations between mental health and job strain, as explanatory variables, and alcohol consumption as the outcome variable. Low risk drinking is the reference group. Row frequencies and percentages, with multinomial odds ratios (MOR) are shown.

Characteristic	Non-drinkers			Low risk (ref)	Hazardous use			Harmful use		
	N (%)	MOR (95% CI)	AMOR (95% CI)	N (%)	N (%)	MOR (95% CI)	AMOR (95% CI)	N (%)	MOR (95% CI)	AMOR (95% CI)
Mental health										
Depression case	474 (11.98)	1.41 (1.26 to 1.56)***	1.34 (1.20 to 1.49)***	2,098 (53.01)	1,160 (29.31)	0.93 (0.87 to 1.01)	1.04 (0.97 to 1.13)	226 (5.71)	2.18 (1.88 to 2.54)***	2.30 (1.97 to 2.69)***
Anxiety case	386 (11.33)	1.35 (1.20 to 1.52)***	1.32 (1.17 to 1.48)***	1,757 (51.57)	1,090 (31.99)	1.06 (0.98 to 1.15)	1.27 (1.17 to 1.38)***	174 (5.11)	1.94 (1.64 to 2.29)***	2.20 (1.85 to 2.61)***
PTSD case	155 (10.20)	1.29 (1.08 to 1.54)**	1.27 (1.06 to 1.52)*	725 (47.70)	556 (36.58)	1.34 (1.20 to 1.50)***	1.33 (1.18 to 1.49)***	84 (5.53)	2.28 (1.80 to 2.88)***	2.28 (1.80 to 2.89)***
Job strain										
Low	930 (8.44)	1.00	1.00	5,896 (53.53)	3,822 (34.70)	1.00	1.00	367 (3.33)	1.00	1.00
High	1,013 (10.42)	1.15 (1.05 to 1.27)**	1.09 (0.98 to 1.20)	5,550 (57.09)	2,885 (29.67)	0.80 (0.75 to 0.85)***	0.89 (0.84 to 0.95)***	274 (2.82)	0.79 (0.67 to 0.93)**	0.86 (0.73 to 1.01)
Active	992 (8.82)	1.04 (0.95 to 1.15)	1.01 (0.92 to 1.12)	6,028 (53.60)	3,886 (33.55)	0.99 (0.94 to 1.05)	0.99 (0.94 to 1.05)	340 (3.02)	0.91 (0.78 to 1.06)	0.89 (0.76 to 1.04)
Passive	785 (9.36)	1.03 (0.93 to 1.14)	0.96 (0.87 to 1.07)	4,834 (57.62)	2,528 (30.13)	0.81 (0.76 to 0.86)***	0.94 (0.88 to 1.00)	242 (2.88)	0.80 (0.68 to 0.95)**	0.90 (0.76 to 1.07)
Interactions [a]										
Job strain X support										
Low X support	-	1.00	-	-	-	1.00	-	-	1.00	-
High X support	-	0.97 (0.93 to 1.01)	-	-	-	1.01 (0.98 to 1.03)	-	-	1.00 (0.93 to 1.07)	-
Active X support	-	0.97 (0.93 to 1.01)	-	-	-	1.00 (0.97 to 1.03)	-	-	1.01 (0.94 to 1.08)	-
Passive X support	-	0.99 (0.95 to 1.03)	-	-	-	0.99 (0.96 to 1.02)	-	-	0.95 (0.89 to 1.02)	-
Job strain X mental health										
Low X MHC	96 (10.56)	1.00	-	479 (52.70)	290 (31.90)	1.00	-	44 (4.84)	1.00	-
High X MHC	291 (12.53)	1.09 (0.82 to 1.43)	-	1,229 (52.93)	690 (29.70)	1.19 (0.99 to 1.43)	-	112 (4.82)	1.58 (1.04 to 2.38)*	-
Active X MHC	187 (10.57)	1.07 (0.80 to 1.43)	-	859 (48.56)	641 (36.24)	1.28 (1.06 to 1.55)*	-	82 (4.64)	1.24 (0.82 to 1.89)	-
Passive X MHC	140 (10.53)	0.95 (0.70 to 1.29)	-	724 (54.44)	396 (29.77)	1.14 (0.93 to 1.39)	-	70 (5.26)	1.50 (0.97 to 2.32)	-

*p < .05, **p < .01, ***p < .001

Adjusted for age, gender, education, ethnicity, income, marital status, children under 18, and smoking status. Reference groups for mental health are non-case.

[a] Support is a continuous variable; mental health is a categorical variable representing the presence of any mental health problem (depression, anxiety or PTSD) (case vs non-case); MHC: mental health case.

Table 5.4. Unadjusted and adjusted logistic regression analysis showing the associations between mental health and job strain, as explanatory variables, and binge drinking as the outcome variable. Row frequencies and percentages are shown.

Characteristic	Does not frequently binge drink	Frequently binge drinks		
	N (%)	N (%)	OR (95% CI)	AOR (95% CI)
Mental health				
Depression case	2,697 (9.57)	1,261 (10.35)	1.09 (1.02 to 1.17)*	1.14 (1.06 to 1.23)***
Anxiety case	2,320 (8.23)	1,087 (8.92)	1.09 (1.01 to 1.18)*	1.23 (1.14 to 1.33)***
PTSD case	985 (3.65)	535 (4.64)	1.29 (1.15 to 1.43)***	1.27 (1.13 to 1.42)***
Job strain				
Low	7,487 (26.56)	3,528 (28.95)	1.00	1.00
High	6,930 (24.59)	2,792 (22.91)	0.85 (0.81 to 0.91)***	0.88 (0.83 to 0.94)***
Active	7,734 (27.44)	3,512 (28.82)	0.96 (0.91 to 1.02)	0.96 (0.91 to 1.02)
Passive	6,033 (21.41)	2,356 (19.33)	0.83 (0.78 to 0.88)***	0.90 (0.84 to 0.96)**
Interactions [a]				
Job strain X support				
Low X support	-	-	1.00	-
High X support	-	-	1.02 (0.99 to 1.05)	-
Active X support	-	-	1.02 (1.00 to 1.05)	-
Passive X support	-	-	0.99 (0.97 to 1.02)	-
Job strain X mental health				
Low X MHC	602 (66.23)	307 (30.58)	1.00	-
High X MHC	1,612 (69.42)	710 (33.77)	1.03 (0.87 to 1.23)	-
Active X MHC	1,162 (65.69)	607 (34.31)	1.08 (0.91 to 1.30)	-
Passive X MHC	931 (70.00)	399 (30.00)	1.02 (0.85 to 1.24)	-

*p < .05, **p < .01, ***p < .001

Adjusted for age, gender, education, ethnicity, income, marital status, children under 18, and smoking status.

Reference groups for mental health are non-case.

[a] Support is a continuous variable; mental health is a categorical variable representing the presence of any mental health problem (depression, anxiety or PTSD) (case vs non-case); MHC: mental health case.

Exploratory sensitivity analysis, using only "non-drinkers", identified that "former drinkers" (responded "yes" to ever drinking alcohol) were significantly more likely to report depression and anxiety than "never drinkers" (responded "no" to ever drinking alcohol), but the association with anxiety was not significant after adjustments (Appendix 10).

5.4.4 Moderating effect of support or mental health on the association between job strain and alcohol use

The interaction term between support and job strain was not associated with the categories of alcohol use or binge drinking. The interaction term between mental health (meeting criteria for any mental health problem) and job strain was not associated with binge drinking but was significantly associated with the categories of alcohol use. Specifically, the interaction between mental health and active job strain was significantly associated with hazardous drinking, and the interaction between high job strain and mental health was significantly associated with harmful drinking.

To explore these interactions, the sample was stratified by presence/absence of a mental health problem (Table 5.5). For those without a mental health problem, low strain (relative to high and passive strain) was associated with a greater risk of hazardous or harmful drinking, remaining significant after adjustments. For those with a mental health problem, active strain (relative to low strain) was associated with a greater risk of hazardous drinking, but this attenuated to the null after adjustment for confounders.

Table 5.5. Stratified by the presence of any mental health problem (mental health case vs mental health non-case), unadjusted and adjusted multinomial logistic regression analysis showing the associations between job strain and alcohol consumption. Low risk drinking is the reference group. Row frequencies and percentages, with multinomial odds ratios (MOR) are shown.

Characteristic	Non-drinkers				Low risk		Hazardous use				Harmful use			
	N	%	MOR (95% CI)	AMOR (95% CI)	N	%	N	%	MOR (95% CI)	AMOR (95% CI)	N	%	MOR (95% CI)	AMOR (95% CI)
Mental health case														
Job strain														
Low	96	10.56	1.00	1.00	479	52.70	290	31.90	1.00	1.00	44	4.84	1.00	1.00
High	291	12.53	1.18 (0.92 to 1.52)	1.18 (0.90 to 1.12)	1,229	52.93	690	29.72	0.93 (0.78 to 1.10)	0.91 (0.76 to 1.09)	112	4.82	0.99 (0.69 to 1.43)	0.96 (0.66 to 1.39)
Active	187	10.57	1.08 (0.83 to 1.42)	1.08 (0.82 to 1.42)	859	48.56	641	36.24	1.23 (1.03 to 1.47)*	1.17 (0.97 to 1.41)	82	4.64	1.04 (0.71 to 1.52)	0.96 (0.65 to 1.41)
Passive	140	10.53	0.96 (0.73 to 1.28)	0.98 (0.73 to 1.30)	724	54.44	396	29.77	0.90 (0.75 to 1.09)	1.00 (0.82 to 1.22)	70	5.26	1.05 (0.71 to 1.56)	1.11 (0.75 to 1.67)
Mental health non-case														
Job strain														
Low	834	8.25	1.00	1.00	5,417	53.60	3,532	34.95	1.00	1.00	323	3.20	1.00	1.00
High	722	9.76	1.08 (0.97 to 1.21)	1.01 (0.90 to 1.12)	4,321	58.39	2,195	29.66	0.78 (0.73 to 0.83)***	0.87 (0.81 to 0.94)***	162	2.19	0.63 (0.52 to 0.76)***	0.70 (0.57 to 0.85)***
Active	805	8.49	1.01 (0.91 to 1.12)	0.98 (0.88 to 1.09)	5,169	54.54	3,245	34.24	0.96 (0.91 to 1.02)	0.96 (0.89 to 1.02)	258	2.72	0.84 (0.71 to 0.99)*	0.83 (0.70 to 0.98)*
Passive	645	9.14	1.02 (0.91 to 1.14)	0.95 (0.85 to 1.06)	4,110	58.22	2,132	30.20	0.80 (0.74 to 0.85)***	0.92 (0.86 to 0.99)*	172	2.44	0.70 (0.58 to 0.85)***	0.80 (0.66 to 0.96)*

*p < .05, **p < .01, ***p < .001

Adjusted for age, gender, education, ethnicity, income, marital status, children under 18, and smoking status.

5.4.5 Exploratory associations between sociodemographic, occupational and health variables with alcohol use

Men were more likely than women to report hazardous and harmful drinking (Appendix 10). Those aged 40-49 (reference) were more likely to drink hazardously than any other age group, and more likely to drink harmfully than those under 39. Being single (reference: married) was associated with harmful drinking. Those who had served for 11 to 20 years (reference) were more likely to be hazardous or harmful drinkers than those who had served for less than 10 years, but less likely than those who had served for over 20 years. Police officers (reference) were more likely to be hazardous or harmful drinkers than police staff. Those with more than 10 days of sickness (reference: none) were more likely to drink harmfully but also more likely to report abstinence. Being a current smoker was associated with almost 3 times greater odds of harmful alcohol use. Similar associations were observed with binge drinking as the outcome (Appendix 11).

5.5 Discussion

5.5.1 Key findings

This is the first and largest study of alcohol use in the UK Police Service. Approximately one third of police employees reported hazardous drinking and frequent binge drinking, with 3% drinking at harmful levels. Men were more likely than women to report hazardous and harmful drinking, reflecting findings from the general population (NHS Digital, 2018a). Police employees with a probable mental health problem, were more likely to report harmful drinking, but were also more likely to report abstinence. Opposing our hypothesis, those reporting low strain drank more

than those reporting high strain, but when stratified by mental health, this association was only shown in police employees without a mental health problem.

The prevalence of hazardous drinking was higher in the UK Police Service than the general population, for men (40% vs 24%) and women (19% vs 11%) (NHS Digital, 2018a), though the level of harmful drinking is similar. However, this is not a direct comparison with the UK general population data and there may be considerable differences between samples (e.g. age, year of data collection). The present findings reflect those observed in a representative sample of Australian police officers (Davey, Obst, et al., 2000b), whereby men reported more hazardous drinking than women, but showed comparable levels of harmful drinking (approx. 3%). However, US literature shows much lower levels of hazardous drinking in police officers and little difference between genders, e.g. 17% (Lindsay, 2008), 18% (Chopko et al., 2013), 14% of men and 12% of women (Ménard & Arter, 2014), 18% of men and 16% of women (Ballenger et al., 2011). Nevertheless, there are cultural differences in alcohol consumption between the UK and US (Ritchie & Roser, 2018).

5.5.2 Alcohol use and the associations with mental health and job strain

Police employees with probable depression, anxiety or PTSD were twice as likely to report harmful alcohol use and frequent binge drinking, compared to those without a mental health problem, but were also more likely to abstain from alcohol. This is in line with findings from a global study whereby low-risk drinking, compared to abstinence, was associated with lower depression and anxiety, but harmful drinking was associated with greater levels of depression and anxiety (Bellos et al., 2013). Similar findings have been observed in military personnel, but for PTSD only (Goodwin et al., 2017). Taken together, these findings suggest a J-shaped curve in the relationship between mental health and alcohol use, whereby positive self-reports of

mental health are associated with low-risk drinking, but not heavy drinking or abstinence (El-Guebaly, 2007). There are mental health differences between "lifestyle choice abstainers" and "previous problem drinking abstainers" (El-Guebaly, 2007), with our exploratory analyses suggesting that former drinkers were more likely to report depression compared to those who have never drank. It may be that police employees who now abstain from alcohol do so because of a previous alcohol problem or because alcohol was poorly affecting their mental health. However, longitudinal, and qualitative data are needed to better understand the causal relationship.

Few studies have explored the relationship between mental health and alcohol use in police officers, with the few focussing on PTSD. The prevalence of PTSD is lower in the present study than other UK and international studies of police officers (Skogstad et al., 2013; Violanti et al., 2017). However, the TSQ was only administered if participants reported experiencing a traumatic event in the past 6 months, excluding those with delayed onset PTSD (>6 months) or earlier trauma exposure (Utzon-Frank et al., 2014). An abundance of literature has shown a relationship between mental health and alcohol problems (Debell et al., 2014b; McFarlane, 1998), with the self-medication hypothesis suggesting that alcohol is used as a form of avoidance coping to alleviate negative affect (Khantzian, 1997; Stewart, Mitchell, Wright, & Loba, 2004). The existing evidence on PTSD and alcohol use in police officers is mixed, with some studies showing an association (Chopko et al., 2013; Ménard & Arter, 2014), whereas others do not (Ballenger et al., 2011; Violanti et al., 2011). One study noted that the combined effect of heavy drinking and PTSD led to a ten-fold greater risk of suicide ideation in police officers (Violanti, 2004). A qualitative exploration of mental health in five police officers observed that some used alcohol to cope with work

pressures and psychological symptoms, and reported that "macho" police culture and stigma are barriers to help-seeking (Edwards & Kotera, 2020).

Opposing our hypothesis, police employees reporting low strain were more likely to drink hazardously than those reporting high strain, remaining significant after adjustment for indicators of seniority (e.g. income and years of service). However, when stratified by mental health, the association was only apparent in those without a mental health problem. Previous research in police officers is mixed, with some studies showing an association between work stress and hazardous drinking (Kohan & O'connor, 2002; Violanti et al., 1985; Violanti et al., 2011), whereas others do not (Sterud, Hem, Ekeberg, & Lau, 2007a). Further, there is inconsistent evidence that alcohol is used to self-medicate negative affect caused by work stressors (Frone, 1999; Siegrist & Rödel, 2006). The biphasic self-medication model suggests that work stressors increase negative affect, which initially leads to higher alcohol use in those with higher stress, but the sedative effects of alcohol increase negative affect and work fatigue, making this pattern of behaviour difficult to maintain (Frone, 2016). Those with low strain may experience lower negative affect (or better mental health) from work stress, and have more time to socialise, and therefore drink more, due to holding less senior job roles.

5.5.3 Strengths and limitations

The main strength of this study is that it utilises a large sample of police employees. Both men and women were recruited, across all regions of the UK, including large numbers of men aged between 20 and 40, who are often under-represented in other epidemiological studies (Medical Research Council, 2014). The study was originally designed to measure the physical effects of TETRA radio usage, rather than alcohol use or mental health, reducing bias from framing effects (Goodwin et al., 2013;

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Tversky & Kahneman, 1981). Nevertheless, there are caveats. Alcohol consumption was measured using a 7-day drinks diary, which may be subject to recall bias, and the TSQ was only asked to those who reported experiencing a traumatic event in the past 6 months. A further limitation is that we were unable to distinguish across different police roles, such as constables and sergeants, as participants were grouped into "police officers", "police staff" and "other" ranks of police employees, for identification purposes. Finally, as this study is cross-sectional, we were unable to determine the causal relationship between alcohol consumption and mental health.

5.6 Implications

Identifying occupational groups at a higher risk of alcohol harm enables us to develop targeted interventions within that occupation, such as those being trialled in military personnel (Leightley et al., 2018). Evidence from military personnel and first responders shows low levels of help-seeking for alcohol problems, due to stigma (Haugen, McCrillis, Smid, & Nijdam, 2017; Sharp et al., 2015). Education on low-risk drinking should be implicated within police workforces and avenues for help-seeking should be made easily available, without disciplinary action (Home Office, 2012). The present findings show that police employees with a mental health problem were more likely to drink harmfully. Longitudinal and qualitative research is needed to explore whether alcohol is used as a coping mechanism within police employees, and to examine trends in the relationship between alcohol use and strain over time, particularly following changes to workforce pressures (e.g., budget cuts).

5.7 Conclusions

One third of UK police employees drink hazardously and binge drink at least twice a month. Further, there is evidence for a J-shaped relationship between alcohol use and

mental health in UK police employees, with those reporting mental health problems being more likely to report both abstinence and harmful drinking. Interventions to reduce risky drinking within police employees should also integrate support for mental health.

Chapter 6. Probable post-traumatic stress disorder and harmful alcohol use among male members of the British Police Forces and the British Armed Forces: a comparative study

6.1 Foreword

What is already known from the previous Chapters?

- The previous Chapter identified that 33% of UK police employees met criteria for hazardous drinking and 3% for harmful drinking. Compared to those without a mental health problem, police employees with probable depression, anxiety, or PTSD were more likely to drink harmfully, but also more likely to report abstinence.

- Chapter 4, the systematic review of trauma-exposed occupations, identified the highest levels of hazardous and harmful drinking in studies of Armed Forces personnel, compared to studies of first responders and health care workers.

What does the current Chapter aim to do?

- This Chapter aimed to directly compare the level of (and associations with) harmful alcohol use and probable PTSD across covariate-balanced samples of male police employees and male military personnel.

- To address the aims, this Chapter used data from the Airwave Health Monitoring Study (police sample) and the Health and Wellbeing Cohort Study (military sample). A statistical reweighting method was used to balance the samples on a range of pre-specified covariates (year of data collection, age, educational attainment), before multinomial and logistic regression analyses were conducted to determine sample differences.

What new findings does this Chapter add?

- The level of probable PTSD was similar in military personnel and police employees (approximately 4%). The level of harmful drinking was almost three times greater in male military personnel compared to male police employees (10% vs 3%). Military personnel were also more likely to report comorbid PTSD and harmful alcohol use (vs reporting neither problem). These findings remained following a sensitivity analysis which excluded police staff.

- Among both samples, higher educational attainment was associated with decreased odds of probable PTSD and harmful alcohol use, whereas current smokers and those aged over 40 showed increased odds of harmful alcohol use. In military personnel only, being a current smoker and being divorced/separated was associated with increased odds of probable PTSD. In police employees only, those aged over 50 years old had reduced odds of reporting probable PTSD.

6.2 Introduction

The military and police respond rapidly during national, and international, disasters and conflicts, and often operate under high pressure, potentially being exposed to traumatic situations. Nevertheless, there may be some differences between

these occupations in the types of exposure or type of traumatic experience. For example, military personnel may face intense stressors during set periods of time (e.g. deployment to a conflict situation), whereas for police employees the exposures may occur more regularly and in some cases be part of their daily routines. In terms of traumatic experiences, military personnel are more likely to have killed others, whereas police employees have to respond to and investigate civilian deaths and severe abuse of vulnerable others such as children (Hartley, Sarkisian, Violanti, Andrew, & Burchfiel, 2013; Osório et al., 2018; Stevelink, Pernet, et al., 2020). In addition, both groups may experience other causes of occupational stressors, such as competing demands with family life, demand-control imbalances or poor organisational support (Harvey et al., 2017; Harvey et al., 2018). It is possible that varied nature of occupational and trauma stressors experienced by military personnel and police employees may have a differential impact on their mental health and patterns of alcohol consumption.

Prevalence estimates of adverse mental health outcomes among members of the UK Armed Forces are well documented as a result of a representative, longitudinal study set up to explore the impact of deployment to Iraq, and subsequently Afghanistan, on the health and wellbeing of military personnel (Fear et al., 2010; Hotopf et al., 2006; Stevelink et al., 2018). The most recent estimates from this cohort study indicate a prevalence of 6% for probable PTSD and 10% for alcohol misuse among military personnel (Stevelink et al., 2018). Most relevant mental health research concerning the UK police forces, has often been conducted in the aftermath of an emergency, and/or included only a select few police forces (Lawson et al., 2012; Maia et al., 2007; Van der Velden et al., 2013). Though recently, a large UK survey suggested that of those police employees exposed to trauma, about one in five would

develop symptoms of PTSD (Brewin et al., 2020). Additionally, a recent meta-analysis identified a pooled global prevalence of 5% for harmful alcohol use among police employees and 14% for PTSD (Syed et al., 2020). However, an international review of hazardous and harmful drinking in trauma-exposed occupations, identified no UK studies of alcohol use in police officers (Irizar, Puddephatt, Fallon, Gage, & Goodwin, 2021).

In this paper, we explore the proportions, and pre-specified associated factors, of probable PTSD and harmful alcohol use among covariate-balanced samples of male members of the British Armed Forces and the British Police Forces. In addition, we explore whether there is a difference in the comorbidity of probable PTSD and harmful alcohol consumption between the two samples. This study is pre-registered on Open Science Framework (DOI 10.17605/OSF.IO/7PTWX), where the research questions and data analyses plan are outlined in more detail.

6.3 Materials and methods

6.3.1 Study samples and data collection

6.3.1.1 Airwave Health Monitoring Study

Cross-sectional data on police employees was obtained from the Airwave Health Monitoring Study, which was established to determine possible health risks associated with the use of Terrestrial Trunked Radio (TETRA), a digital communication system used by emergency services since 2001 (Elliott et al., 2014). A total of 41,038 police employees completed measures relating to mental health and alcohol consumption, between June 2006 and March 2015. Out of the 54 existing police forces, 28 agreed to participate, with the response rates averaging 50% across participating forces. Participants completed an enrolment questionnaire including demographic, health and

lifestyle items, and a health screen conducted by trained nurses. The Airwave Health Monitoring Study design and protocol have been described in detail in a previous publication (Elliott et al., 2014). We will refer to this sample as the "police sample" throughout the rest of this paper.

Participants were eligible for inclusion in the study if they identified themselves as an active member of the police force (e.g. inspector, police constable/sergeant or police staff). Those whose data were collected in 2006 were excluded as this version of the protocol did not include the measure of PTSD. This procedure is outlined in detail in Figure 6.1.

6.3.1.2 Health and Wellbeing Cohort Study

Data on UK military personnel was obtained from the health and wellbeing cohort study established by the King's Centre for Military Health Research. Participants completed a self-administered questionnaire that was available in both hard copy and electronically (latest phase only), and included questions relating to demographics, service information, experiences during and returning from deployment, mental health, physical health and lifestyle. This cohort study was initially set up to investigate the impact of deployment to the conflict in Iraq on the health and wellbeing of military personnel (data collected between 2004-2006) (Hotopf et al., 2006) including a random sample of regular and reserve personnel of the UK Armed Forces, stratified by deployment status (phase 1; n=10,272, response rate 59%). As the conflict in Iraq continued and personnel were also deployed to Afghanistan, all personnel included in phase 1 were asked to take part in phase 2 (data collected between 2007-2009). In addition, a random sample of personnel deployed to Afghanistan between April 2006 and April 2007 (termed the HERRICK sample), and a sample of newly trained personnel who joined the Armed Forces since April 2003 (termed the replenishment

sample), were included (phase 2; n=9990, response rate 56%) (Fear et al., 2010). An additional 300 responders were included who only filled in a short version of the phase 2 questionnaire after the main data collection for this phase had finished. Again, a replenishment sample of newly trained personnel who joined after June 2009 was included in phase 3 (data collected between 2014-2016), in addition to those who took part in phase 2 and agreed to future contact (phase 3; n=8,093, response rate 57.8%) (Stevelink et al., 2018). The procedures for each phase are described in detail in previous publications (Fear et al., 2010; Hotopf et al., 2006; Stevelink et al., 2018). We will refer to this sample as the "military sample" throughout the rest of the paper.

To ensure comparability with the police sample, only regular serving personnel were included from the military sample for which data was collected during phase 2 (2007-2009) and phase 3 (2014-2016) of the military health and wellbeing cohort study. Further, military personnel who filled in the short questionnaire at phase 2 were also dropped. Not all measures needed for the current comparative analysis were available. Females were also excluded for the purpose of this analysis (analysis will be repeated for females in a separate study); it is important to study males and females separately, as female members of both samples are relatively unique with regards to the type of role they can hold (particularly within the military) and have higher rates of mental health problems, than males (McManus et al., 2016). Further, the proportion of females is usually substantially higher in the police force (approx. 30%) (Allen & Audickas, 2020) than in the Armed Forces (approx. 10%) (Dempsey, 2019).

Flowchart diagram:

KCMHR branch (left):

- Full KCMHR Dataset (n = 15736)
- ↓
- Drop those who completed phase 1 data only (n = 2800)
- ↓
- Drop females (n = 1564)
- ↓
- Drop if were not a serving regular in either phase 2 or phase 3 (n = 3591)
- ↓
- Drop short questionnaire (n = 382)
- ↓ (branches to Phase 2 and Phase 3)

Phase 2:
- Those who only completed phase 2 data assigned to phase 2 (n = 2981)
- ↓
- Completed both phases but were only serving regular in phase 2 assigned to phase 2 (n = 1095)
- ↓
- Phase 2 N = 4076

Phase 3:
- Completed both phases, but only serving regular in phase 3, assigned to phase 3 (n = 1584)
- ↓
- Serving regular in both phase 2 and phase 3 assigned to phase 3 (n = 1739) [a]
- ↓
- Phase 3 N = 3323

Airwave branch (right):

- Full Airwave Dataset (n = 41,038)
- ↓
- Drop if role is "other" (n = 739)
- ↓
- Drop females (n = 14,900)
- ↓
- Drop those who completed survey in 2006 (n = 1,573) [b]
- ↓ (branches to Phase 2 and Phase 3)

Phase 2:
- Data collected between January 2007 to June 2011 assigned to phase 2
- ↓
- Phase 2 N = 14,154

Phase 3:
- Data collected between July 2011 and December 2015 assigned to phase 3
- ↓
- Phase 3 N = 9,672

[a] Participants with data for both phases were included in phase 3 to create a more equal distribution, which reflects the distribution of the Airwave data.

[b] Participants who completed the Airwave Health Monitoring Study survey in 2006 were not asked the PTSD items, and so, were dropped. The phase 1 KCMHR data were also dropped as this was the same timeframe.

Figure 6.1. Flow diagram showing the allocation of participants to phase 2 and phase 3.

6.3.2 Measures

6.3.2.1 Demographic, occupational and health variables

Comparable demographic, occupational, and health variables were obtained from both samples, including age, marital status, educational attainment, and smoking status. Income and police role (police staff, police constable/sergeant, inspector or above) were also obtained from the police sample. Type of Service at baseline (Naval Services, Army, Royal Air Force), rank (commissioned officer, non-commissioned officer or other) and deployment (yes/no), were obtained from the military sample.

6.3.2.2 PTSD

In the police sample, probable PTSD was measured using the 10-item Trauma Screen Questionnaire (TSQ) (Brewin et al., 2002), which has good criterion validity (sensitivity 0.86, specificity 0.93, Brewin et al., 2002) and internal reliability (McDonald's omega $\omega = 0.99$). Response options were on a five-point scale ranging from 'not at all' to 'extremely'. Any responses other than 'not at all' were scored as 1 (score range 0-10). A score of 6 or more was defined as indicative of probable PTSD. The TSQ was only asked if participants responded positive to the following screening question: "Have you been bothered by a disturbing incident which has occurred over the past 6 months?".

In the military sample, probable PTSD was measured using the 17-item National Centre for PTSD Checklist, civilian version (PCL-C) (Blanchard et al., 1996), which had good internal reliability ($\omega = 0.97$). Response options on the PCL-C are based on a five-point scale ranging from 'not at all' to 'extremely' (score range 17-85). A score of 50 or more was defined as indicative of probable PTSD, with a sensitivity of 0.82 and specificity of 0.86 (Blanchard et al., 1996). Research indicates that the PCL-C and

TSQ, using the same defined cut-off scores as above, show similar prevalence estimates in the UK general population (McManus et al., 2016).

6.3.2.3 Alcohol consumption

In the police sample, alcohol consumption was measured using a past week's drinks diary, which asked participants to state the number of drinks they had consumed, for the following: white wine, red wine, fortified wine, spirits and beer (converted to units). In the military sample, the Alcohol Use Disorder Identification Test (AUDIT) (Saunders et al., 1993) was used. To harmonise the measure of alcohol consumption with the police sample, two items were used ('how often do you have a drink containing alcohol?' and 'how many units do you have on a typical day of drinking?'), to estimate total weekly units. AUDIT responses for the latter item are usually on a five-point scale, ranging from 1-2 drinks (scored as 0) to 10 or more drinks (scored as 4), but participants were given additional options, up to 30 or more, and provided responses in units. The frequency of consumption was multiplied with the midpoint for typical units, e.g. a participant who drinks two to three times a week and has 7 to 9 units on a typical day of drinking, would score 16 on total weekly units (2 x 8).

The UK's Chief Medical Officer's recommendation for weekly alcohol consumption was used to code both samples as 'low-risk' (≤14 units) and the National Institute for Health and Care Excellence (NICE) guidance for males was used to code anyone drinking above this as 'hazardous' (>14-50 units) and 'harmful' (>50 units) drinkers (Department of Health and Social Care, 2016; NICE, 2014). In the police sample, participants were asked if they currently drink alcohol; those who responded 'no' were categorised as "non-drinkers". In the military sample, participants who

responded with 'never' to the first item of the AUDIT, were categorised as "non-drinkers".

Both datasets included a measure of binge drinking, i.e., "how often do you have six or more drinks on one occasion?". Responses were given on a five-point scale; however, the comparability of this variable was reduced as the outcomes were worded slightly differently in each sample, except for "daily or almost daily". Therefore, a binary variable, "binge drinks daily or almost daily" vs "does not binge drink daily or almost daily", was created to reflect more harmful drinking behaviours.

6.2.3 Statistical analysis

6.2.3.1 Entropy balancing

Entropy balancing is a multivariate reweighting method, building on propensity score matching but allowing the full use of the larger sample (rather than selecting a matched sub-sample), used to achieve covariate balance on a range of pre-specified variables (year of data collection, age and educational attainment), to increase comparability (Hainmueller, 2012). Entropy balancing was used to create a weight value for all police employees, to be more comparable to the military dataset (which is smaller and more occupationally distinct), which is then used as a weight when estimating proportions in police employees.

A binary variable was created for year of data collection (January 2007-June 2011, reflecting phase 2 of the military sample, vs July 2011-December 2016, reflecting phase 3 of the military sample), using broad ranges rather than precise year to account for differences between the samples. Age was grouped into 10-year age bands, from <30 (starting at 18 and 20 years old for police employees and military personnel, respectively) up to ≥50 years old (up to 70 years old across both samples). Educational

attainment was split into low (O levels/GCSEs or below) and high (A levels and equivalent or higher). There was some variation in the wording of the education question, as police employees were asked to report their qualifications at the time of the survey, and military personnel at the time of joining service. However, during research advisory groups, it was suggested that it is unlikely that police officers would gain education as part of their service, whereas military personnel may gain qualifications as part of their training. Entropy balancing was conducted in STATA using the *ebalance* command (Hainmueller & Xu, 2013).

6.2.3.2 Estimating sample differences

Frequencies and percentages, with 95% confidence intervals (CI), were used to describe demographic, occupational and health variables for each sample. Descriptive statistics were also reported for the outcome variables, i.e., probable PTSD, alcohol consumption (non-drinkers, low risk, hazardous use and harmful use), binge drinking and comorbid probable PTSD and harmful alcohol consumption. The percentages were reported with entropy balance weights applied.

Stratifying by sample, logistic regressions (when PTSD and binge drinking were outcomes) and multinomial logistic regressions (when harmful alcohol use was the outcome, using low risk drinking as the reference group) were used to determine any associations between the demographic, occupational and health variables with PTSD and harmful alcohol use.

Logistic regressions were used to determine sample differences in probable PTSD and binge drinking. Multinomial logistic regressions determined sample differences in harmful alcohol use (low risk drinking as reference) and comorbidity of probable PTSD and harmful alcohol use (presence of neither as reference). Analyses were

adjusted for variables hypothesised *a priori* to be associated with PTSD and harmful alcohol use: marital status and smoking status. Previous evidence shows that being married or in a relationship is protective against PTSD (Jakupcak et al., 2010) and harmful drinking (Prescott & Kendler, 2001), compared to those who are not in a relationship, whereas smoking has been found to be positively associated with PTSD (Fu et al., 2007) and harmful drinking (Room, 2004). We did not adjust for age and education as these variables were used to create the entropy balancing weight, though higher education is thought to be protective against PTSD and harmful drinking (Iversen et al., 2008; Jones, Bates, et al., 2015).

We conducted sensitivity analyses to explore whether the previously outlined associations differed if we restricted the police sample to inspectors, constables and sergeants, excluding police staff. Police staff may be less comparable to serving regular military personnel, as they are considered to have more desk-based duties compared to inspectors and police constables/sergeants.

Unadjusted and adjusted odds ratios or multinomial odds ratios, with 95% confidence intervals are reported. All statistical analyses were conducted in STATA SE 15.

6.2.4 Ethics

The Airwave Health Monitoring Study received ethical approval from the National Health Service multi-site research ethics committee (MREC/13/NW/0588). Written informed consent was obtained from all participants. Ethical approval was obtained for each of the phases of the Health and Wellbeing Cohort Study from both the UK Ministry of Defence Research Ethics Committee and the local Ethics Committee at King's College London.

6.4 Results

6.4.1 Sample characteristics

The total sample size was 31,255, including 23,826 police employees and 7,399 military personnel (Table 6.1). The entropy balancing resulted in balanced estimates of age and education whereby approximately 75% of both samples were under the age of 40 years and approximately 57% of both samples had a higher educational attainment. About 80% of police employees were constables and sergeants. Over 55% of military personnel were non-commissioned officers (NCOs) and had been on deployment. Almost 25% of military personnel reported smoking, compared to just 10% of police employees.

Table 6.1. Demographic (age, marital status, education, income), occupational (role, rank, deployment, service) and health (smoking status) characteristics from police (N = 23,826) and military personnel (N = 7,399).

Characteristic	Total	Police N	Police %	Police 95% CI	Total	Military N	Military %	Military 95% CI
Age (years)	23,651				7,399			
< 29		2,469	35.71	34.64 to 36.79		2,896	39.18	38.06 to 40.31
30 to 39		7,394	40.55	39.66 to 41.45		2,694	36.35	35.25 to 37.46
40 to 49		10,193	21.09	20.56 to 21.63		1,428	19.26	18.37 to 20.18
≥ 50		3,770	2.66	2.55 to 2.76		381	5.21	4.72 to 5.75
Marital status	23,240				7,298			
Married/Cohabiting		19,747	79.06	78.19 to 79.92		5,764	79.00	78.04 to 79.93
Divorced/Separated		1,619	5.18	4.83 to 5.55		395	5.32	4.82 to 5.86
Single		1,874	15.76	14.94 to 16.61		1,139	15.68	14.86 to 16.54
Education	23,651				7,233			
Low (GSCE/O level or below)		8,167	42.77	41.77 to 43.77		3,094	42.78	41.64 to 43.92
High (Vocational/A levels or higher)		15,484	57.23	56.22 to 58.23		4,139	57.22	56.08 to 58.36
Smoking status	23,617				7,113			
Non-smoker		21,681	89.98	89.36 to 90.56		5,481	75.48	74.47 to 76.47
Current smoker		2,111	10.02	9.44 to 10.64		1,791	24.52	23.53 to 25.53
Income (police only)	23,651							
Less than £25999		2,096	15.49	14.62 to 16.41		-	-	-
£26000 - £37999		9,655	48.47	47.49 to 49.44		-	-	-
£38000 – £59999		10,832	34.09	33.25 to 34.95		-	-	-
More than £60000		1,068	1.94	1.79 to 2.12		-	-	-
Role (police only)	21,290							
Police staff		3,627	15.28	14.53 to 16.07		-	-	-
Police constable/sergeant		15,645	79.81	79.00 to 80.60		-	-	-
Inspector or above		2,182	4.91	4.62 to 5.21		-	-	-
Rank (military only)					7,233			
Other		-	-	-		1,717	21.47	20.54 to 22.43
Non-commissioned officer		-	-	-		4,108	55.23	54.08 to 56.38
Commissioned officer		-	-	-		1,574	23.30	22.34 to 24.28
Deployed (military only)					7,195			
Not deployed		-	-	-		1,128	15.44	14.62 to 16.29
Deployed		-	-	-		6,233	84.56	83.70 to 85.38
Service (military only)					7,399			
Naval Services		-	-	-		1,197	16.18	15.47 to 17.17
Army		-	-	-		4,751	64.21	62.70 to 64.92
Royal Air Force		-	-	-		1,451	19.61	19.88 to 20.82

Percentages are weighted with entropy balancing (e.g. year of data collection, age and educational attainment).

Supplementary Table 1 (Appendix 14) compares the unweighted frequencies and percentages with the entropy balanced frequencies and percentages for the police sample. The weighted estimates for the outcomes of interest (i.e., PTSD, categories of alcohol consumption, binge drinking) were similar to the unweighted estimates. As expected, due to the covariate-balancing, the weighting increased the proportion of police employees under the age of 40 years and with lower educational attainment, similar to the military sample. The weighting lowered the proportion of inspectors and the proportion with a salary over £60,000.

6.4.2 Sample differences in probable PTSD and harmful alcohol use

For probable PTSD, 3.95% of police employees and 3.67% of military personnel met criteria. For harmful alcohol use, 2.87% of police employees and 9.59% of military personnel met criteria, with 1.50% of police employees and 3.04% of military personnel reporting daily or almost daily binge drinking. Military personnel were less likely to meet the criteria for probable PTSD compared to police employees (Adjusted Odds Ratio (AOR) 0.84, 95% CI 0.72 to 0.99), however this association was borderline significant only in the adjusted regression (Table 6.2). In contrast, military personnel were significantly more likely to report harmful alcohol use (AOR 2.79, 95% CI 2.42 to 3.21) compared to police employees and this is also reflected in their binge drinking behaviour (AOR 1.67, 95% CI 1.37 to 2.03). Military personnel were also more likely to report comorbid PTSD and harmful alcohol use (AOR 2.84, 95% CI 1.67 to 4.84), though this is likely driven by harmful alcohol use.

Table 6.2. Logistic and multinomial regression analyses showing the differences in PTSD and alcohol consumption characteristics stratified among police and military personnel. The police sample is the reference group [a].

Outcome variable	Police N (%)	Military N (%)	OR (95% CI)	AOR (95% CI) [b]
PTSD				
Non-case	22,721 (96.05)	7,009 (96.33)	1.00	1.00
Case	944 (3.95)	266 (3.67)	0.93 (0.79 to 1.09)	0.84 (0.72 to 0.99)*
			N = 30,749	*N = 30,217*
Alcohol use (UK government guidelines)				
Non-drinker	1,810 (8.52)	294 (3.93)	0.46 (0.40 to 0.54)***	0.46 (0.40 to 0.53)***
Low risk (0 to 14 units)	11,656 (52.03)	3,754 (51.63)	1.00	1.00
Hazardous (15 to 50 units)	9,429 (36.57)	2,524 (34.84)	0.96 (0.90 to 1.02)	0.90 (0.84 to 0.96)**
Harmful (above 50 units)	767 (2.87)	683 (9.59)	3.37 (2.94 to 3.88)***	2.79 (2.42 to 3.21)***
			N = 30,656	*N = 30,143*
Binge drinking [c]				
No	23,169 (98.50)	7,075 (96.96)	1.00	1.00
Yes	493 (1.50)	216 (3.04)	2.06 (1.71 to 2.48)***	1.67 (1.37 to 2.03)***
			N = 30,672	*N = 30,160*
Comorbidity				
PTSD non-case <u>and</u> non-case harmful alcohol use	21,924 (93.41)	6,327 (87.58)	1.00	1.00
PTSD case <u>only</u>	888 (3.71)	199 (2.77)	0.79 (0.67 to 0.95)*	0.75 (0.63 to 0.89)**
Harmful alcohol use <u>only</u>	709 (2.62)	614 (8.69)	3.52 (3.07 to 4.04)***	3.02 (2.62 to 3.48)***
PTSD case <u>and</u> harmful alcohol use case	55 (0.25)	61 (0.87)	3.76 (2.20 to 6.43)***	2.84 (1.67 to 4.84)***
			N = 30,590	*N = 30,083*

***p<.001, **p<.01, *p<.05. Percentages are weighted with entropy balancing (e.g. year of data collection, age and educational attainment).

[a] Age and education were not adjusted for as these variables were used in the entropy balancing to match the samples.

[b] Adjusted for marital status and smoking status.

[c] Binge drinking defined as drinking 6 or more units daily or almost daily.

The sensitivity analyses whereby the military personnel were compared to inspectors and police constables/sergeants only, and police staff were dropped, did not reveal any differences in the associations found between PTSD and alcohol consumption characteristics between military personnel and police employees (Appendices 16 and 17).

6.4.3 Associations with probable PTSD and alcohol consumption

Among both samples, greater educational attainment was significantly associated with decreased odds of PTSD (police employees: Odds Ratio (OR) 0.80, 95% Confidence Interval (CI) 0.65 to 0.98; military personnel: OR 0.69, 95% CI 0.54 to 0.89) (Table 2). Police employees aged ≥50 years (compared to those aged 30 to 39 years) had decreased odds of PTSD (OR 0.70, 95% CI 0.55 to 0.89). Among military personnel, being divorced/separated was significantly associated with increased odds of PTSD (OR 3.05, 95% CI 2.08 to 4.44,) and smoking (OR 1.95, 95% CI 1.51 to 2.53). Deployment reduced the likelihood of PTSD (OR 0.72, 95% CI 0.53 to 0.99) as well as holding a higher rank (NCOs OR 0.58, 95% CI 0.44 to 0.75, Commissioned Officers OR 0.30, 95% CI 0.19 to 0.46). Those in the Army were more likely to meet the criteria for PTSD, compared to those in the Royal Air Force or Naval Service.

Table 6.3. Demographic, occupational and health associations with PTSD caseness (PTSD non-case is the reference group) stratified by police and military personnel. Row percentages are shown representing the number of participants with probable PTSD.

| Explanatory variable | *PTSD Case* | | | |
| | *Police* | | *Military* | |
	N caseness (%)	*OR (95% CI)*	*N caseness (%)*	*OR (95% CI)*
Age (years)				
< 29	85 (3.64)	0.87 (0.66 to 1.15)	120 (4.27)	1.23 (0.93 to 1.63)
30 to 39	281 (4.15)	1.00	92 (3.50)	1.00
40 to 49	463 (4.20)	1.01 (0.86 to 1.20)	46 (3.19)	0.91 (0.63 to 1.31)
≥ 50	115 (2.95)	0.70 (0.55 to 0.89)**	8 (2.14)	0.60 (0.29 to 1.25)
Marital status				
Married/Cohabiting	771 (3.91)	1.00	185 (3.23)	1.00
Divorced/Separated	77 (3.79)	0.97 (0.68 to 1.37)	43 (3.90)	3.05 (2.08 to 4.44)***
Single	73 (4.42)	1.14 (0.83 to 1.56)	35 (9.23)	1.22 (0.87 to 1.71)
Education				
Low (GSCE/O level or below)	324 (4.44)	1.00	134 (4.42)	1.00
High (Vocational/A levels or higher)	617 (3.57)	0.80 (0.65 to 0.98)*	127 (3.11)	0.69 (0.54 to 0.89)***
Smoking status				
Non-smoker	871 (3.97)	1.00	161 (2.96)	1.00
Current smoker	73 (3.75)	0.94 (0.64 to 1.38)	99 (5.62)	1.95 (1.51 to 2.53)***
Income (police only)				
Less than £25999	76 (3.75)	1.00	-	-
£26000 - £37999	406 (4.16)	1.11 (0.78 to 1.59)	-	-
£38000 – £59999	428 (3.74)	1.00 (0.71 to 1.42)	-	-
More than £60000	31 (3.40)	0.90 (0.49 to 1.68)	-	-
Role (police only)				
Police constable/sergeants	661 (4.08)	1.00	-	-
Police staff	104 (3.90)	0.95 (0.67 to 1.36)	-	-
Inspector or above	94 (4.31)	1.06 (0.78 to 1.44)	-	-
Rank (military only)				
Other	-	-	98 (5.87)	1.00
Non-commissioned officer	-	-	140 (3.48)	0.58 (0.44 to 0.75)***
Commissioned officer	-	-	28 (1.82)	0.30 (0.19 to 0.46)***
Deployed (military only)				
Not deployed	-	-	52 (4.74)	1.00
Deployed	-	-	213 (3.48)	0.72 (0.53 to 0.99)*
Service (military only)				
Naval Services	-	-	33 (2.77)	0.45 (0.43 to 0.92)*
Army	-	-	199 (4.30)	1.00
Royal Air Force	-	-	34 (2.38)	0.54 (0.37 to 0.78)**

***p<.001, **p<.01, *p<.05. Percentages are weighted with entropy balancing (e.g. year of data collection, age and educational attainment).

For both samples, higher educational attainment reduced the odds of harmful alcohol use, whereas smoking and being over 40 years of age (compared to those aged 30 to 39 years) increased the odds of harmful alcohol use (Table 6.3). Harmful alcohol use was about twice as likely among police employees in the top two income brackets. Military personnel who had deployed had 2.14 times the odds (95% CI 1.64 to 2.81) of harmful alcohol use, compared to those who had not deployed. Higher ranked military personnel were less likely to report harmful alcohol use compared to other ranks.

Interestingly, younger military personnel (<29) were more likely to binge drink compared to those aged 30 to 39, but younger police employees were less likely to binge drink (Table 6.4). For both samples, binge drinking was less likely among those with higher educational attainment and more likely among current smokers. Police employees who reported to be single were less likely to binge drink (OR 0.34, 95% CI 0.19 to 0.61) compared to their married/cohabiting peers. In contrast, single, divorced and separated military personnel had an increased odds of binge drinking compared to their married/cohabiting counterparts. Military personnel who had deployed had a higher odds of binge drinking compared to those who had not deployed (OR 1.69, 95% CI 1.07 to 2.66).

Table 6.4. Demographic, occupational and health associations with harmful alcohol use (low risk drinking is reference group) and daily or almost daily binge drink (not binge drinking daily or almost daily is the reference group) stratified by police and military personnel. Row percentages are shown representing the number of participants drinking alcohol at harmful levels or reporting daily or almost daily binge drinking.

	Harmful alcohol use				Daily or almost daily binge drinking			
	Police		Military		Police		Military	
Explanatory variable	N caseness (%)	OR (95% CI)	N caseness (%)	OR (95% CI)	N caseness (%)	OR (95% CI)	N caseness (%)	OR (95% CI)
Age (years)								
< 29	61 (2.36)	0.95 (0.80 to 1.15)	383 (13.84)	1.25 (0.96 to 1.63)	13 (0.46)	0.25 (0.14 to 0.46)***	101 (3.64)	1.54 (1.12 to 2.13)**
30 to 39	205 (2.93)	1.00	194 (7.46)	1.00	125 (1.83)	1.00	62 (2.39)	1.00
40 to 49	357 (3.48)	1.16 (1.03 to 1.32)*	93 (6.77)	1.46 (1.03 to 2.07)*	245 (2.42)	1.33 (1.05 to 1.69)*	42 (3.05)	1.28 (0.86 to 1.91)
≥ 50	144 (3.96)	1.20 (1.02 to 1.42)*	13 (3.46)	2.61 (1.21 to 5.63)*	110 (2.94)	1.63 (1.22 to 2.16)**	11 (2.93)	1.23 (0.64 to 2.36)
Marital status								
Married/Cohabiting	637 (2.79)	1.00	417 (7.44)	1.00	426 (1.67)	1.00	150 (2.70)	1.00
Divorced/Separated	56 (3.66)	1.44 (0.97 to 2.14)	61 (16.31)	2.71 (1.99 to 3.70)***	40 (0.57)	1.46 (0.93 to 2.30)	22 (5.82)	2.24 (1.42 to 3.56)***
Single	60 (3.26)	1.23 (0.85 to 1.77)	202 (18.35)	3.66 (3.00 to 4.45)***	19 (2.42)	0.34 (0.19 to 0.61)***	44 (3.99)	1.51 (1.07 to 2.12)**
Education								
Low (GSCE/O level or below)	311 (3.21)	1.00	395 (13.08)	1.00	223 (2.00)	1.00	124 (4.10)	1.00
High (Vocational/A levels or higher)	451 (2.62)	0.79 (0.64 to 0.99)*	286 (7.01)	0.48 (0.41 to 0.57)***	267 (1.13)	0.56 (0.44 to 0.72)***	92 (2.25)	0.54 (0.41 to 0.71)***
Smoking status								
Non-smoker	631 (2.54)	1.00	382 (7.14)	1.00	404 (1.24)	1.00	119 (2.23)	1.00
Current smoker	135 (5.83)	2.90 (2.17 to 3.87)***	295 (17.02)	3.27 (2.75 to 3.89)***	89 (3.79)	3.13 (2.26 to 4.34)***	95 (5.48)	2.54 (1.93 to 3.35)***
Income (police only)								
Less than £25999	47 (1.83)	1.00	-	-	22 (0.06)	1.00	-	-
£26000 - £37999	280 (2.62)	1.48 (0.97 to 2.24)	-	-	176 (1.22)	2.04 (1.11 to 3.74)**	-	-
£38000 – £59999	403 (3.69)	2.31 (1.53 to 3.47)***	-	-	273 (2.27)	3.85 (2.13 to 6.96)***	-	-
More than £60000	32 (3.06)	2.07 (1.17 to 3.67)**	-	-	19 (1.98)	3.34 (1.44 to 7.74)***	-	-
Role (police only)								
Police constable/sergeants	539 (3.02)	1.00	-	-	341 (1.61)	1.00	-	-
Police staff	59 (2.82)	0.90 (0.65 to 1.24)	-	-	47 (2.01)	0.82 (0.55 to 1.23)	-	-
Inspector or above	108 (2.22)	0.82 (0.56 to 1.19)	-	-	67 (1.33)	1.25 (0.82 to 1.91)	-	-
Rank (military only)								
Other	-	-	240 (14.66)	1.00	-	-	69 (4.22)	1.00
Non-commissioned officer	-	-	381 (9.66)	0.57 (0.47 to 0.68)***	-	-	111 (2.82)	0.66 (0.48 to 0.89)**
Commissioned officer	-	-	62 (4.03)	0.23 (0.17 to 0.32)***	-	-	36 (2.34)	0.54 (0.36 to 0.82)**
Deployed (military only)								
Not deployed	-	-	65 (5.97)	1.00	-	-	21 (1.93)	1.00
Deployed	-	-	615 (10.27)	2.14 (1.64 to 2.81)***	-	-	192 (3.21)	1.69 (1.07 to 2.66)*
Service (military only)								
Naval Services	-	-	130 (11.23)	1.25 (1.00 to 1.55)*	-	-	43 (3.70)	1.21 (0.86 to 1.72)
Army	-	-	459 (10.12)	1.00	-	-	139 (3.07)	1.00
Royal Air Force	-	-	94 (6.59)	0.61 (0.48 to 0.77)***	-	-	34 (2.39)	0.77 (0.53 to 1.13)

***p<.001, **p<.01, *p<.05. Percentages are weighted with entropy balancing (e.g. year of data collection, age and educational attainment).

6.5 Discussion

6.5.1 Key findings

This is the first study to directly compare the proportions, and associated factors, of probable PTSD and harmful alcohol use, among male members of the Armed Forces and Police Forces. We found several key findings. First, similar proportions of probable PTSD (approx. 4%) in both samples. Second, military personnel reported higher proportions of harmful alcohol use than police employees (approx. 10% vs 3%, respectively). Third, comorbid PTSD and harmful alcohol use were more common in military personnel compared to police employees, driven by the higher proportion of harmful alcohol use. In military personnel, holding a lower rank, being in the Army, divorced or separated or a current smoker all increased the likelihood of probable PTSD. Interestingly, the risk of binge drinking was higher in the youngest military personnel but higher in older police employees. Higher educational attainment was protective against probable PTSD, harmful alcohol use and daily binge drinking in both samples. Likewise, military personnel with lower ranks were more likely to drink harmfully. But contrarily, this was true for police employees with higher, not lower, salaries.

6.5.2 Proportions of probable PTSD, harmful alcohol use and binge drinking

Whilst there was a borderline significantly lower proportion of PTSD among military personnel than police employees, the proportions were similar (3.67% vs 3.95%). Both estimates are lower than observed in the UK general population (4.4%, using the PCL-C) (McManus et al., 2016) and lower than the most recent figures from the full cohort from which the military sample was derived (6.2%) (Stevelink et al., 2018). However, the current sample included only serving regular military personnel

with the full military cohort showing higher proportions of probable PTSD in ex-serving and reserve personnel (Stevelink et al., 2018). Personnel with poor mental health are more likely to leave service and have poorer outcomes after leaving (Buckman et al., 2013; Iversen et al., 2005). We observed lower proportions of probable PTSD in police employees than other UK and international studies, as a recent study identified that 8% met criteria for PTSD (Brewin et al., 2020), and a systematic review estimated that 14% of police employees develop PTSD (Syed et al., 2020). However, these studies were based on occupational surveys, focussing on traumatic exposures, mental health and working conditions, which we have suggested causes a non-random bias from framing effects, increasing the reported prevalence of mental health disorders (Goodwin et al., 2013), whereas current data were obtained using a non-mental health focussed survey.

Our finding that the proportions of probable PTSD in both the Armed Forces and Police Forces were lower than those in the general population is of interest. This may be because both use stringent employment selection procedures and medical screening (Royal Navy, 2016; Violanti et al., 2017), which may lead to a more resilient workforce, otherwise known as the 'healthy worker effect' (Li & Sung, 1999). A recent review identified that the rates of PTSD among police officers were lower than for civilians who experienced similar traumatic events (Regehr et al., 2019), indicating that police employees may be more resilient, following trauma-exposure (Andrew et al., 2008). This could be because police employees and military personnel are trained to operate in traumatic situations, therefore trauma is an expected part of their role and experienced collectively, rather than individually as with civilians, with evidence showing that team and supervisory support is protective of mental health, in military personnel (Jones et al., 2012). Further, there may be selection bias as those who

experience poor mental health are more likely to leave service early (Buckman et al., 2013), or reporting bias as these occupational groups may underreport their symptoms due to stigma and barriers to care (Haugen et al., 2017; Sharp et al., 2015).

We found that the proportions of harmful alcohol use, and daily binge drinking, were three times greater in military personnel compared to police employees, with similarly increased proportions of comorbid PTSD and harmful alcohol use. Approximately 10% of military personnel met criteria for harmful alcohol use whereas only 3% of police employees did so, which is similar to males in the UK general population (NHS Digital, 2018a). The higher proportions of harmful drinking in military personnel may relate to coping motivations for drinking, hence the higher proportions of comorbid PTSD and harmful alcohol use. Recent findings showed that military personnel who drink to cope are more likely to drink harmfully and binge drink (Irizar et al., 2020). Alcohol use has historically been part of military culture, often used to create social bonds or to destress following deployment (Ames et al., 2007; Jones & Fear, 2011). In addition, 'dry periods' during operational deployment may make it more difficult to manage alcohol use upon return (Goodwin et al., 2017; Jacobson et al., 2008; Stevelink et al., 2018), though deployment can be protective against dependence. Military organisations are referred to as "greedy institutions", with extensive demands for commitment and dedication, leading to the development of a strong military identity and group cohesion, with traditions and rituals encouraging heavy drinking to increase social bonding within the unit (Hatch et al., 2013). Alcohol has also been seen as an integral part of police culture, through social ponding rituals or to cope with the stress of the job, as drinking with colleagues provides an opportunity for an informal debriefing of shared experiences (Abdollahi, 2002; Richmond et al., 1999; Violanti, 2004). However, it is possible that the drinking

culture has shifted in police employees, more so than military personnel, due to the "greedy" nature of the military institution.

6.5.3 *Factors associated with probable PTSD, harmful alcohol use and binge drinking*

There were sample differences in the factors associated with harmful drinking and binge drinking. Police employees with higher salaries (indicating higher rank) were more likely to drink harmfully, and contrarily, military personnel holding a lower rank were more likely to drink harmfully. Moreover, the youngest police employees were less likely to binge drink compared to the older age groups, but the youngest military personnel were more likely to binge drink (consistent with the UK general population (Kuntsche, Kuntsche, Thrul, & Gmel, 2017)). The pattern of harmful drinking in police employees is similar to that of the general population, which shows that alcohol use is decreasing in younger people but increasing in older people (Bardsley et al., 2018; Oldham et al., 2020). Younger military personnel are more likely than those over 50 to report social pressure motivations for drinking (Irizar et al., 2020) and may be more susceptible to military culture, which has historically facilitated risky drinking (Ames et al., 2007; Jones & Fear, 2011).

Smoking, which was more prevalent in military personnel than police employees (25% vs 10%), was only associated with probable PTSD in military personnel. Smoking was associated with harmful drinking and binge drinking in both samples, replicating findings from the full military cohort, though smoking rates have declined (Hooper et al., 2008; Thandi et al., 2015). In both samples, higher educational attainment was protective against all outcomes (PTSD, harmful drinking and binge drinking), in line with existing literature (Iversen et al., 2008; Jones, Bates, et al., 2015; Tang, Deng, Glik, Dong, & Zhang, 2017). In military personnel, holding a higher rank

and deployment were associated with a lower risk of PTSD, in congruence with previous findings from the first two phases of the cohort study, though deployment was associated with an increased risk of PTSD in the third phase of the cohort study (Stevelink et al., 2018), but this was more likely in reserves than regular serving personnel. The relationship between deployment and PTSD is complex and there are several interacting factors, such as whether personnel held a combat role and number of deployments (Jones et al., 2013; Sundin, Fear, Iversen, Rona, & Wessely, 2010).

6.5.4 Strengths and limitations

This study utilised two large samples with good response rates (above 50%). Using entropy balancing, we increased the comparability of the samples by balancing covariate distribution of variables known to be associated with the outcome variables across all participants, unlike methods such as propensity matching. Further, we were able to harmonise several variables which had variations, including the categorisation of alcohol consumption and daily binge drinking. Nevertheless, a previous study has shown that higher quantities of alcohol are reported in a weekly drinks diary, as used in our police sample, compared to quantity-frequency measures (e.g. AUDIT) as used in our military sample (Heeb & Gmel, 2005). However, our study included additional response options for our military sample to capture higher quantities (up to 30 drinks or more), preventing an upper limit on weekly drinks. Another caveat is that police employees only completed the TSQ if they experienced a traumatic stressor in the past 6 months, possibly missing participants with chronic or delayed onset PTSD (Utzon-Frank et al., 2014), and reducing the comparability with the military sample, where the timeframe of the PCL-C was not limited. In our pre-registered protocol, we stated that we would harmonise the measures of probable PTSD by selecting 10 items of the PCL-C which were most comparable to the TSQ, but due to different scoring approaches

we were unable to do this, and so the full PCL-C and TSQ were used for the military sample and police sample respectively, though both scales show similar prevalence estimates in the UK general population (McManus et al., 2016). However, there are currently no formal comparisons of the TSQ and PCL-C, other than comparing prevalence estimates, so the validity of this approach is unknown. Despite these incompatibilities, the samples were carefully matched, both manually (i.e., selecting male serving regulars only) and statistically (i.e., balancing covariates), to increase comparability.

6.6 Implications

The current emphasis on ensuring support is available for both the Armed Forces and Police Forces should continue, through 'active monitoring' for those who have been exposed to trauma and further help being accessible to those who need it (Greenberg, Megnin-Viggars, & Leach, 2019). Further, a brief screen for harmful alcohol use should be integrated with mental health support, as those who use alcohol to cope may experience further mental health decline (Strid et al., 2018), which is particularly important for military personnel, given the higher rates of harmful drinking and comorbid PTSD and harmful drinking.

6.7 Conclusions

We identified comparable proportions of probable PTSD in a covariate-balanced sample of male UK military personnel and police employees and much higher proportion of harmful alcohol use in military personnel, compared with police employees. The latter findings highlight a need for evidence-based interventions, such as brief alcohol screens, which are effective in civilian occupational settings (Hermansson, Helander, Brandt, Huss, & Rönnberg, 2010), in military occupational

settings, more so than other occupational groups. Low proportions of PTSD were observed in both samples, which could be indicative of protective effects of unit cohesion and resilient workforces. These factors should be explored further.

Chapter 7: A comparison of probable post-traumatic stress disorder and hazardous/harmful alcohol consumption among female members of the UK Police Service and UK Armed Forces.

Chapter 7 was submitted as a manuscript for peer review in European Journal of Psychotraumatology on 11th October 2021 (211865816).

7.1 Foreword

What is already known from the previous Chapters?

- The previous Chapter compared the level of probable PTSD and harmful alcohol use across covariate-balanced samples of male police employees and male military personnel. The level of probable PTSD was similar in military personnel and police employees (approximately 4%), but the level of harmful drinking was much greater in male military personnel compared to male police employees (10% vs 3%), as was the level of comorbidity.

- Women were not included in the analyses from the previous Chapter, as female members of both samples are relatively unique with regards to the type of role they can hold, and the proportion of females is higher in the police force (approximately 30%) than in the Armed Forces (approximately 10%). Therefore, it was decided that women would be analysed separately from men.

What does the current Chapter aim to do?

- This Chapter aimed to directly compare the level of hazardous/harmful alcohol use and probable PTSD across a sample of female police employees and a sample of female military personnel. Due to small numbers, this Chapter was

unable to explore the sociodemographic and occupational associations with the outcomes.

- Multinomial and logistic regression analyses were conducted to determine sample differences in the levels of hazardous/harmful alcohol use and probable PTSD, using data from the Airwave Health Monitoring Study (police sample) and the Health and Wellbeing Cohort Study (military sample).

What new findings does this Chapter add?

- The level of probable PTSD was similar in female military personnel and female police employees (approximately 4%), as with the analysis of males. There was no significant difference in the level of hazardous drinking between military personnel and police employees (16% vs 19%).
- Female military personnel showed significantly higher levels of harmful drinking than female police employees (5% vs 3%), as well as higher levels of comorbid PTSD and hazardous/harmful drinking (2% vs 1%).
- These findings remained significant after controlling for marital status, smoking status, age, education, year of data collection.

7.2 Introduction

The Police and Armed Forces are occupations characterised by frequent trauma exposure, intensive demands, comprising mostly of men. Women constitute approximately 40% of the United Kingdom (UK) Police Service (30% of police officers and 60% of police staff) (Home Office, 2019), whereas only 10% of the UK Armed Forces are women (Ministry of Defence, 2020). Female police employees and military personnel may have unique experiences and face additional strains to their male counterparts, such as being a minority group, failed belongingness and lack of

peer support (Jones & Hanley, 2017; Jones, Jones, et al., 2020). Moreover, mental health problems are more common in women in the general population, than in men (McManus et al., 2016).

Historically, alcohol has been used by both occupational groups to enhance unit cohesion or to relieve stress (Abdollahi, 2002; Jones & Fear, 2011). This could relate to the machismo culture encouraging heavy drinking to increase bonding, regardless of gender (Wells et al., 2014; Zamboanga, Audley, Iwamoto, Martin, & Tomaso, 2017). Compared to the UK general population, both men and women in the UK Armed Forces show higher rates of hazardous and harmful drinking (Fear et al., 2007), though lower levels are observed in women (compared to men) in the general population and the military (Fear et al., 2007; Jones, Jones, et al., 2020). For UK police employees (sworn officers and non-sworn staff), data from the Airwave Health Monitoring Study showed that 40% of men and 19% of women met criteria for hazardous or harmful drinking (Irizar, Gage, Fallon, Field, & Goodwin, 2021), with separate data for the UK general population finding that 24% of men and 11% of women met the same criteria (not a direct comparison) (NHS Digital, 2018a).

In the UK, military women have previously been restricted in their roles, with all combat roles only becoming open to women within recent years (since the data for the current analysis was collected) (Jones, Jones, et al., 2020). Nevertheless, military women are still exposed to trauma, for example, through participating in combat-support operations and serving as combat medics (Maguen et al., 2012). Police women are not limited in the roles they can obtain, though a larger proportion of women (approx. 60%) are non-sworn police staff (e.g., administration, response call operators, intelligence analysts) than sworn police officers (approx. 30%) (Home Office, 2019). Of the limited literature available, police women are more likely to report physical

strains than men, but show no difference in the level of poor mental health (Gächter, Savage, & Torgler, 2011).

Post-traumatic stress disorder (PTSD) is characterised by intrusive thoughts, increased arousal, and avoidance of reminders, following a traumatic experience (American Psychiatric Association, 2013). Both occupations are frequently exposed to trauma, increasing the risk of PTSD. Hazardous or harmful alcohol use often co-occur with PTSD (Debell et al., 2014a), as alcohol is used, through avoidance coping, to relieve negative affective states resulting from symptoms (Khantzian, 1997). Recent statistics from the UK adult general population (including those economically inactive) show that those with probable PTSD have three times greater odds of reporting hazardous or harmful alcohol use, compared to those without PTSD (Puddephatt et al., 2020). However, there is a lack of research into PTSD and hazardous/harmful drinking, and their comorbidity, in female members of the UK Police Service and Armed Forces, and there are no direct comparisons of women in these occupations.

This study aims to compare the levels of (i) probable PTSD, (ii) hazardous and harmful alcohol use, and (iii) comorbid PTSD and hazardous/harmful alcohol use, in a sample of female military personnel and a sample of female police employees. To increase comparability across the samples, this study will explore the impact of a statistical reweighting method, which balances the samples on pre-specified covariates (i.e., year of data collection, age, educational attainment), compared to regression adjustments of the same covariates.

7.3 Methods

7.3.1 Study samples and data collection

7.3.1.1 Airwave Health Monitoring Study

Data for the police sample were obtained from the Airwave Health Monitoring Study, which is a cohort study of UK police officers and staff, originally designed to determine the long-term health impact of Terrestrial Trunked Radio (TETRA) usage, but obtaining data on a range of additional demographic, occupational, physical/mental health, and lifestyle variables. The study procedure has been described in detail in previous publications (Elliott et al., 2014; Irizar, Gage, et al., 2021).

Cross-sectional data were collected via an enrolment questionnaire and a health screen, conducted by trained nurses (June 2006-March 2015) from 41,038 police employees from 28 participating police forces across the UK (England, Scotland, Wales). Males were excluded from the current analysis as these findings have been reported separately (Irizar, Stevelink, et al., 2021), as were those who completed the survey in 2006, as they were not administered the Trauma Screening Questionnaire (TSQ) (Figure 7.1). The final sample included 14,145 female police employees.

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│    Full KCMHR Dataset    │
│      (n = 15,736)        │
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│  Drop those who completed│                    │   Full Airwave Dataset   │
│    phase 1 data only     │                    │      (n = 41,038)        │
│      (n = 3,078)         │                    └─────────────────────────┘
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             │                                               ▼
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┌─────────────────────────┐                    │  Drop if role is "other" │
│       Drop males         │                    │        (n = 739)         │
│      (n = 11,112)        │                    └─────────────────────────┘
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             ▼                                  ┌─────────────────────────┐
┌─────────────────────────┐                    │       Drop males         │
│  Drop if were not a      │                    │      (n = 25,399)        │
│  serving regular in      │                    └─────────────────────────┘
│  either phase 2 or       │                                 │
│  phase 3 (n = 597)       │                                 ▼
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             │                                  │ Drop those who completed │
             ▼                                  │    survey in 2006        │
┌─────────────────────────┐                    │    (n = 755) b           │
│ Drop short questionnaire │                    └─────────────────────────┘
│      (n = 21)            │
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Phase 2 / Phase 3

Only completed phase 2 data (n = 318)

Completed both phases but were only serving regular in phase 3 (n = 9)

Data collected between January 2007 to June 2011

Data collected between July 2011 and December 2015

Completed both phases but were only serving regular in phase 2 (n = 148)

Serving regular in both phase 2 and phase 3 (n = 224)

'Phase 2' N = 8,782

'Phase 3' N = 5,363

Phase 2 N = 466

Only completed phase 3 (n = 229)

Phase 3 N = 462

[a] Participants with data for both phases were included in phase 3 to create a more equal distribution, which reflects the distribution of the Airwave data.

[b] Participants who completed the survey in 2006 were not asked the PTSD items and the phase 1 KCMHR data were dropped as this was the same timeframe.

Figure 7.1. Flow diagram showing the allocation of participants to one category of the binary variable, 'year of data collection'. Military personnel were allocated to either phase 2 or phase 3. Police employees were allocated to a category which reflected the data collection period from phase 2 or phase 3.

7.3.1.2 Health and Wellbeing Cohort Study

Data for the military sample were selected from the Health and Wellbeing of UK Armed Forces cohort study, which was established in 2003 to determine the physical and mental health impact of deployment to Iraq (phase 1) (Hotopf et al., 2006), then Afghanistan (phase 2) (Fear et al., 2010), and since to explore the long-term impact of deployment (phase 3) (Stevelink et al., 2018). Data from all three phases were collected via a self-administered questionnaire which was available in hard copy (and an electronic version for phase 3) (Fear et al., 2010; Hotopf et al., 2006; Stevelink et al., 2018). The questionnaire collected data on the following factors: sociodemographic, service information, experiences during/transitioning from deployment, physical/mental health and lifestyle.

Phase 1 collected data from a random stratified sample of 10,272 personnel (59% response rate; June 2004-March 2006) (Hotopf et al., 2006), but participants with only phase 1 data were excluded from this analysis, to increase comparability with the police sample, which did not collect data before 2006. Phase 2 followed up participants who completed phase 1 (November 2007-September 2009), and obtained data from two additional samples, including a random sample of personnel who had deployed to Afghanistan between April 2006 and April 2007, and a replenishment sample to include personnel who had joined since 2004 (N = 9,990, 56% response rate). Phase 3 (October 2014-December 2016) collected data from participants who consented to further contact in phases 1 and 2 and from a replenishment sample of new recruits (joined after June 2009), with a final sample size of 8,093 personnel (58% response rate) (Stevelink et al., 2018).

All phases recruited regular and reservist personnel and those who were still serving and who had left service. To increase comparability with the police sample (which

included only serving police employees), only serving regular personnel were included in this analysis. Males were excluded, as were those who completed only phase 1 and who completed the short questionnaire, leaving a total of 928 female military personnel (Figure 7.1).

7.3.2 Measures

7.3.2.1 Demographic, occupational and health variables

Both samples had comparable data on the following demographic and health variables: age (<30, 30 to 39, ≥40), marital status (married/cohabiting, divorced/separated, single), educational attainment (GSCE/O levels or below, Vocational/A levels or higher), and smoking status. For marital status, police employees had an additional option of "other", which was re-coded as missing, due to a lack of information on what this included, meaning it could not be compared with the military sample. Data on police role (police staff, police constable/sergeant, inspector or above) were available from the police sample, and military rank (other, non-commissioned officer, commissioned officer) from the military sample.

7.3.2.2 Post-traumatic Stress Disorder (PTSD)

For police employees, probable PTSD was measured using the 10-item Trauma Screen Questionnaire (TSQ) (Brewin et al., 2002), whereby responses were provided on a five-point scale ranging from 'not at all' (scored as 0) to 'extremely' (all other responses coded as 1), with total scores of 6 or more being indicative of probable PTSD (range 0 to 10). The TSQ had excellent internal reliability (McDonald's omega ω = 0.99) and criterion validity (sensitivity 0.86, specificity 0.93, Brewin et al., 2002). However, participants were only asked the PTSD items if they responded 'yes' to being bothered by a disturbing incident which occurred in the past 6 months.

For military personnel, probable PTSD was measured using the 17-item PTSD Checklist – civilian version (PCL-C) (Blanchard et al., 1996), with response options provided on a five-point scale ranging from 'not at all' to 'extremely'. The PCL-C had good internal reliability ($\omega = 0.97$). Scores of 50 or more indicate probable PTSD (range 17 – 85), with a sensitivity of 0.82 and specificity of 0.86 (Blanchard et al., 1996). Though not directly comparable, the PCL-C and TSQ show similar prevalence estimates for PTSD in the general population (McManus et al., 2016).

7.3.2.3 Alcohol consumption

In both samples, participants were asked if they currently drink alcohol, with those responding 'no' being categorised as 'non-drinkers'. For police employees, hazardous and harmful alcohol consumption was measured using a past week's drinks diary, i.e., the total number of drinks from the following options: white wine, red wine, fortified wine, spirits, beer/cider. This was converted to units and categorised into hazardous use (>14 to 35 units) and harmful use (>35 units), based on the UK Chief Medical Officer's guidelines for low-risk drinking (0 to 14 units) and the NICE guidelines for hazardous (referred to as 'increasing risk') and harmful drinking (referred to as 'high risk') specifically for females (Department of Health and Social Care, 2016; NICE, 2014).

The full 10-item Alcohol Use Disorder Identification Test (AUDIT) (Saunders et al., 1993) was administered in the military sample. To increase comparability, only two items were used (frequency of consumption and typical units on a drinking day) to estimate average weekly units, by multiplying frequency (conservative estimate) with the midpoint for typical units (e.g., frequency of two or three times a week = 2, typical units of 3 or 4 drinks = 3.5, would equate to 7 weekly units) (Irizar, Stevelink, et al., 2021). Responses to 'typical units' are usually on a five-point scale, up to 10 or

more drinks, but additional options were available (up to 30 or more). Hazardous and harmful alcohol consumption was categorised using the same cut-offs as the police sample.

7.3.3 Statistical analysis

7.3.3.1 Estimating sample differences

All analyses were conducted in STATA SE 15 (StataCorp., 2017). Descriptive statistics, i.e., frequencies and proportions, with 95% confidence intervals (CIs), were obtained for the demographic, occupational, and health variables, and for the outcome variables (probable PTSD, categories of alcohol consumption, comorbidity).

Logistic regressions were used to estimate sample differences in probable PTSD (non-case PTSD as reference group). Multinomial logistic regressions were used to estimate differences in the categories of alcohol consumption (non-drinkers, hazardous, harmful, with low risk as reference group), and to estimate differences in comorbid PTSD and hazardous/harmful alcohol use (presence of neither as reference group). Analyses were adjusted for pre-determined covariates (Irizar, Stevelink, et al., 2021) which may affect the outcomes, in steps, first adjusting for year of data collection, age, and educational attainment, then also for marital status and smoking status. The police sample was the reference group as it was the larger sample. Unadjusted and adjusted odds ratios (OR) and multinomial odds ratios (MOR), with 95% CIs are reported.

7.3.3.2 Entropy balancing

Sensitivity analyses explored the impact of entropy balancing and determined whether the estimates from the entropy balanced analyses differed to the regression analyses adjusting for covariates. Entropy balancing is a multivariate reweighting

method which creates a weight value for participants in the larger sample to be more comparable to the smaller sample on a range of pre-determined covariates (year of data collection, age, and educational attainment - the second step of adjustments from the previous analyses) (Hainmueller, 2012). A binary variable was created for year of data collection, to reflect phase 2 (January 2007-June 2011 in the police sample) and phase 3 (July 2011-December 2016 in the police sample) of the military sample. Age was categorised into '<30 years old', '30 to 39 years old', and '≥40 years old', as there were few female military personnel above 40 years old. Educational attainment was categorised as low (GCSEs/equivalent or below) and high (A levels/equivalent or higher). Entropy balancing was conducted in STATA SE 15 using the *ebalance* command (Hainmueller & Xu, 2013). The regressions estimating sample differences were repeated, now applying the entropy balancing weights, and adjusting for marital status and smoking status.

7.3.4 Ethics

All participants provided written informed consent. The Airwave Health Monitoring Study received ethical approval from the National Health Service multi-site research ethics committee (MREC/13/NW/0588). The Health and Wellbeing Cohort Study Ethical obtained ethical approval for each phase of from both the UK Ministry of Defence Research Ethics Committee and the local Ethics Committee at King's College London.

7.4 Results

7.4.1 Sample characteristics

The sample characteristics are shown in Table 7.1. The study sample included 14,145 female police employees and 928 female military personnel (total N = 15,073).

There were large differences in the age distribution between the samples, with 47.20% of the police sample being over 40 years old compared with 14.12% of the military sample. Approximately 70% of both samples were married or cohabiting. Around two thirds of both samples reported high educational attainment. There were more current smokers in the military sample (16.85%), than the police sample (11.24%).

Table 7.1. Demographic (age, marital status, education), occupational (role, rank) and health (smoking status) characteristics from police (N = 14,145) and military personnel (N = 928).

Characteristic	Total	*Police* N	%	95% CI	Total	*Military* N	%	95% CI
Age (years)	14,145				928			
< 30		2,479	17.53	16.91 to 18.16		447	48.17	44.96 to 51.39
30 to 39		4,989	35.27	34.49 to 36.06		350	37.72	34.65 to 40.89
≥ 40		6,677	47.20	46.38 to 48.03		131	14.12	12.02 to 16.51
Marital status	13,582				918			
Married/Cohabiting		9,519	70.09	69.31 to 70.85		631	68.74	65.66 to 71.66
Divorced/Separated		2,625	19.33	18.67 to 20.20		229	24.95	22.25 to 27.85
Single		1,438	10.59	10.08 to 11.12		58	6.32	4.91 to 8.09
Education	14,063				910			
Low (GSCE/O level or below)		4,257	30.27	29.52 to 31.04		330	36.26	33.20 to 39.45
High (Vocational/A levels or higher)		9,806	69.73	68.96 to 70.48		580	63.74	60.55 to 68.80
Smoking status	14,134				920			
Non-smoker		12,546	88.76	88.23 to 89.27		765	83.15	80.59 to 85.44
Current smoker		1,588	11.24	10.73 to 11.77		155	16.85	14.56 to 19.41
Role (police only)	12,663							
Police staff		6,156	48.61	47.74 to 49.49		-	-	-
Police constable/sergeant		6,079	48.01	47.14 to 48.88		-	-	-
Inspector or above		428	3.38	3.08 to 3.71		-	-	-
Rank (military only)					928			
Other		-	-	-		205	22.09	19.53 to 24.88
Non-commissioned officer		-	-	-		471	50.75	47.53 to 54.97
Commissioned officer		-	-	-		252	27.16	24.39 to 30.11

7.4.2 Sample differences in probable PTSD and alcohol consumption

A total of 3.74% of police employees met criteria for probable PTSD, compared with 4.47% of military personnel, and the difference was not statistically significant (Table 7.2). Female military personnel were significantly more likely to meet criteria for harmful alcohol consumption (4.71%) than female police employees (2.42%), remaining statistically significant after all adjustments (Adjusted Odds Ratio [AOR] = 2.26, 95% Confidence Intervals [CIs] = 1.60 to 3.21). However, military personnel were significantly less likely to be non-drinkers (7.45%) than police employees (11.88%), which remained significant after adjustments (AOR = 0.53, 95% CI = 0.41 to 0.70). Before adjustments, hazardous drinking was significantly lower in military personnel (16.32%) than police employees (19.20%), but this attenuated after adjustments.

Due to small numbers, hazardous and harmful alcohol consumption were combined when estimating sample differences in comorbidity. Of those reporting hazardous/harmful alcohol use, 4.63% (N = 140) of female police employees and 8.85% (N = 17) of female military personnel also met criteria for probable PTSD. Of those meeting criteria for probable PTSD, 26.62% (N = 140) of police employees and 42.50% (N = 17) of military personnel also reported hazardous/harmful alcohol use. A four-category variable was created to examine sample differences in comorbid PTSD and hazardous/harmful alcohol (versus meeting criteria for neither). Before and after adjustments, military personnel were significantly more likely to meet criteria for comorbidity (1.87%) than police employees (1.00%; AOR = 2.07, 95% CI = 1.21 to 3.54).

Table 7.2. Logistic and multinomial logistic regressions showing the differences in PTSD, categories of alcohol consumption, and comorbidity, among police and military personnel. The police sample is the reference group.

Outcome variable	Police N (%)	Military N (%)	OR (95% CI)	AOR (95% CI) [a]	AOR (95% CI) [b]
PTSD					
Non-case	13,532 (96.26)	876 (95.53)	1.00	1.00	1.00
Case	526 (3.74)	41 (4.47)	1.20 (0.87 to 1.67)	1.30 (0.93 to 1.82)	1.29 (0.92 to 1.81)
			N = 14,975	*N = 14,946*	*N = 14,448*
Alcohol use (UK government guidelines for women)					
Non-drinker	1,666 (11.88)	68 (7.45)	0.58 (0.45 to 0.75)***	0.53 (0.41 to 0.70)***	0.53 (0.41 to 0.70)***
Low risk (0 to 14 units)	9,329 (66.50)	653 (71.52)	1.00	1.00	1.00
Hazardous (15 to 35 units)	2,694 (19.20)	149 (16.32)	0.79 (0.66 to 0.95)*	0.90 (0.74 to 1.09)	0.90 (0.74 to 1.09)
Harmful (above 35 units)	339 (2.42)	43 (4.71)	1.81 (1.31 to 2.51)***	2.30 (1.63 to 3.25)***	2.26 (1.60 to 3.21)***
			N = 14,941	*N = 14,877*	*N = 14,382*
Comorbidity					
PTSD non-case <u>and</u> non-case hazardous/harmful alcohol use	10,571 (75.60)	693 (76.32)	1.00	1.00	1.00
PTSD case <u>only</u>	386 (2.76)	23 (2.53)	0.91 (0.59 to 1.39)	1.00 (0.65 to 1.56)	1.01 (0.65 to 1.57)
Hazardous/harmful alcohol use <u>only</u>	2,886 (20.64)	175 (19.27)	0.92 (0.78 to 1.10)	1.08 (0.91 to 1.29)	1.08 (0.90 to 1.29)
PTSD case <u>and</u> hazardous/harmful alcohol use	140 (1.00)	17 (1.87)	1.85 (1.11 to 3.08)*	2.12 (1.24 to 3.62)**	2.07 (1.21 to 3.54)**
			N = 14,891	*N = 14,863*	*N = 14,368*

***p<.001, **p<.01, *p<.05.

[a] Adjusted for age, education, and year of data collection.

[b] Adjusted for marital status and smoking status.

7.4.3 Sensitivity analyses using entropy balancing weights

Table 7.3 shows the sample characteristics of female police employees before and after the entropy balancing weights were applied. The entropy balancing gave more weight to police employees aged under 30 and less weight to those aged over 40, reflecting the age composition of females in the military sample. The reweighting also resulted in more weight given to police employees who were divorced or separated, a small increase in current smokers, and a small decrease in higher ranking police employees (inspector or above).

Table 7.3. Demographic (age, marital status, education), occupational (role) and health (smoking status) for female police employees before and after entropy balancing (reweighted based year of data collection, age and educational attainment) (N = 14,145).

Characteristic	Police (representative estimates)			Police (entropy balanced)	
	N	%	95% CI	%	95% CI
Age (years)					
< 30	2,479	17.53	16.91 to 18.16	50.79	49.48 to 52.10
30 to 39	4,989	35.27	34.49 to 36.06	33.12	32.05 to 34.21
≥ 40	6,677	47.20	46.38 to 48.03	16.08	15.52 to 16.67
Marital status					
Married/Cohabiting	9,519	70.09	69.31 to 70.85	67.31	66.02 to 68.58
Divorced/Separated	2,625	19.33	18.67 to 20.20	26.41	25.18 to 27.67
Single	1,438	10.59	10.08 to 11.12	6.28	5.78 to 6.81
Education					
Low (GSCE/O level or below)	4,257	30.27	29.52 to 31.04	36.26	34.91 to 37.64
High (Vocational/A levels or higher)	9,806	69.73	68.96 to 70.48	63.74	62.36 to 65.09
Smoking status					
Non-smoker	12,546	88.76	88.23 to 89.27	86.55	85.55 to 87.49
Current smoker	1,588	11.24	10.73 to 11.77	13.45	12.51 to 14.45
Role (police only)					
Police staff	6,156	48.61	47.74 to 49.49	45.37	43.99 to 46.75
Police constable/sergeants	6,079	48.01	47.14 to 48.88	53.19	51.81 to 54.57
Inspector or above	428	3.38	3.08 to 3.71	1.44	1.26 to 1.64

The results of the sensitivity analyses are presented in Table 7.4. The entropy balancing marginally reduced the proportion of police employees meeting criteria for probable PTSD and harmful alcohol use, which may indicate reduced likelihood of these outcomes in younger female police employees (as more weight is given to younger participants). After applying the entropy balancing and adjusting for marital status and smoking status, the significant differences and effect sizes (odds ratios) remained similar, showing no difference in the level of probable PTSD but higher levels of harmful alcohol use and comorbid PTSD and hazardous/harmful alcohol use in military personnel compared to police employees.

Table 7.4. Sensitivity analyses, reweighting the police sample using entropy balancing. Logistic and multinomial regression analyses showing the differences in PTSD, categories of alcohol consumption, and comorbidity, among police and military personnel. The police sample is the reference group.

Outcome variable	Police N (%)	Military N (%)	OR (95% CI)	AOR (95% CI) [a][b]
PTSD				
Non-case	13,532 (96.64)	876 (95.53)	1.00	1.00
Case	526 (3.36)	41 (4.47)	1.37 (0.98 to 1.93)	1.34 (0.95 to 1.89)
			N = 14,946	N = 14,448
Alcohol use (UK government guidelines for women)				
Non-drinker	1,666 (12.61)	68 (7.45)	0.54 (0.41 to 0.71)***	0.54 (0.41 to 0.71)***
Low risk (0 to 14 units)	9,329 (68.45)	653 (71.52)	1.00	1.00
Hazardous (15 to 35 units)	2,694 (17.07)	149 (16.32)	0.91 (0.75 to 1.11)	0.92 (0.75 to 1.11)
Harmful (above 35 units)	339 (1.88)	43 (4.71)	2.44 (1.71 to 3.48)***	2.37 (1.65 to 3.42)***
			N = 14,877	N = 14,382
Comorbidity				
PTSD non-case <u>and</u> non-case hazardous/harmful alcohol use	10,571 (78.56)	693 (76.32)	1.00	1.00
PTSD case <u>only</u>	386 (2.49)	23 (2.53)	1.07 (0.68 to 1.67)	1.05 (0.67 to 1.64)
Hazardous/harmful alcohol use <u>only</u>	2,886 (18.07)	175 (19.27)	1.10 (0.92 to 1.32)	1.09 (0.91 to 1.31)
PTSD case <u>and</u> hazardous/harmful alcohol use case	140 (0.88)	17 (1.87)	2.22 (1.29 to 3.83)**	2.14 (1.24 to 3.71)**
			N = 14,863	N = 14,368

***p<.001, **p<.01, *p<.05. Percentages are weighted with entropy balancing (year of data collection, age and educational attainment).

[a] Age, education were not adjusted for as these variables were used in the entropy balancing.

[b] Adjusted for marital status and smoking status.

7.5 Discussion

7.5.1 Key findings

This was the first study to directly compare the level of probable PTSD, hazardous and harmful alcohol consumption, and their comorbidity, between female military personnel and police employees. The level of probable PTSD was comparable across the samples, as was the level of hazardous drinking. However, female military personnel were more likely to meet criteria for harmful alcohol use and less likely to be non-drinkers, than female police employees. Military women also showed higher levels of comorbid PTSD and hazardous/harmful alcohol use, though the levels were small in both samples and most likely driven by the higher levels of harmful alcohol use in military women. To increase confidence in the findings, as there were large demographic differences between the samples, this study compared two statistical techniques to control for the same pre-specified covariates (regression adjustment and entropy balancing), finding that covariate adjustment had the same impact as entropy balancing on the level of association and effect sizes.

7.5.2 Sample differences

The comparable levels of probable PTSD in female military personnel and police employees is harmonious with the findings from our analysis of male military personnel and police employees (approximately 4% for men and women in both occupational groups) (Irizar, Stevelink, et al., 2021). This is consistent with previous evidence, whereby female gender is a risk factor for PTSD in general population samples, but studies of police and military samples often show no difference between genders (Brewin, Andrews, & Valentine, 2000). The levels of PTSD are slightly lower than observed in women in the general population (5.1%), especially women aged 16

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to 24 years old, who show much higher levels of PTSD (12.6%) (McManus et al., 2016). Almost half of the military sample were under 30 years old, whereas almost half of the police sample were over 40 years old, suggesting lower levels of probable PTSD in young military women compared to young women in the general population. However, a direct comparison with data from the general population, controlling for age, is needed.

Given the high levels of trauma exposure in these occupational groups, higher levels of PTSD may have been expected. Nevertheless, this is in line with previous literature, showing reduced PTSD symptom severity in police employees, compared to civilians, following a traumatic incident (Kerswell, Strodl, Johnson, & Konstantinou, 2020). The relatively low levels of PTSD across both men and women in these occupations could reflect protective effects of leadership, training, and support (Jones et al., 2012). Another explanation may be the healthy worker effect (Li & Sung, 1999), as longitudinal evidence shows higher levels of mental health problems in military personnel who have left service, compared to those still in service (Stevelink et al., 2018). Those with poorer mental health may leave service (Iversen et al., 2005), or alternatively, ex-serving personnel may have reduced access to support and services or experience difficulties transitioning to civilian life (Oster, Morello, Venning, Redpath, & Lawn, 2017). When focussing on women in these occupations, the low levels of PTSD could be related to protective characteristics of women who enter male-dominated environments, such as self-assertion, toughness, and resilience (Froehlich, Olsson, Dorrough, & Martiny, 2020). Future research should also monitor police employees' mental health after they leave service to determine whether additional support is needed.

As with the analysis of males, the present study also identified higher rates of harmful drinking, and comorbidity, in female military personnel, compared to female police employees (Irizar, Stevelink, et al., 2021). The levels of harmful drinking observed in male and female police employees (approximately 3% for both) are similar to general population estimates (4% of men and 3% of women, using the same criteria) (NHS Digital, 2018a), but are higher in both military men (10%) and women (5%), in line with an existing direct comparison (Fear et al., 2007). The higher levels of harmful drinking in military women may relate to the male-dominated drinking culture being more prominent in the Armed Forces than the Police Service, as settings which facilitate drinking are still available in the military (e.g. messes) but no longer exist for police employees (e.g. removal of police bars) (Abdollahi, 2002; Jones & Fear, 2011). Although the proportion of those meeting criteria for both conditions was low in the whole population, a large proportion of those with probable PTSD were drinking at hazardous/harmful levels (43% of military personnel, 27% of police employees), suggesting that women in both occupational groups may be using alcohol to cope. Alternatively women may show high-levels of help-seeking and receive adequate support if needed (Stevelink, Jones, Jones, Dyball, Khera, Pernet, MacCrimmon, Murphy, Hull, & Greenberg, 2019).

7.5.3 Strengths and limitations

This study utilised large samples of female military personnel and police employees, with good response rates (above 50%). Given that both occupations are male-dominated, women are often underrepresented when researching these occupations. This study is the first to directly compare the levels of probable PTSD and hazardous/harmful alcohol use in female military personnel and police employees, and separately from men. By taking a robust approach to increase comparability, first

adjusting for covariates in regression models and then applying weights to balance the samples on the same covariates, we have provided robust estimates of sample differences. However, there are several limitations. Due to the smaller sample size and small number of female military personnel meeting criteria for probable PTSD and harmful drinking, we were not able to explore the demographic associations with these outcomes, as with the analysis of males (Irizar, Stevelink, et al., 2021). Further, though we were able to harmonise the measures of probable PTSD and alcohol consumption, they were not directly comparable. For example, the PCL-C was used in the military sample and the TSQ was used in the police sample (though both questionnaires show similar estimates in the general population (McManus et al., 2016)), with the latter being limited to participants who had been bothered by a traumatic incident in the six months prior.

7.6 Implications

Previous research has shown that unit cohesion and good leadership are protective against probable PTSD in military research (Jones et al., 2012), and future research should explore whether similar factors are protective in police employees and other high-risk occupations. The higher levels of harmful alcohol use observed in military women supports existing evidence and emphasises the need for alcohol-reduction interventions, such as digital apps which are currently being trialled (Leightley et al., 2018), tailored specifically for military personnel of both genders.

7.7 Conclusions

This study identified comparable levels of probable PTSD in female military personnel and police employees, which are slightly lower than estimates in the female

general population, but higher levels of harmful alcohol use were observed in military women compared to policewomen; reasons for this should be explored.

Chapter 8: A latent class analysis of health (risk) behaviours in the UK Police Service and associations with mental health and job strain.

Chapter 8 was submitted as a manuscript for peer review in the Journal of Affective Disorders on 5th August 2021 (JAFD-D-21-02802).

8.1 Foreword

What is already known from the previous Chapters?

- This Chapter was informed by the findings from Chapter 5.

- Chapter 5 determined the prevalence of hazardous (33%) and harmful (3%) drinking in a representative sample of UK police employees. Compared to those without a mental health problem, police employees with probable depression, anxiety, or PTSD were more likely to be harmful drinkers and more likely to report abstinence. Low job strain (versus high job strain) was associated with increased odds of hazardous drinking.

What does the current Chapter aim to do?

- Health risk behaviours, such as hazardous/harmful alcohol use and smoking, often cluster together. Therefore, this Chapter aimed to explore the classes of health (risk) behaviours, and associations with mental health and job strain, in the same sample of police employees.

- Latent Class Analysis (LCA) was used to identify classes of health (risk) behaviours (alcohol use, fruit and vegetable consumption, red meat consumption, smoking status, physical activity), in male and female police employees separately, using data from the Airwave Health Monitoring Study.

Multinomial logistic regressions analysed their associations with mental health and job strain. Exploratory analyses determined the sociodemographic and occupational associations with the identified classes.

What new findings does this Chapter add?

- A 5-class solution was the best fit for both genders, with a class representing "high health risk behaviours", a class representing the "healthiest", and the remaining classes reflecting a mixture of health (risk) behaviours, for both genders.

- For men and women, probable depression, anxiety, or PTSD was associated with at least double the odds of being assigned to the "high health risk behaviours" class. Men and women with probable depression were more likely to be in the "healthy abstainers" class (as were men with probable anxiety or PTSD). For both genders, those reporting high strain had increased odds of being assigned to the "low risk drinkers with other health risk behaviours" class.

- Male and female police employees in the "high health risk behaviours" class were characterised by older age, lower educational attainment, having served longer in the Police Service, and having several days of sickness absence. Those in the "low risk drinkers but other health risk behaviours" class were characterised by younger age and having served for fewer than five years.

8.2 Introduction

Health behaviours are actions to maintain, attain or regain good health, such as exercising regularly and eating a balanced diet (Cockerham, 2014). Contrarily, health risk behaviours, such as heavy drinking and smoking (World Health Organization,

2009), are major causes of chronic disease and premature mortality (World Health Organization, 2008). Whilst health risk behaviours are often researched separately, evidence suggests they co-occur (McAloney et al., 2013; Meader et al., 2016; Schuit et al., 2002), particularly heavy drinking and smoking (Noble et al., 2015). However, not all health risk behaviours cluster together. Certain sociodemographic characteristics are related to clustered health risk behaviours, such as male gender (Kritsotakis et al., 2016; Noble et al., 2015) and older age (Birch et al., 2019). Further, clusters of health risk behaviours have associations with mental health problems (Conry et al., 2011; Vermeulen-Smit et al., 2015). One study showed that men and women with depression had double the odds of being assigned to one of the three health risk behaviour clusters, than the healthiest cluster (Vermeulen-Smit et al., 2015). Additional research identified that individuals reporting more frequent mental distress were more likely to experience clustered poor diet, insufficient physical activity and poor sleep (Oftedal et al., 2019).

Work stressors impact health behaviours and mental health (Jones et al., 2006; Payne et al., 2012), with evidence suggesting that high job strain (high demands, low control) is linked to heavy drinking and smoking (Lallukka et al., 2008; Lallukka et al., 2004), and poor mental health (Karasek Jr, 1979). High strain could be linked to health risk behaviours through maladaptive coping, but conversely, there is evidence that health behaviours, such as keeping active, can be used as a form of proactive coping (though over-exercising can be problematic) (Aspinwall and Taylor, 1997; Carver et al., 1989). Certain occupations are characterised by stressors (e.g., intensive demands, lack of control) which negatively impact mental health, such as policing (Gershon et al., 2009; Papazoglou and Andersen, 2014; Sterud et al., 2007), which could have associations with health risk behaviours. For example, one third of United

Kingdom (UK) police employees met criteria for hazardous or harmful drinking, and those with a mental health problem were twice as likely to drink harmfully (Irizar et al., 2021). Contradicting previous evidence, police employees reporting high strain were less likely to drink hazardously than those with low strain (Irizar et al., 2021), which may reflect proactive coping. These findings highlight the importance of understanding how health (risk) behaviours cluster in those working in stressful occupations, and to determine the characteristics of those more likely to engage in multiple health risk behaviours.

No existing research has determined clusters of health (risk) behaviours in police employees. Latent Class Analysis (LCA) is a statistical technique used to identify distinct classes based on responses to multiple variables and has previously been used to determine classes of health (risk) behaviours in adolescents (Laska et al., 2009), older adults (Liao et al., 2019) and the UK general population (Mawditt et al., 2016). This study aims to utilise LCA to identify classes of health (risk) behaviours (alcohol use, fruit and vegetable intake, red meat consumption, smoking, physical activity) in UK police employees (in men and women separately), and to determine their associations with mental health (depression, anxiety, PTSD) and job strain (high, low, active, passive). The sociodemographic and occupational associations with the identified classes will be explored, to determine the characteristics of each class and the covariates to be included in the main analyses. This study has been pre-registered with Open Science Framework https://osf.io/4j7mx.

8.3 Methods

8.3.1 Study Sample

The study sample was obtained from the Airwave Health Monitoring Study (Elliott et al., 2014). Data were collected through an enrolment questionnaire sent from administration or occupational health services and through health screens conducted by trained nurses. Data was collected between June 2006 and March 2015 from 28 participating forces (out of 54), with the current sample including 40,986 police officers and staff (response rate averaged 50% across participating forces). The sample was representative of the UK Police Service in terms of gender and ethnic composition (Allen and Audickas, 2020). A detailed design and protocol for the Airwave Health Monitoring Study is available elsewhere (Elliott et al., 2014).

8.3.2 Measures of health (risk) behaviours

8.3.2.1 Alcohol use

Two measures of alcohol use were included: categorisation of alcohol consumption (non-drinkers, low risk, hazardous, harmful), and frequency of binge drinking (6 or more drinks on one occasion). Participants who stated "no" to ever drinking alcohol were categorised as "non-drinkers". The remaining categories were derived from the UK Chief Medical Officer's guidelines for "low risk" drinking (0-14 units per week) (Department of Health and Social Care, 2016), and the National Institute for Health and Care Excellence (NICE) guidelines for hazardous (14 to 35/50 units for women/men) and harmful drinking (above 35/50 units for women/men) (NICE, 2014). Participants stated the number of drinks consumed (white wine, red wine, fortified wine, beer, and spirits) over the past seven days, which was converted to units. Frequency of binge drinking was measured using a single item, with the following

options: never, monthly or less, two to four times a month, two to three times a week, and daily or almost daily.

8.3.2.2 Smoking status

Smoking status was derived from two items which asked if participants currently smoked cigarettes and if so, how many cigarettes did they smoke per day. Participants were categorised as "non-smokers", "0 to 10 cigarettes per day" (light to moderate smoking) or "more than 10 cigarettes per day" (heavy smoking) (Jones et al., 2011).

8.3.2.3 Physical activity

Physical activity was measured using the validated seven-item International Physical Activity Questionnaire – Short Form (Craig et al., 2003; IPAQ-SF, 2015), which has also been validated in occupational settings (Prince et al., 2018; Puciato et al., 2018). The IPAQ-SF measures the frequency, intensity and duration of walking, moderate and vigorous physical activity. MET minutes were computed for each activity (one minute of walking = 3.3 MET mins, moderate activity = 4 MET mins, vigorous activity = 8 MET mins). High physical activity was defined as vigorous intensity activity on at least three days (minimum of 1500 MET minutes), or seven days of any combination of walking, moderate or vigorous intensity activities (minimum of 3000 MET minutes). Moderate physical activity was defined as three or more days of vigorous intensity activity, five or more days of moderate intensity activity, five or more days of walking (at least 30 minutes per day), or five or more days of any combination of walking, moderate or vigorous intensity activities (minimum of 600 MET minutes per week). Low physical activity was categorised as not meeting either criteria (IPAQ-SF, 2015). UK government guidelines recommend

achieving a minimum of 600 MET minutes per week (Department of Health and Social Care, 2019).

8.3.2.4 Average daily fruit and vegetable intake

Four items measured frequency (days per week) and quantity (how many) of fruit (portions) and vegetable (heaped tbsp.) consumption. Public Health England (PHE) guidance recommends five portions of fruit and vegetables per day, and states that three heaped tbsp of vegetables is equivalent to one portion (Public Health England, 2016). Quantity of vegetables was divided by three to reflect portions. Average daily fruit and vegetable intake was computed by calculating total weekly fruit and vegetable intake (multiplying frequency and quantity), then dividing by seven. This was categorised into "2 or less servings per day", "3 to 4 servings per day", and "5 or more servings per day".

8.3.2.5 Red meat consumption

A single item measured frequency of red meat consumption, with the following response options: "never", "less than once a week", "once a week", "two or more times a week".

8.3.3 Measures of mental health and job strain

8.3.3.1 Probable depression

The Patient Health Questionnaire-9 (PHQ-9) (Kroenke et al., 2001) is a 9-item self-report screen of symptoms of depression (e.g., trouble sleeping, suicidal thoughts), where responses are provided on a 4-point Likert scale, ranging from "not at all" to "nearly every day". Scores range from 0 to 27, with a validated cut-off of 10 indicating

probable depression (sensitivity = 0.88, specificity = 0.88, Kroenke et al., 2001). McDonald's omega (ω) indicated excellent internal reliability (ω = 0.93).

8.3.3.2 Probable anxiety

The anxiety subscale of the Hospital Depression and Anxiety Scale (HADS-A) (Zigmond and Snaith, 1983) is a 7-item self-report screen of symptoms of anxiety (e.g., feeling tense, restlessness). Scores range from 0 to 21, with a validated cut-off of 9 indicating probable anxiety (sensitivity = 0.90, specificity = 0.78, Bjelland et al., 2002). The scale showed excellent internal reliability (ω = 0.90).

8.3.3.3 Probable PTSD

The Trauma Screen Questionnaire (TSQ) (Brewin et al., 2002) is a 10-item screen of symptoms of PTSD (e.g., upsetting thoughts/memories, bodily reactions). Participants were only asked these items if they reported a traumatic experience in the 6 months prior to the survey. A 4-point Likert scale was used, ranging from "not at all" to "extremely". However, responses to the TSQ are usually binary, so "not at all" was coded as 0 and all other response options were coded as 1. Scores ranged from 0 to 10, with a validated cut-off of 6 indicating probable PTSD (sensitivity = 0.86, specificity = 0.93, Brewin et al., 2002). The scale showed excellent internal reliability (ω = 0.99).

8.3.3.4 Job strain

Job strain was measured using six items from the Job Content Questionnaire (JCQ) (Karasek et al., 1998), with four items measuring control and two items measuring demand. A validated quadrant approach was used to group participants into high strain (high demand, low control), low strain (low demand, high control), active strain (high demand, high control), and passive strain (low demand, low control). The sample

medians for total scores on the demand items and control items were used to categorise participants into high or low demand and control (Gibson et al., 2018).

8.3.4 Sociodemographic and occupational measures

The Airwave Health Monitoring Study obtained several self-reported sociodemographic measures: age, gender, country (England, Wales, Scotland), marital status (married/cohabitating, divorced/separated, single, other), education (GSCE or below, vocational qualifications/NVQ1+2, A levels/Highers or equivalent, Bachelor's or postgraduate degree), ethnicity (White, Asian, Black, Mixed ethnic background, other), and number of children under 18 (none, one, two, three or more). Several self-reported occupational variables were measured, including job role (police officer, police staff, other), income (less than £25,999, £26k to £37,999, £38k to £59,999, more than £60k), years in the police force (less than five, six to ten, 11 to 20, more than 20), and number of days sickness absence in the past year (none, one to five, six to ten, more than ten). Body Mass Index (BMI) was derived from participant's weight and height (underweight >18.5 kg/m2, normal weight 18.5 to 25 kg/m2, overweight 25 to 30 kg/m2, obese <30 kg/m2).

8.3.5 Data analysis

LCA is a statistical technique whereby constructs (classes) are identified from unobserved (latent) subgroups, based on individual responses from multiple variables (Lazarsfeld, 1950). For the current study, LCA was conducted in Mplus version 8.3, to determine underlying classes of health (risk) behaviours by estimating and evaluating a series of models with an incrementally greater number of classes, starting with a 2-class model, to determine the optimal number of classes (Figure 8.1).
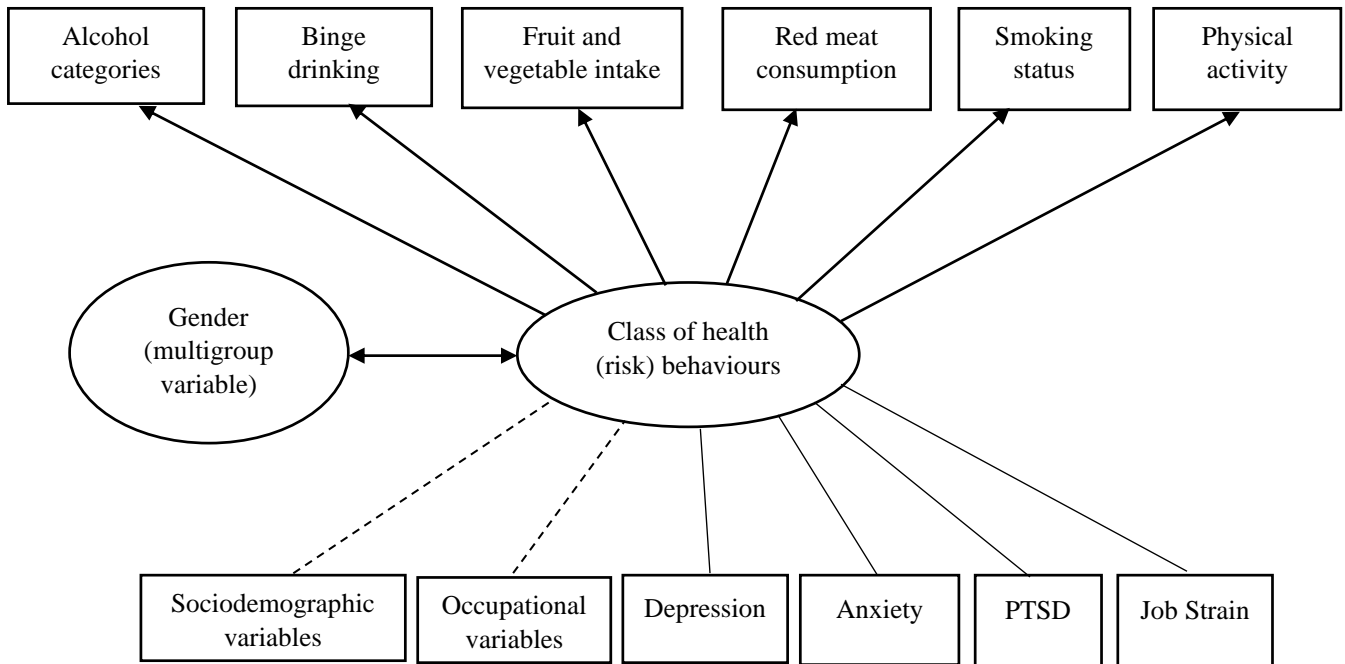
Figure 8.1. Multigroup latent class model of health (risk) behaviours, grouped by gender, with explanatory variables which were analysed in regression models (sociodemographic variables, occupational variables, mental health and job strain variables).

In LCA, the number of classes is considered optimal when there is homogeneity within the classes and heterogeneity between the classes. The models were evaluated with a range of model fit criteria: Akaike Information Criterion (AIC) (Akaike, 1987), Bayseian Information Criteria (BIC) (Gideon, 1978), sample size adjusted BIC (SSABIC) (Sclove, 1987), entropy values (Ramaswamy et al., 1993), number of bivariate residuals (BVR) (Maydeu-Olivares and Joe, 2006), and Voung-Lo-Mendell-Rubin likelihood ratio test (VLMR LRT) (Lo et al., 2001). Smaller AIC, BIC and SSABIC values indicate better model fit (Nylund et al., 2007). Larger entropy values (>0.70) indicate better classification accuracy (Boeschoten et al., 2016; Ramaswamy

et al., 1993). Non-significant (p>.05) VLMR LRT indicates that an additional class does not provide a better fit than a model with one less class, favouring a simpler model (Nylund et al., 2007). Models containing fewer significant BVR (>3.84) suggest better model fit (Maydeu-Olivares and Joe, 2006; Schreiber and Pekarik, 2014). Response probabilities were assessed to determine the most informative number of cases (Nylund et al., 2007). After the optimal number of classes was determined, gender was added using "knownclass", to determine whether the multigroup LCA model was a good fit (class memberships and response probabilities can differ for men and women).

Class membership and the conditional probability of assignment to each class were saved in Mplus and imported into STATA SE 15, for the regression analyses. The probability of assignment was used as a probability weight in the regression models to account for individual differences (i.e., individuals in the same class will not all have a probability of 1.0) (Clark and Muthén, 2009). Descriptive statistics (mean and standard deviation) explored differences in BMI across the classes.

Unadjusted multinomial regression analyses were first used to determine the sociodemographic (age, education, marital status, children under 18) and occupational (role, years in police force, income, days of sickness absence) associations with each of the classes, separately for men and women (supplementary materials). Variables with statistically significant associations were included as covariates in the subsequent analyses. Adjusted multinomial regression analyses then determined the mental health (depression, anxiety, PTSD) and job strain (high, low, active, passive) associations with each of the classes, separately for men and women. The reference groups were determined based on size and characteristics of the classes (i.e., sufficient numbers and meaningfulness of reference class).

8.3.6 Missing data

The proportion of missing data was typically less than 1%, except for PTSD and job role. For PTSD, 6% (N = 2,469) of the data was missing (completely at random), as participants who completed the study in 2006 were not provided with the PTSD items. For police role, 9% (N = 3,859) of the data was missing, with no record of a result having been received and no explanation why. PTSD and role were only included as explanatory variables, not as covariates, and so, had little impact on sample sizes for the main analyses. The minimal missing data for the health (risk) behaviour variables included in the LCA were handled using Full Information Maximum Likelihood (FIML) estimation, whereby the available data was used to estimate the model and population parameters.

8.3.7 Ethics

The Airwave Health Monitoring Study received ethical approval from the National Health Service multi-site research ethics committee (MREC/13/NW/0588). Written informed consent was obtained from all participants.

Table 8.1. Descriptive statistics for health (risk) and mental health variables (N = 40,986)

Variable	Complete N / % Missing	N	%	95% CI
Alcohol				
Past weekly consumption	40,986 (0.00)			
Non-drinkers		3,764	9.18	8.91 to 9.47
Low risk (0-14 units)		22,612	55.17	54.69 to 55.65
Hazardous drinkers (14-35/50 units)		13,365	32.61	32.16 to 33.06
Harmful drinkers (35/50+ units)		1,245	3.04	2.88 to 3.21
6 or more drinks on one occasion	40,986 (0.00)			
Never		11,187	27.29	26.87 to 27.73
Monthly or less		17,390	42.43	41.95 to 42.91
Two to four times a month		8,469	20.66	20.27 to 21.06
Two to three times a week		3,278	8.00	7.74 to 8.26
Daily/almost daily		662	1.62	1.50 to 1.74
Diet				
Fruit & vegetable intake	40,876 (0.27)			
5 or more servings per day		5,664	13.86	13.52 to 14.19
3 to 4 servings per day		11,710	28.65	28.21 to 29.09
2 or less servings per day		23,502	57.50	57.02 to 57.97
Red meat consumption	40,876 (0.27)			
Never		2,184	5.34	5.13 to 5.57
Less than once a week		10,018	24.51	24.09 to 24.93
Once a week		14,100	34.49	34.03 to 34.96
Two or more times a week		14,574	35.65	35.19 to 36.12
Smoking status	40,942 (0.11)			
Non-smoker		37,338	91.20	90.92 to 91.47
0 to 10 cigarettes a day		2,403	5.87	5.65 to 6.10
More than 10 cigarettes a day		1,201	2.93	2.77 to 3.10
Physical activity	40,978 (0.02)			
High physical activity		20,731	50.59	50.11 to 51.07
Moderate physical activity		14,040	34.26	33.80 to 34.72
Low physical activity		6,207	15.15	14.80 to 15.49
Body mass index (BMI)	40,922 (0.16)			
Underweight >18.5 kg/m^2		138	0.34	0.29 to 0.40
Normal weight 18.5 to 25 kg/m^2		12,719	31.08	30.63 to 31.53
Overweight 25 to 30 kg/m^2		19,042	46.53	46.05 to 47.02
Obese <30 kg/m^2		9,023	22.05	21.65 to 22.45
Mental health				
Depression	40,372 (1.50)			
Probable case		3,958	9.80	9.52 to 10.10
Non-case		36,414	90.20	89.90 to 90.48
Anxiety	40,372 (1.50)			
Probable case		3,407	8.44	8.17 to 8.71
Non-case		36,965	91.56	91.29 to 91.83
PTSD	38,517 (6.02)			
Probable case		1,520	3.95	3.76 to 4.15
Non-case		36,997	96.05	95.85 to 96.24
Job strain [a]	40,372 (1.50)			
Low		9,722	24.08	23.67 to 24.50
High		11,015	27.28	26.85 to 27.72
Active		11,246	27.86	27.42 to 28.30
Passive		8,389	20.78	20.39 to 21.18

[a] Quadrant approach used to create categories of job strain based on sample medians for demand and control: low (low demands, high control), high (high demands, low control), active (high demands, high control), passive (low demands, low control).

8.4 Results

8.4.1 Sample characteristics

The sociodemographic and occupational characteristics of the current sample (N = 40,986) are outlined in supplementary table 1 (Appendix 18). Descriptive statistics for the health (risk), mental health, and job strain variables, for the full sample, are shown in Table 8.1. Most of the sample were low-risk drinkers (55%) and over half of the sample reported binge drinking monthly or less, or never binge drink. Only 14% of the sample reported sufficient fruit and vegetable intake (5 or more servings per day). Around 70% of the sample consumed red meat once a week or more. Almost all participants were non-smokers. Over 50% met criteria for high physical activity. The screening measures of mental health indicated that 10% met criteria for probable depression, 8% for probable anxiety and 4% for probable PTSD.

8.4.2 Latent class analysis of health (risk) behaviours

The LCA identified a five-class solution as the best fit for the full sample, based on the model fit criteria and meaningfulness of the classes (Table 8.2). The AIC, BIC and SSABIC decreased with every additional class, though reductions levelled off after five classes (Appendix 18). The number of significant BVRs decreased from 20 for four classes, to seven for five classes, suggesting greater conditional independence for a five-class solution. Entropy was highest for four classes (0.85), indicating better classification accuracy, though this was still sufficient for five classes (0.71) (Boeschoten et al., 2016), and the additional class was meaningful. After selecting a five-class model, gender was added using the "knownclass" function. The AIC, BIC, SSABIC, entropy, and number of significant BVRs indicated that a five-class solution was a good fit to the multigroup model.

Table 8.2. Model fit criteria for deciding the number of classes for the full sample (N = 40,986), then for the multigroup analysis with gender added using the known class function, to determine number of classes for men (N = 25,788) and women (N = 15,198). Derived from Mplus.

Number of classes	Entropy	AIC	BIC	SSABIC	VLMR-LRT (p-value)	BVR	Range of class probabilities
Full sample							
2	0.71	465395.85	465680.35	465575.47	16062.07 (0.000)	38	0.87 to 0.97
3	0.78	457361.07	457792.12	457633.22	8024.34 (0.000)	25	0.88 to 0.97
4	0.85	456432.73	457010.34	456797.41	957.04 (0.000)	20	0.60 to 0.99
5	**0.71**	**455663.65**	**456387.81**	**456120.86**	**798.66 (0.000)**	**7**	**0.60 to 0.86**
6	0.71	455486.82	456357.54	456036.56	209.67 (0.000)	5	0.31 to 0.90
7	0.63	455363.84	456381.12	456006.11	156.12 (0.152)	3	0.29 to 0.92
8	0.64	455198.67	456362.50	455933.47	113.96 (0.001)	2	0.43 to 0.82
Multigroup							
5	**0.77**	**505344.14**	**506766.60**	**506242.23**	**-**	**4**	**-**

AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion; SSABIC, Sample-size adjusted Bayesian Information Criterion; VLMR-LRT, Voug-Lo-Mendell-Rubin adjusted Likelihood Ratio Test; BVR, bivariate residuals.

The response probabilities for men (N = 25,788) and women (N = 15,198) are shown in Table 8.3 and the class descriptions are defined in Table 8.4, with the probability-weighted proportions of participants in each class. There were five distinct classes for men and women. Both genders had a "healthiest" class (17.6% of men, 28.7% of women) and a "healthy abstainers" class (13.8% of men, 16.2% of women). The largest class for both genders was "low risk drinkers but other health risk behaviours" (35.6% of men, 39.1% of women) and the smallest class for both genders was "high health risk behaviours" (4.1% of men, 3.8% of women). For men, the final class reflected "some health risk behaviours but physically active" (28.9%). For women, the final class reflected "moderate health risk" (12.2%).

Table 8.3. Class probabilities for each class, by gender. The largest probabilities for each class are bolded and the smallest probabilities for each class are italicised. Derived from Mplus.

Variable	Men N = 25,788					Women N = 15,198				
	Class 1 N = 5,407	Class 2 N = 3,560	Class 3 N = 7,092	Class 4 N = 8,839	Class 5 N = 990	Class 1 N = 4,543	Class 2 N = 1,894	Class 3 N = 2,072	Class 4 N = 6,121	Class 5 N = 568
Alcohol										
Past weekly consumption										
Non-drinkers	*0.00*	**0.55**	*0.00*	*0.00*	*0.00*	*0.00*	**0.72**	*0.00*	*0.00*	*0.00*
Low risk	**0.75**	0.44	0.04	**0.77**	0.03	**0.89**	0.28	0.20	**0.89**	0.06
Hazardous drinkers	0.25	0.01	**0.93**	0.23	0.42	0.11	*0.00*	**0.77**	0.11	**0.55**
Harmful drinkers	*0.00*	*0.00*	0.03	*0.00*	**0.55**	*0.00*	0.00	0.03	*0.00*	0.40
6 or more drinks on one occasion										
Never	0.17	**1.00**	*0.00*	0.15	*0.01*	0.37	**1.00**	*0.00*	0.26	*0.00*
Monthly or less	**0.68**	*0.00*	0.20	**0.71**	0.03	**0.55**	*0.00*	0.31	**0.61**	0.09
Two to four times a month	0.14	*0.00*	**0.54**	0.14	0.12	0.08	*0.00*	**0.56**	0.12	0.32
Two to three times a week	0.01	*0.00*	0.25	0.01	**0.46**	0.01	*0.00*	0.13	0.01	**0.45**
Daily/almost daily	*0.00*	*0.00*	0.01	*0.00*	0.38	*0.00*	*0.00*	*0.00*	*0.00*	0.14
Diet										
Fruit & vegetable intake										
2 or less servings per day	*0.00*	**0.57**	**0.61**	**0.84**	**0.71**	*0.20*	**0.53**	**0.50**	**0.84**	**0.67**
3 to 4 servings per day	**0.59**	0.27	0.28	0.15	0.19	**0.53**	0.29	0.35	0.12	0.23
5 or more servings per day	0.41	*0.17*	*0.12*	*0.01*	0.10	0.26	*0.18*	0.15	*0.04*	*0.10*
Red meat consumption										
Never	*0.03*	*0.07*	*0.01*	*0.02*	*0.01*	*0.13*	*0.15*	*0.07*	*0.07*	*0.06*
Less than once a week	0.24	0.26	0.18	0.24	0.15	0.29	0.29	0.27	0.30	0.24
Once a week	0.36	0.32	0.36	**0.38**	0.25	**0.32**	**0.30**	**0.34**	0.35	0.35
Two or more times a week	**0.37**	**0.35**	**0.45**	0.37	**0.59**	0.26	0.26	0.32	0.28	**0.35**
Smoking status										
Non-smoker	**0.97**	**0.94**	**0.90**	**0.93**	**0.83**	**0.96**	**0.91**	**0.82**	**0.88**	**0.74**
0 to 10 cigarettes	0.02	0.04	0.07	0.05	*0.08*	0.04	0.05	0.14	0.09	0.13
More than 10 cigarettes	*0.01*	*0.03*	*0.03*	*0.03*	0.09	*0.00*	*0.03*	*0.04*	*0.04*	*0.12*
Physical activity										
Low physical activity	*0.05*	*0.15*	*0.11*	*0.19*	*0.17*	*0.11*	*0.19*	*0.15*	*0.25*	*0.21*
Moderate physical activity	0.25	0.29	0.34	0.35	0.35	0.36	0.35	0.38	**0.40**	**0.40**
High physical activity	**0.70**	**0.56**	**0.55**	**0.46**	**0.49**	**0.54**	**0.47**	**0.48**	0.36	0.39

Class descriptions for men: class 1 (healthiest), class 2 (healthy abstainers), class 3 (some health risk behaviours but physically active), class 4 (low risk drinkers but other health risk behaviours), class 5 (highest health risk behaviours). Class descriptions for women: class 1 (healthiest), class 2 (healthy abstainers), class 3 (moderate health risk behaviours), class 4 (low risk drinkers but other health risk behaviours), class 5 (highest health risk behaviours).

Table 8.4. Class descriptions and weighted class proportions for each class, separately for men and women, with mean body mass index (BMI) for each class. Class proportions are weighted using class probability weights, derived from Mplus.

Class descriptions	
Men (N = 25,788)	
Class 1: healthiest (17.59%) *Mean BMI = 27.50 kg/m^2 (±3.90)*	Mostly low risk drinkers, who reported rarely binge drinking. Highest fruit and vegetable intake and moderate red meat consumption. Most of this class were non-smokers and reported high physical activity.
Class 2: healthy abstainers (13.79%) *Mean BMI = 27.86 kg/m^2 (±4.14)*	Mostly abstainers and low risk drinkers. This class had the second highest fruit and vegetable intake and the second lowest red meat consumption. Mostly non-smokers, with high physical activity.
Class 3: some health risk behaviours but physically active (28.86%) *Mean BMI = 28.11 kg/m^2 (±3.82)*	Mostly hazardous drinkers, who reported binge drinking at least once a week. Average fruit and vegetable intake, with the second highest red meat consumption. This class had the second highest probability of being light to moderate smokers, but most reported high physical activity.
Class 4: low risk drinkers but other health risk behaviours (35.62%) *Mean BMI = 27.77 kg/m^2 (±3.94)*	Mostly low risk drinkers who rarely binge drink. This class reported the lowest fruit and vegetable intake and high red meat consumption. This class were mostly non-smokers but reported the lowest physical activity.
Class 5: high health risk behaviours (4.14%) *Mean BMI = 29.00 kg/m^2 (±3.84)*	Mostly hazardous and harmful drinkers who reported binge drinking multiple times per week. This class reported very low fruit and vegetable intake and the highest red meat consumption. This class had the highest probability of reporting smoking (light to moderate, and heavy). This class reported the second lowest physical activity.
Women (N = 15,198)	
Class 1: healthiest (28.72%) *Mean BMI = 25.97 kg/m^2 (±4.76)*	Mostly low risk drinkers, who reported binge drinking monthly or less. This class reported the highest fruit and vegetable consumption and low red meat consumption. Highest probability of non-smoking and high physical activity.
Class 2: healthy abstainers (16.22%) *Mean BMI = 26.63 kg/m^2 (±5.65)*	Mostly abstainers and low risk drinkers. This class reported moderate fruit and vegetable intake and the lowest red meat consumption. This class were mostly non-smokers, with moderately high physical activity.
Class 3: moderate health risk behaviours (12.19%) *Mean BMI = 26.13 kg/m^2 (±4.33)*	Mostly hazardous drinkers who reported binge drinking at least once a week. Moderate fruit and vegetable intake, and red meat consumption. This class had the highest probability of reporting light to moderate smoking (0-10 cigarettes) but reported high physical activity.
Class 4: low risk drinkers but other health risk behaviours (39.07%) *Mean BMI = 25.75 kg/m^2 (±4.85)*	Mostly low risk drinkers who reported rarely binge drinking. This class reported the lowest fruit and vegetable intake and high red meat consumption. This class included some light to moderate smokers and reported the lowest physical activity.
Class 5: high health risk behaviours (3.80%) *Mean BMI = 27.00 kg/m^2 (±4.87)*	Mostly hazardous and harmful drinkers, who reported binge drinking multiple times per week. Low fruit and vegetable intake and the highest red meat consumption. This class had some light to moderate, and heavy, smokers. This class reported the second lowest physical activity.

8.4.3 Sociodemographic and occupational associations

The sociodemographic and occupational associations with each class are outlined in supplementary table 2 (Appendix 20) for men and supplementary table 3 for women (Appendix 21). The "healthiest" class was the reference group for both men and women.

Men over 40 had double the odds of being in the "high health risk" class, and men aged over 50 had 1.5 times greater odds of being in the "healthy abstainers" class, but reduced odds of being in the "low risk drinkers but other health risks" class (versus <29 years old). Men who held a GCSE education or below had increased odds of being in the "high health risk" class, compared to all other categories. Asian men showed 9 times greater odds of being in the "healthy abstainers" class, and Black men showed 3 times greater odds (versus White men). Police staff showed 1.7 times greater odds of being in the "healthy abstainers" class than police officers, and those who had served for over 10 years (versus <5) showed double the odds of being in the "high health risk" class. Men with the lowest income (versus all other categories) were significantly more likely to be in the "healthy abstainers" class. Men with more than 10 days of sickness absence (versus none) had at least 1.5 times greater odds of being in the "high health risk" class and the "healthy abstainers" class.

Women aged 40-49 years old had double the odds of being in the "high health risk" class, and women over 50 had reduced odds of being in the "moderate health risk" class (versus <29 years old). Women under 29 had increased odds of being in the "low risk drinkers but other risks" class, versus all other age groups. Women with a bachelor's/postgraduate degree showed reduced odds of being assigned to the "high health risk" and "low risk drinkers but other risks" classes (versus GCSE education or below). Asian women had 5.4 times greater odds of being in the "healthy abstainers"

class, and Black women had 4.6 times greater odds, compared to White women. Single women had at least 1.3 times greater odds of being assigned to the "low risk drinkers but other risks" and "moderate health risk" classes, than married/cohabiting women. Women who had served for more than 10 years (versus <5) showed 1.8 times greater odds of being in the "high health risk" class, but reduced odds of being in the "low risk drinkers but other risks" class. Women with more than 10 days of sickness absence (versus none) were 1.6 times more likely to be in the "high health risk" class and "healthy abstainers" class.

8.4.4 Mental health and job strain associations

The mental health and job strain associations with class membership are shown in Table 5, separately for men and women. The sociodemographic and occupational variables found to be significantly associated with class membership in men and women (age, country, education, ethnicity, marital status, number of children under 18, years in police force, income, days of sickness absence in past year) were included as covariates. The "healthiest" classes for men and women were the reference groups.

Men with probable depression, anxiety or PTSD had 2.5 to 3.5 times greater odds of being in the "high health risk behaviours" class (versus those with no mental health problem). Men with depression or anxiety had double the odds of being in the "healthy abstainers" class, with weaker associations for PTSD. Men with depression, anxiety or PTSD had between 1.3 to 1.8 greater odds of being assigned to the "health risk behaviours but physically active" class. Men with probable depression or anxiety, but not PTSD, had at least 1.5 times the odds of being in the "low risk drinkers but other health risk behaviours" class.

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Women with probable depression or anxiety had at least double the odds of being in the "high health risk behaviours" class, compared to those without depression or anxiety. Probable PTSD was also associated with 1.7 times greater odds of being in the "high health risk behaviours" class, and 1.4 times greater odds of being in the "moderate health risk behaviours" class. Women with probable depression had 1.3 times greater odds of being in the "healthy abstainers", "moderate health risk behaviours" and "low risk drinkers but other health risk behaviours" classes, compared to those without depression. Women with probable anxiety showed 1.1 and 1.2 times greater odds of being in the "moderate health risk behaviours" and "low risk drinkers but other health risk behaviours" classes, respectively.

Both men and women reporting high strain (versus low strain) were significantly more likely to be in the "low risk drinkers but other health risk behaviours" class, but the odds ratios were small (1.1 for men, 1.2 for women).

Table 8.5. Multinomial logistic regressions examining the mental health and job strain associations with the identified classes of health (risk) behaviours for men and women. Percentages are weighted with conditional probability weights. Adjusted multinomial odds ratios (AMOR), with 95% confidence intervals (CIs) are shown). Adjusted for sociodemographic and occupational variables found to be significantly associated with the identified classes for men and women.

Men (N = 25,788)	Class 1 N = 5,307 Healthiest (Ref.)	Class 2 N = 3,560 Healthy abstainers		Class 3 N = 7,092 Health risks but physically active		Class 4 N = 8,839 Low risk drinkers but other risks		Class 5 N = 990 High health risk behaviours	
	N (%)	N (%)	AMOR (95% CI)	N (%)	AMOR (95% CI)	N (%)	AMOR (95% CI)	N (%)	AMOR (95% CI)
Depression									
Non-case	4,981 (95.07)	3,163 (89.35)	1.00	6,381 (91.86)	1.00	7,928 (91.11)	1.00	830 (85.40)	1.00
Probable case	257 (4.93)	348 (10.65)	2.07 (1.73 to 2.47)***	573 (8.14)	1.66 (1.42 to 1.95)***	775 (8.89)	1.80 (1.55 to 2.10)***	137 (14.60)	3.09 (2.45 to 3.89)***
Anxiety									
Non-case	5,030 (96.16)	3,244 (92.00)	1.00	6,476 (93.14)	1.00	8,200 (94.34)	1.00	845 (87.09)	1.00
Probable case	208 (3.84)	267 (8.00)	2.10 (1.72 to 2.56)***	478 (6.86)	1.82 (1.53 to 2.16)***	503 (5.66)	1.49 (1.25 to 1.77)***	122 (12.91)	3.51 (2.75 to 4.48)***
PTSD									
Non-case	4,773 (96.68)	3,228 (95.46)	1.00	6,273 (95.56)	1.00	8,076 (96.43)	1.00	818 (91.80)	1.00
Probable case	164 (3.32)	145 (4.54)	1.34 (1.04 to 1.71)*	291 (4.44)	1.34 (1.09 to 1.64)**	306 (3.57)	1.09 (0.89 to 1.33)	73 (8.20)	2.53 (1.89 to 3.40)***
Job Strain									
Low	1,598 (21.78)	990 (27.95)	1.00	2,137 (30.99)	1.00	2,484 (28.18)	1.00	306 (32.27)	1.00
High	1,142 (21.78)	878 (25.79)	1.21 (1.07 to 1.38)**	1,491 (21.52)	1.00 (0.89 to 1.11)	2,080 (24.40)	1.14 (1.03 to 1.26)**	208 (21.65)	1.01 (0.82 to 1.23)
Active	1,525 (29.45)	1,018 (28.78)	1.10 (0.98 to 1.24)	2,120 (30.29)	1.04 (0.94 to 1.14)	2,484 (28.47)	1.07 (0.97 to 1.17)	303 (30.81)	1.05 (0.88 to 1.26)
Passive	973 (18.53)	625 (17.47)	0.95 (0.83 to 1.09)	1,206 (17.20)	0.92 (0.82 to 1.03)	1,651 (18.95)	1.03 (0.93 to 1.15)	150 (15.26)	0.83 (0.67 to 1.03)*

Women (N =15,198)	Class 1 N = 4,543 Healthiest (Ref)	Class 2 N = 1,894 Healthy abstainers		Class 3 N = 2,072 Moderate health risk behaviours		Class 4 N = 6,121 Low risk drinkers but other risks		Class 5 N = 568 High health risk behaviours	
	N (%)	N (%)	AMOR (95% CI)	N (%)	AMOR (95% CI)	N (%)	AMOR (95% CI)	N (%)	AMOR (95% CI)
Depression									
Non-case	4,034 (90.22)	1,612 (86.25)	1.00	1,612 (87.47)	1.00	5,280 (86.86)	1.00	429 (72.98)	1.00
Probable case	439 (9.78)	258 (13.75)	1.36 (1.14 to 1.62)**	255 (12.53)	1.31 (1.10 to 1.55)**	775 (13.14)	1.39 (1.22 to 1.58)***	141 (27.02)	3.24 (2.57 to 4.08)***
Anxiety									
Non-case	3,982 (89.02)	1,637 (87.72)	1.00	1,784 (86.98)	1.00	5,319 (87.91)	1.00	448 (79.30)	1.00
Probable case	491 (10.98)	233 (12.28)	1.10 (0.92 to 1.31)	256 (13.02)	1.20 (1.01 to 1.42)*	736 (12.09)	1.14 (1.01 to 1.30)*	113 (20.70)	2.16 (1.70 to 2.75)***
PTSD									
Non-case	4,140 (96.58)	1,654 (96.39)	1.00	1,677 (95.54)	1.00	5,681 (96.39)	1.00	518 (93.54)	1.00
Probable case	147 (3.42)	63 (3.61)	1.01 (0.74 to 1.37)	80 (4.46)	1.35 (1.02 to 1.80)*	213 (3.61)	1.09 (0.87 to 1.36)	33 (6.46)	1.71 (1.12 to 2.60)*
Job Strain									
Low	1,086 (24.27)	418 (22.70)	1.00	488 (23.78)	1.00	1,370 (22.26)	1.00	138 (24.22)	1.00
High	1,091 (24.40)	508 (26.96)	1.08 (0.92 to 1.27)	496 (24.50)	0.99 (0.85 to 1.16)	1,684 (28.14)	1.19 (1.06 to 1.34)**	144 (25.62)	1.01 (0.78 to 1.32)
Active	1,198 (26.70)	466 (24.93)	1.00 (0.85 to 1.17)	552 (26.70)	1.02 (0.87 to 1.19)	1,452 (23.88)	1.02 (0.91 to 1.14)	124 (22.19)	0.78 (0.59 to 1.02)
Passive	1,098 (24.63)	478 (25.41)	1.04 (0.88 to 1.21)	504 (25.02)	1.02 (0.88 to 1.20)	1,549 (25.72)	1.10 (0.98 to 1.23)	155 (27.97)	1.11 (0.86 to 1.44)

8.5 Discussion

8.5.1 Key findings

This study utilised the largest sample of police employees worldwide, to explore classes of health (risk) behaviours and associations with mental health and job strain. Five classes were identified, with the smallest reflecting "high health risk behaviours" in both men and women, the most common reflecting "low risk drinkers but other health risk behaviours", and two healthy classes, reflecting the "healthiest" and "healthy abstainers". The final class for men reflected "some health risks but physically active" and "moderate health risk" for women. For both genders, those with probable depression, anxiety, or PTSD (compared to no mental health problem) had greater odds of being assigned to the "high health risk behaviours" class, though the odds were not as large for women. Men and women with probable depression were more likely to be in the "healthy abstainers" class, which was also apparent in men with probable anxiety and PTSD. Men and women reporting high strain (compared to low strain) had increased odds of being in the "low risk drinkers with other health risk behaviours" class. These findings highlight the importance of understanding clustering health risk behaviours, as the mental and physical health consequences will be greater for those with multiple risks (Akasaki et al., 2019).

8.5.2 Classes of health (risk) behaviours

Previous literature has identified similar clusters of health (risk) behaviours, with clusters at either end of the spectrum (healthiest versus multiple health risk behaviours), with remaining classes reflecting a mixture of behaviours, which are usually more common (Conry et al., 2011; Oftedal et al., 2019; Schuit et al., 2002; Vermeulen-Smit et al., 2015). Across the literature, there are differences in the

proportion of participants considered "healthy". In this study, 35% of male police employees and 42% of female police employees were in the two healthy classes ("healthiest" and "healthy abstainers"), compared to 80% of the Dutch general population (Vermeulen-Smit et al., 2015), 23% of the UK general population (Birch et al., 2019), and 36% of men and 37% of women in the Australian general population (Oftedal et al., 2019), being in the "healthiest" classes. These findings suggest that UK police employees may engage in some health behaviours more than the UK general population, such as physical activity, but show other health risk behaviours, such as poor diet (13% met criteria for recommended fruit and vegetable intake, vs 25% of UK general population (Oyebode et al., 2014)). This may be because a certain level of fitness is required in police employees, and the latter may relate to shift work, which is associated with irregular eating patterns and unhealthy eating (Souza et al., 2019).

8.5.3 Mental health and job strain

Previous findings of the same sample showed a relationship between poor mental health and harmful drinking (and abstinence) (Irizar et al., 2021). These findings extend this, showing a relationship between poor mental health and multiple health risk behaviours, in line with the few existing studies (Kwan et al., 2016; Oftedal et al., 2019; Vermeulen-Smit et al., 2015). A study independently examining associations between health (risk) behaviours and mental health, found that poor mental health was linked with smoking, low fruit and vegetable intake, and abstinence (Stranges et al., 2014). The latter is harmonious with current findings, showing poorer mental health in "healthy abstainers" than police employees in the "healthiest" class, and with a growing body of literature evidencing a J-shaped relationship, whereby poor mental health is associated with abstinence and heavy drinking (El-Guebaly, 2007; Goodwin et al., 2017; Puddephatt et al., 2020). Taken together, these findings suggest that health

risk behaviours are associated with poor mental health and adverse consequences are greater for those engaging in multiple health risk behaviours.

Regarding job strain, existing evidence in police employees showed that those reporting high strain (compared to low strain) had reduced odds of heavy drinking (Irizar et al., 2021; Siegrist and Rödel, 2006), contradicting previous evidence (Heikkilä et al., 2012). The present findings can disentangle these unexpected findings, as police employees reporting high strain were more likely to be low risk drinkers but engage in other health risk behaviours. High demands and low control may reduce free time to eat healthily (Gibson et al., 2018) or exercise regularly (Kouvonen et al., 2005). However, the current evidence-base is limited and mixed. Some research links high strain with smoking, and high control with high physical activity (Hellerstedt and Jeffery, 1997), with other research showing weak and inconsistent associations between high strain and health risk behaviours across samples (Lallukka et al., 2008). Nevertheless, high strain is consistently associated with poor mental health (Burns et al., 2016) and increased days of sickness absence due to poor mental health (Mather et al., 2015). In line with this, police employees in the "low risk drinkers but other health risk behaviours" class, characterised by high strain, also showed strong associations with probable depression and sickness absence (more so for men).

8.5.4 Sociodemographic and occupational contributors

Male and female police employees engaging in multiple health risk behaviours were characterised by older age, lower educational attainment, having served longer in the police service, and having several days of sickness absence in the past year. These factors were previously found to be associated with harmful alcohol use in the same sample (Irizar et al., 2021), and can now be linked to co-occurring health risk behaviours, such as smoking and poor diet. Conversely, police employees who were

low risk drinkers but reported other health risk behaviours were characterised by younger age and fewer than five years in service, in line with findings from the UK general population, indicating a decline in youth drinking (Oldham et al., 2020). There were some gender differences in the characteristics of the classes. For example, having children was unrelated to class membership in men, but having no children (compared to one or two) was associated with moderate health risk behaviours in women. Compared to the healthiest class, all other classes were characterised by lower educational attainment. The link between low education and health risk behaviours is well-established (Cutler and Lleras-Muney, 2010; Meader et al., 2016). However, the specific pathways in which education influences health behaviours are complex and could be attributed to a range of economic and/or social inequalities (Raghupathi and Raghupathi, 2020).

8.5.5 Strengths and limitations

This is the first study to determine classes of health (risk) behaviours in police employees, and one of few studies examining their mental health associations, in any population. This study utilised a representative sample with a good response rate and sufficient data to stratify by gender. Using LCA, this study determined co-occurring health risk behaviours and their associations, contrasting previous literature researching health (risk) behaviours independently (Stranges et al., 2014). However, these findings may not be the same for other occupational groups, given the specific nature of policing (e.g., expected level of physical fitness, time spent driving). Due to the cross-sectional nature of the data, temporal associations could not be determined, and it is unknown whether poor mental health is a contributor or consequence of engaging in health risk behaviours. Existing longitudinal evidence found associations

with poor mental health and subsequent health risk behaviours but not vice versa (Walsh et al., 2013), and this should be explored in police employees.

8.6 Implications

This study emphasises the importance of developing interventions which target co-occurring health risk behaviours, as individual behaviours have adverse physical and/or mental health consequences, but the combined impact of multiple health risk behaviours is much greater (Akasaki et al., 2019; Bellis et al., 2016; Spring et al., 2012). Police employees experiencing poor mental health may engage in multiple health risk behaviours and workplace mental health support should incorporate a whole person approach, facilitating ones' physical and mental health needs (Vreeland, 2007). The workplace offers an advantageous environment for interventions targeting health (risk) behaviours, given the amount of time spent working (Goldgruber and Ahrens, 2010; Malik et al., 2014). At an organisational level, health promotion campaigns can encourage healthy eating, smoking cessation, and physical activity. Addressing demand-control imbalances could allow more free time to for health behaviours. This study identified the characteristics of police employees who may be more likely to engage in multiple health risk behaviours and can be targeted by workplace interventions at an individual level.

8.7 Conclusions

This is the first study to determine how health (risk) behaviours cluster in police employees, and their associations with mental health and job strain. Police employees with poor mental health were more likely to engage in multiple health risk behaviours, than those without a mental health problem. Those reporting high strain were more likely to be low risk drinkers but engage in other health risk behaviours, such as low

physical activity and poor diet, than those reporting low strain. These findings highlight the importance of targeting co-occurring, not just individual, health risk behaviours to prevent physical and/or mental health consequences.

Chapter 9: "It's a crutch": a qualitative exploration of UK police employees' experiences of at-risk alcohol consumption or abstinence.

Chapter 9 was submitted as a manuscript for peer review in Policing: A Journal of Policy and Practice on 11th October 2021 (POLICE-2021-167).

9.1 Foreword

What is already known from the previous Chapters?

- This Chapter was informed by Chapters 5 and 8.

- Chapter 5 showed that 33% of UK police employees met criteria for hazardous drinking and 3% for harmful drinking. Compared to those without a mental health problem, those with probable depression, anxiety, or PTSD were more likely to be harmful drinkers and more likely to report abstinence. Low job strain (vs high job strain) was associated with increased odds of hazardous drinking.

- Chapter 8 found that UK police employees with probable depression, anxiety, or PTSD had at least double the odds of engaging in multiple health risk behaviours. Men and women with probable depression were more likely to be in the "healthy abstainers" class (as were men with probable anxiety or PTSD). High job strain (vs low job strain) was associated with increased odds of low risk drinking but other health risk behaviours (for both genders).

What does the current Chapter aim to do?

- The reasons for the quantitative associations are unknown. Therefore, this Chapter aimed to qualitatively explore police employees' experiences of

hazardous/harmful alcohol use or abstinence, motivations for drinking or abstaining, and the organisational culture of drinking and attitudes towards abstainers.

- To address these aims, semi-structured telephone interviews were conducted with 16 UK serving police employees (12 hazardous/harmful drinkers, four abstainers), and analysed using Braun and Clarke's six-step inductive thematic analysis.

What new findings does this Chapter add?

- Five themes were identified from the qualitative data, including a central theme which reflected the 'organisational culture of drinking and changes over time', outlining the general attitudes towards alcohol and a cultural shift.

- Motivations for drinking were reflected across two themes, 'alcohol as a coping mechanism' and 'alcohol and socialising', with an additional theme representing 'motivations for abstinence/cutting down'. The final theme highlighted the 'contrasting perceptions of available support' for alcohol problems.

9.2 Introduction

Policing in the United Kingdom (UK) can be a highly stressful occupation (Anshel, 2000), characterised by operational stressors such as witnessing a traumatic event (e.g., traffic accident) (Cartwright & Roach, 2020; Syed et al., 2020), and organisational stressors such as insufficient support and leadership changes (Demou, Hale, & Hunt, 2020; Houdmont, Kerr, & Randall, 2012; Jackman, Clay, Coussens, Bird, & Henderson, 2021). These stressors have been exacerbated by unprecedented budget cuts, reducing officer numbers (Allen & Audickas, 2020; Home Office, 2019) and

increasing demands (Elliott-Davies, 2019; Houdmont et al., 2019). The negative impact of operational stressors on police mental health is well-established (Brewin et al., 2020; Syed et al., 2020). The consequences of organisational stressors have also been evidenced (Charman & Bennett, 2021; Houdmont et al., 2020; Purba & Demou, 2019), and are more commonly reported as sources of strain (Biggam, Power, Macdonald, et al., 1997; Shane, 2010).

Regularly experiencing strains and stressors can lead to maladaptive coping strategies, such as at-risk alcohol use (hazardous or harmful use) (Hawn, Bountress, Sheerin, Dick, & Amstadter, 2020; Khantzian, 1997). The relationship between poor mental health and at-risk alcohol use is well-known (Debell et al., 2014b; Lai et al., 2015), as alcohol is used to alleviate negative affective states (Dixon et al., 2009), but can lead to further mental health decline (Strid et al., 2018). Conversely, abstinence from alcohol (compared to low-risk drinking) is also associated with poor mental health (El-Guebaly, 2007; Puddephatt et al., 2021). The 'sick quitter hypothesis' proposes that this may be driven by former drinkers becoming abstinent as a result of poor health, which could include alcohol problems (Ng Fat, 2014; Shaper et al., 1988).

In a study of 40,000 UK police employees (police officers are crown servants, not employees, but this collective term will be used to refer to officers and staff), one third met criteria for at-risk alcohol use, and those with a mental health problem had significantly greater odds of reporting harmful drinking and abstinence (Irizar, Gage, et al., 2021). The relationship between organisational strains and at-risk alcohol consumption in police employees is unclear (Houdmont & Jachens, 2021; Kohan & O'connor, 2002; Sterud et al., 2007b), with our previous study identifying lower odds of at-risk drinking in those reporting high strain, compared to low strain (Irizar, Gage, et al., 2021). Moreover, despite historic accounts of a drinking ("canteen") culture in

UK policing, as police stations previously had bars (Waddington, 1999) and alcohol was used to encourage bonding or to 'debrief' after stressful incidents (Abdollahi, 2002; Richmond et al., 1999), there is a dearth of recent literature exploring the organisational culture of drinking.

This study is part of a sequential multi-method project. The previous epidemiological study (Irizar, Gage, et al., 2021) determined the prevalence of at-risk alcohol use and abstinence, and their associations, but qualitative data is needed to gain an in-depth understanding of this phenomenon. This study aimed to qualitatively explore UK serving police employees' experiences of at-risk alcohol use or abstinence from alcohol, specifically, (i) motivations for alcohol consumption or abstinence (e.g., relating to mental health), and (ii) the organisational culture of drinking, and attitudes towards those who abstain, within the UK Police Service.

9.3 Methods

9.3.1 Participants

This study recruited police employees who met criteria for either (i) at-risk drinking or (ii) current abstinence from alcohol. Participants were eligible if they (i) were currently serving in a UK police force (any rank or any police staff grade), (ii) were aged over 18, (iii) had not been diagnosed with or received treatment for an alcohol problem in the past year, and (iv) spoke fluent English. Individuals meeting criteria for possible alcohol dependence (scoring ≥20 on the Alcohol Use Disorder Identification Test (AUDIT) screening questionnaire) were not eligible, nor were those who were retired or pregnant. Ethical approval was received from the University of Liverpool Research Ethics Committee.

Using convenience sampling, participants were recruited nationally via a study advertisement which was distributed on social media (Twitter, Facebook, LinkedIn, Reddit). Members of an established project advisory group (see Acknowledgements for names) for this research also shared the study advertisement, via email and social media. The researchers sought to recruit 12 participants for each group, as 12 interviews are generally sufficient to achieve data saturation (Vasileiou et al., 2018).

A total of 16 participants were eligible to participate based upon responses to a screening questionnaire, with 12 meeting criteria for at-risk alcohol use (four women, eight men) and four for abstinence (all men). Participant characteristics are summarised in Table 9.1. Categories are grouped to prevent identification. Participants interviewed described the wide-range of areas that they had worked in, including child criminal exploitation, neighbourhood policing, response policing, traffic policing, and working in criminal investigation departments (CID).

9.3.2 Materials

An online Qualtrics screening questionnaire was used to determine eligibility and assignment of participants to 'at risk drinking' or 'abstinence' groups. The questionnaire included the 10-item AUDIT (Saunders et al., 1993), which determined at-risk drinking (scores between 8 and 19, i.e., hazardous or harmful alcohol use), and current abstinence (appendix 26). The questionnaire also measured demographic and occupational factors (age, gender, ethnicity, marital status, educational attainment, number of children under 18, job role, years in service).

Two topic guides directed the semi-structured telephone interviews, depending on whether the participant met criteria for at-risk drinking or abstinence (appendix 27). Both topic guides included questions regarding participants' time in the Police Service;

impacts on their personal life and physical/mental health; coping strategies; general attitudes towards drinking; and available support. The remaining questions for at-risk drinkers related to their drinking habits, motivations for drinking and to cut down, whereas the questions for abstainers focused on their previous drinking habits and motivations to stop.

Table 9.1. Demographic and occupational characteristics of participants for at-risk drinkers (N = 12) and abstainers (N = 4).

	Gender	Age	Ethnicity	Marital Status	Educational Attainment	Children Under 18	Police Role	Years in Service	AUDIT Score
1	Female	40-50	White - British	Married	A levels/Highers or equivalent	2	Inspector/chief inspector or above	>20	10
2	Male	30-40	White - British	Married	A levels/Highers or equivalent	0	Police constable/sergeant	6-10	13
3	Male	30-40	White - British	Living with partner	A levels/Highers or equivalent	2	Police constable/sergeant	6-10	8
4	Male	40-50	White - Other	Living with partner	Bachelor/postgraduate degree	3	Police constable/sergeant	11-20	15
5	Male	<30	White - British	Single	Bachelor/postgraduate degree	0	Non-ranked police staff	6-10	0 (abstainer)
6	Female	40-50	White - British	Married	Bachelor/postgraduate degree	0	Police constable/sergeant	11-20	10
7	Male	40-50	White - British	Married	Vocational qualifications	2	Inspector/chief inspector or above	>20	0 (abstainer)
8	Male	30-40	White - British	Separated/divorced	A levels/Highers or equivalent	2	Police constable/sergeant	11-20	0 (abstainer)
9	Male	30-40	White - British	Living with partner	GCSE/O levels or below	0	Police constable/sergeant	6-10	12
10	Female	40-50	White - British	Married	A levels/Highers or equivalent	2	Police constable/sergeant	>20	8
11	Female	<30	Mixed - Other	Living with partner	Bachelor/postgraduate degree	0	Police constable/sergeant	<5	9
12	Male	<30	White - British	Single	Bachelor/postgraduate degree	0	Police constable/sergeant	<5	17
13	Male	30-40	White - British	Married	Bachelor/postgraduate degree	2	Special constable	6-10	0 (abstainer)
14	Male	<30	White - British	Single	Bachelor/postgraduate degree	0	Police constable/sergeant	<5	9
15	Male	>50	White - British	Married	Vocational qualifications	2	Police constable/sergeant	>20	8
16	Female	<30	White - British	Living with partner	Vocational qualifications	1	Police constable/sergeant	<5	15

9.3.3. Procedure

The study procedure is outlined in Figure 9.1. Potential participants could access a link to the online Qualtrics questionnaire, containing the information sheet, via the study advertisement. An email address and telephone number were required. At least 24 hours after reading the information sheet, participants received a link to a second Qualtrics questionnaire, containing a consent form and screening questionnaire (appendices 23-25). Those scoring between 8 and 19 on the AUDIT, or who were currently abstinent, were notified that they were eligible. Those scoring above 8 on the AUDIT also received a link to an online NHS brief alcohol intervention (https://www.nhs.uk/live-well/alcohol-support/), two weeks after completion, as they were drinking to at-risk levels.

A PhD researcher (PI), who completed a qualitative research workshop prior to conducting the study to develop necessary skills, contacted eligible participants via telephone to arrange the interview. As the researcher was female (most participants were male), with no previous experience working within the Police Service, this may have influenced responses, as participants may have felt more comfortable sharing their experiences with someone with no involvement with the Police Service. However, the researcher could not fully relate to their experiences, which may have influenced interpretation of the interviews. The telephone interview (conducted from PI's home) was audio-recorded, with consent. Interviews lasted between 10 and 60 minutes. After the interview, participants were debriefed on the telephone and via email (appendix 29). Participants were reimbursed with a £10 shopping e-voucher. The interview recordings were transcribed verbatim, removing identifiable information, and the pseudo-anonymised transcripts were sent to participants for approval. The recordings were deleted after the transcripts were approved.

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┌─────────────────────────────────────────┐
│ Potential participants clicked link to Qualtrics │
│ questionnaire, via study advertisement, which    │
│ contains information sheet.                       │
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                    │
                    ▼
┌──────────────────────────────────┐        ┌─────────────────────────────┐
│ After 24 hours, they could consent │        │ Anyone scoring above 20 on  │
│ to complete the Qualtrics          │───────▶│ the AUDIT will be sent a link│
│ screening questionnaire            │        │ to an online brief intervention│
└──────────────────────────────────┘        │ and will be notified that they│
                    │                        │ are not eligible to participate│
                    ▼                        └─────────────────────────────┘
┌─────────────────────────────────────────────────────┐
│ The researcher contacted eligible participants (scores 8-19 on AUDIT, │
│ or currently abstinent) to arrange a convenient time/date for the     │
│ interview, and sent another consent form for the interview.           │
└─────────────────────────────────────────────────────┘
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│ Obtained consent to record the interview. Conducted │
│ the telephone interview.                            │
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│ Participant debriefed. Debrief form, information on alcohol and │
│ mental health services and £10 Love2Shop vouched emailed.      │
└──────────────────────────────────────────────────────┘
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│ Researcher emailed pseudo-anonymised │
│ transcript of the interview.        │
└──────────────────────────────────┘
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│ Anyone scoring between 8 and 19 on the AUDIT automatically │
│ received an online brief intervention, 2 weeks after completing the │
│ screening questionnaire.                               │
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Figure 9.1. Flow diagram of the study procedure.

9.3.4 Data analysis

The transcripts were analysed using the six-step inductive thematic analysis (familiarisation, generating codes, generating themes, reviewing themes, naming themes, writing up), to allow the data to drive the codes and themes (Braun & Clarke, 2006, 2019), in NVivo 12. PI first transcribed, read, and re-read the qualitative data.

Relevant aspects of the data were coded systematically, creating a codebook to reflect the initial codes and give meaning. Codes were combined to create potential themes and sub-themes that depict the data. A second female PhD researcher (LJ) coded two transcripts (out of 16) to establish consistency. Memos (records of ideas about codes and their relationships) and meetings were used to discuss inconsistencies and ensure that the codes and themes supported the data, making changes if needed. The themes were then named and defined, and finally, written up below. The qualified research team, with formal training and experience conducting qualitative research, and discussions with the advisory group, helped to focus the findings and reduce influences from biases.

9.4 Results

This research explored UK police employees' experiences of at-risk alcohol use or abstinence from alcohol, reflected across five main themes and sub-themes (Table 9.2). The themes and sub-themes are presented in the thematic map (Figure 9.2), which shows the central theme, 'organisational culture of drinking and changes over time (theme 1)', linking to all other themes, as participants discussed the drinking culture and/or how it has changed when describing their motivations for drinking or abstaining, and when sharing their views on the availability of support for alcohol problems. Two themes, 'alcohol as a coping mechanism (theme 2)' and 'alcohol and socialising (theme 3)', are linked to each other as they both reflect motivations for drinking. Motivations for abstaining are outlined in theme 4, 'motivations for abstinence/cutting down'. The 5th theme reflected the 'contrasting perceptions of available support for alcohol problems'.

Table 9.2. Summary of themes and sub-themes in relation to the research aims category of participants.

Themes	Sub-themes	Relevant Group
1. Organisational culture of drinking & changes over time (aims 1 & 2)	1.1. General attitudes towards alcohol	At-risk drinkers & abstainers
	1.2. Cultural shift	At-risk drinkers & abstainers
2. Alcohol as a coping mechanism (aim 1)	2.1. Trauma exposure	At-risk drinkers only
	2.2. Job strain	At-risk drinkers only
3. Alcohol and socialising (aims 1 & 2)	3.1. Drinking to socialise with colleagues	At-risk drinkers only
	3.2. Social consequences of abstaining	Abstainers only
4. Motivations for abstinence/cutting down (aims 1 & 2)	4.1. Abstainers' motivations	Abstainers only
	4.2. At-risk drinkers' motivations	At-risk drinkers only
	4.3. Positive consequences of abstaining/cutting down	At-risk drinkers & abstainers
5. Contrasting perceptions of available support for alcohol problems (aim 2)	5.1. Discipline	At-risk drinkers & abstainers
	5.2. Lack of awareness	At-risk drinkers & abstainers
	5.3. Awareness and support available	At-risk drinkers & abstainers
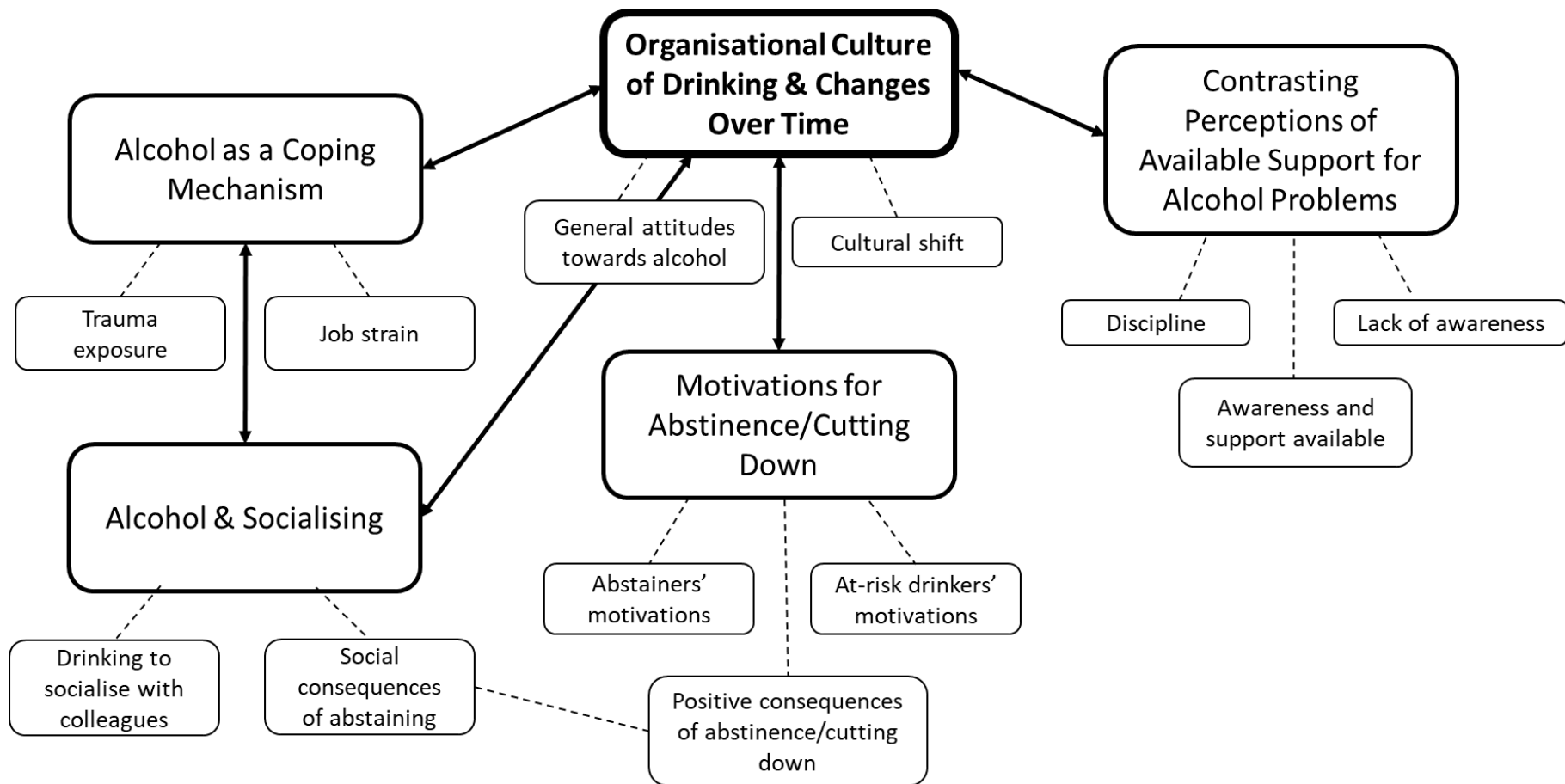
Figure 9.2. Thematic map showing the five main themes and their sub themes (connected with dashed lines). The arrows represent the links between the themes, with all themes linking to the central organising concept (in bold). 'Alcohol as a coping mechanism' and 'alcohol & socialising' are linked as they both reflect motivations for drinking.

9.4.1 Theme 1: Organisational culture of drinking and changes over time

All participants discussed the culture of drinking within the Police Service, and how this has changed over the years. The latter is reflected in sub-theme two, 'cultural shift', whereby participants stated that the drinking culture is no longer prominent and described possible reasons for this. The first sub-theme, 'general attitudes towards drinking', outlines police employees' views on the norms and attitudes towards alcohol, as well as perceptions of what constitutes problematic use.

9.4.1.1 Sub-theme 1: General attitudes towards alcohol

Participants shared their own attitudes towards alcohol and their perceptions of how alcohol is viewed, in general, within the Police Service. Most notably, heavy drinking was perceived as normative amongst colleagues and participants suggested that this was understandable, and unproblematic. It was apparent that dark humour was commonly used when alcohol was discussed between colleagues, "an underlying running joke about, you know, drinking too much, not talking to people" (P14, male, at-risk drinker).

> "There are things that can be a bit of machismo around policing. It's understandable, it can be a can be a really high stressed job and sometimes there's an expectation that, you know, you'll have to go out and have a drink to sort of relax after that shift… But I think the culture is like any other workplace - or where I said sports team, it reminds me of sports teams from Uni days." - P13 (male, abstainer)

There were contrasting perceptions of the current drinking culture, with the older employees (e.g., P15) believing that the drinking culture was still prominent amongst the younger employees, but this was not apparent from the interviews with younger employees (e.g., P5), who described a culture that was more accepting of abstinence.

> "I think there's a culture, you've got probably a 50/50 culture. You've got the older officers who - it's a socialising way of - not so much coping - but just to get out and talk rubbish, you know, with your colleagues and your

friends. But then you've got the younger officers who are, you know, out til 4/5 in the morning" - P15 (male, at-risk drinker)

"It's less common nowadays, the drinking culture in the police… It's much more accepted nowadays that some people don't drink through choice not just because of religion or because they've had a problem in the past, it is a lot more common now than it used to be" - P5 (male, abstainer)

Participants appeared to only view alcohol consumption as problematic if extreme, despite all participants in the at-risk drinking group meeting criteria for hazardous or harmful alcohol consumption. These normative beliefs may relate to the stigma surrounding alcohol problems.

"I have spoken to colleagues about it, saying, I'm not dependent on it but I do drink more than the government would probably recommend, but I think it's just being able to be aware of it and I don't think people would own up to that… there's still a stigma around it, like mental health I suppose." - P6 (female, at-risk drinker)

9.4.1.2 Sub-theme 2: Cultural shift

Participants described how the culture of drinking (e.g., regularly drinking to socialise with colleagues) has changed over the years and is now not as apparent as it used to be, with one participant stating, "years ago, it used to be everyone up the pub, stuff like that, but that's sort of disappeared now" (P10, female, at-risk drinker). The removal of police bars (canteens) was addressed as a major reason for this cultural shift, and those with many years of service recalled the previous drinking norms and their experiences of section houses (accommodation provided for employees).

"When I first started, we all lived in section houses, which was like a big police block. So, there were 50 Old Bill in there, and it was like a big hostel really, for coppers, and that was on the ground that we worked... So, when I first joined the job that was the normal - the done thing - you'd join the late turn, you'd get straight on the piss after, about 10 o'clock, and you'd basically hammer the bar for an hour/2 hours, until they kicked you out." P7 (male, abstainer)

Although this cultural shift can generally be viewed as positive, as heavy drinking is "no longer encouraged" (P8, male, abstainer), one participant highlighted the negative

aspects of these changes, suggesting that this now makes it more difficult to identify colleagues who may be struggling with problematic alcohol use and intervene:

> "In some respects, and I've got nothing to back this up, it was more controlled when you had the canteen and the bars. Whereas now they've closed, it sounds a bit strange, but you notice if one of your friends is drinking to excess, you think is there a problem there, is everything ok? Whereas that used to be picked up on and noticed by your colleagues, but now people just - I know for a fact, because I've seen them - they go home and close the door and drink themselves into a stupor and then obviously hopefully sober up before the morning." - P15 (male, at-risk drinker)

9.4.2 Theme 2: Alcohol as a coping mechanism

Discussions surrounding the mental health consequences of the job were strikingly apparent in both at-risk drinkers and abstainers, with one participant stating that their regular mental health screenings often show "compassion fatigue" and "obviously levels of PTSD" (P2, male, at-risk drinker). Participants shared their experiences of traumatic incidents, which has impacted their mental health, with some taking time off work due to poor mental health. This was also related to alcohol use, as the quote below is from a participant who stopped drinking when they took time off due to poor mental health.

> "There was a period a couple of years ago when I had to take a bit of time off from it because it was just mentally- mental health wise I wasn't doing very well." - P5 (male, abstainer)

Participants also discussed the demands of the job and how this negatively impacts employee well-being, such as the change to mostly single crewing, which has reduced peer support whilst on duty. Given that participants reported using alcohol to cope with both trauma exposure and job demands, this theme contains two sub-themes: 'trauma exposure' and 'job strain'.

> "Because we've got single crewed cars now, officers work predominantly on their own, again, it's changed because when I was there you were almost always double crewed, so there was someone to talk to, someone to share issues" P15 (male, at-risk drinker)

9.4.2.1 Sub-theme 1: Trauma exposure

In this sub-theme, participants described using alcohol as a crutch, particularly after traumatic incidents. Alcohol was used to cope both alone, and with others, after collective experiences. It was suggested that alcohol could help colleagues to talk through a traumatic incident, "and the booze helps, it loosens the tongue" (P7, male, abstainer).

> "But if the late shift has been particularly busy or there's been some horrible stuff, I do try and fill my time quite a lot. I find it hard if I get home and if I don't have a drink, it's just sometimes harder to unwind. So, I know it's a bit of a crutch in a way, because I use it to relax." - P6 (female, at-risk drinker)

> "There's certain jobs where you go to - like suicides or, I mean horrible suicides like at train stations or hanging… the first thing you sort of do, is have a drink. Rather than sort of going round and saying oh let's talk about it, let's have a drink first and then talk about it" - P9 (male, at-risk drinker)

There was some awareness of the potential to become reliant on alcohol as a coping mechanism, with one participant stating, "I don't want to get down that slope of always drinking just to forget about what I've been to and what I've seen" (P16, female, at-risk drinker). It was suggested that this is more of a concern since joining the Police Service, "if do that now [drink to forget], dealing with the traumatic incidents that I'm dealing with, I will always lean on it as a crutch (P16, female, at-risk drinking).

9.4.2.2 Sub-theme 2: Job strain

Alcohol was not only used to cope with traumatic incidents but was also used to cope with more general work stressors, such as the intensive workloads. It was apparent that alcohol was used to 'switch off' after work, and to signify the end of the working day, with participants stating that, "if you've had a drink, you're definitely off duty" (P4, male, at-risk drinker).

"Sometimes the worries and stressors at work are not actually just related to the type of incidents I'm dealing with, sometimes it's just the volume of work I've got on at a particular time… To stop my mind racing, quite often I have a drink because yeh, it just sort of numbs that down a bit and I can relax" - P6 (female, at-risk drinker)

9.4.3 Theme 3: Alcohol and socialising

Participants also reported social reasons for drinking, especially with colleagues, which is reflected in the first sub-theme (drinking to socialise with colleagues). Socialising with alcohol was generally viewed positively by at-risk drinkers, but caused some abstainers to feel excluded, as highlighted in sub-theme two (social consequences of abstaining). Across both sub-themes, there were contrasting perceptions between the older and younger employees, and between police officers and staff.

9.4.3.1 Sub-theme 1: Drinking to socialise with colleagues

Participants shared their experiences of socialising with colleagues, which tended to include drinking for the at-risk drinkers. For example, one participant stated, "the only time I ever meet colleagues outside of work is to meet up for a beer" (P3, male, at-risk drinker). However, linking with the central theme, 'organisational culture of drinking and the changes over time', it was apparent that the way police employees socialise has shifted over time, with some teams now choosing social activities that do not revolve around drinking.

"I think over the years, what's happened in the police, is I think a lot of that's changed. I mean sure, again that probably varies across teams, but certainly within the team I'm in now, we don't tend to arrange – any social stuff we tend to do, it tends to not necessarily revolve around drink. So, we might do team building stuff, erm or meet up for a walk… Early on in my career if there was like a social it was always going to be at a pub, certainly now, it's different stuff." - P6 (female, at-risk drinker)

The use of alcohol to socialise with colleagues was more apparent in older police employees who had served for several years and had stayed in residential police academies.

> "When I joined the police, it was - certainly in training school, because we did it residentially, there was quite a big - I don't want to say drinking culture, but it was almost like a social aspect of it… We would go to training school together, we'd come home, we'd have dinner and then we'd go out to the local sort of club to have some drinks together." - P12 (male, at-risk drinker)

9.4.3.2 Sub-theme 2: Social consequences of abstaining

This sub-theme was relevant to the abstainers only. In the previous sub-theme, participants described using alcohol to socialise with colleagues, and this sub-theme highlights the negative social consequences experienced by police employees who abstain from drinking. Some abstainers described being viewed and treated differently when they made the decision to abstain (particularly after being a previous heavy drinker).

> "I'm just not part of that that companionship anymore, certainly now that I don't drink, you tend to get left out a little bit, tend to be, sort of not included in it…. It had a massive impact on work, people just wouldn't speak to me… I wouldn't get invited to drinks, because they didn't see that I could go to a pub…" - P7 (male, abstainer)

However, there were contrasting experiences within the abstainers. One abstainer reported positive social experiences with colleagues, as abstinence was quite prominent in their office. This may highlight differences in the culture and social environment of drinking, between staff and officers, or younger and older employees.

> "I'm quite fortunate in my office, there's quite a lot of people that don't drink either. It's quite relatively prominent in my office, either for personal or sort of erm family reasons that they don't like to - so I'm not, I don't tend to feel peer pressured into it, I can just sort of enjoy hanging out with my mates" - P5 (male, abstainer)

9.4.4 Theme 4: Motivations for abstinence/cutting down

This theme reflects the motivations for, and benefits of, abstinence or cutting down drinking. This theme is not unique to abstainers, as at-risk drinkers also reported cutting down or periods of abstinence. Therefore, the sub-themes are separated into 'abstainers' motivations' and 'at-risk drinkers' motivations' to show the distinctions. Both groups also shared positive consequences of abstaining or cutting down, outlined in the final sub-theme.

9.4.4.1 Sub-theme 1: Abstainers' motivation

Amongst the four abstainers, there were two distinct reasons for abstinence. One reason related to working in the night-time economy and witnessing excessive drinking, and "the same drunkenness and fights and arguments" (P13, male, abstainer). Regularly dealing with alcohol-related incidents provided an incentive to abstain from drinking, with one participant stating, "I can see from the outside how all these people are excessive drinking, and I don't want to be like that" (P13, male, abstainer). Others made the decision to abstain because alcohol was creating a problem, for example, by worsening an existing mental health problem, or interacting with medication for a mental health problem.

> "I'd drank a litre of gin on my own or just under a litre I believe, something like that, and as a result of that, that's when I ended up self-harming, I think we'd had an argument or something, ended up self-harming and that's when I tried to kill myself… and it was from that point that I was told that because of the medication I was on, I shouldn't drink on it, and I've just stuck to it really from then." - P8 (male, abstainer)

9.4.4.2 Sub-theme 2: At-risk drinkers' motivations

As with the previous sub-theme, at-risk drinkers' motivations to cut down drinking also related to impact of alcohol on mental health, or on physical health, "I was starting to put on a little bit of weight" (P10, female, at-risk drinker). Some at-risk drinkers

were able to see the benefits of reducing their consumption or having periods of abstinence and used this to self-monitor their own drinking habits.

> "I think for me psychologically I've noticed a difference by the complete abstinence and not drinking and not feeling tired and not feeling rough and not feeling miserable. I think I've been able to make that connection. I can have a couple of drinks and enjoy it and it doesn't impact on my mental health. Whereas if I was to keep going and drink in the week, it would do"
> - P1 (female, at-risk drinker)

9.4.4.3 Sub-theme 3: Positive consequences of abstinence/cutting down

The previous two sub-themes highlighted the negative impact of alcohol on mental and physical health and abstaining or cutting down can be beneficial for improving wellbeing. This sub-theme links to the sub-theme, 'social consequences of abstaining' as it shows the contrasting benefits of not drinking. For example, one abstainer described gaining weight whilst drinking and stated, "when I stopped drinking the weight dropped off, and I've been running marathons and ultras and iron men" (P7, male, abstainer). Participants also discussed the mental health benefits of abstaining.

> "The alcohol I think was just masking problems or even exacerbating it at certain times so, I think it gives you clearer thinking processes and what have you. I mean there's the obvious benefit of not having a hangover or not feeling worse for wear and everything." - P8 (male, abstainer)

9.4.5 Theme 5: Contrasting perceptions of available support for alcohol problems

The final theme outlines the contrasting views of the available support for alcohol problems within the Police Service. Across the interviews, participants discussed the availability of support for alcohol problems in comparison to support for mental health problems, and it was apparent that mental health support is now widely accessible. However, there were no consistent perceptions of available support for alcohol problems across participants, highlighting that there may be variations across forces and roles.

9.4.5.1 Sub-theme 1: Discipline

The first sub-theme worryingly showed that some police employees were unaware of available support for alcohol problems and outlined that misconduct or unsatisfactory performance procedures are sometimes used. The below quote highlights that this may be a result of stigma towards alcohol problems.

> "I mean one of my colleagues did end up losing her job because she was drinking too much, so I know that there is an issue in certain areas and with people who can't recognise when it becomes a problem, but I don't know whether it is talked about openly and honestly." - P6 (female, at-risk drinker)

Nevertheless, it appeared that this has changed over the years, as misconduct or unsatisfactory performance procedures were the previous course of action for alcohol problems and was a 'taboo' topic, whereas now support is offered to those who need it.

> "It's definitely changed since I joined, when I joined, pretty much if you had a problem in any way shape or form, you hid it, because if you didn't and it came out, you'd either be punished by being disciplined or you'd be put on a unit where you were taken away from the public, so it's very much like a taboo sort of subject, but I think now they're far more understanding." - P8 (male, abstainer)

9.4.5.2 Sub-theme 2: Lack of awareness

Other participants were aware of support for mental health problems but were not aware of any services specifically relating to alcohol. It was clear that participants were aware of the link between poor mental health and using alcohol to cope, and how that could contribute to problematic use. However, participants were unaware of alcohol services within the Police Service.

> "I think because suicide is quite a high thing in the police force, they kind of hammer that home, as opposed to having [poor] mental health and then what you what it makes you do. So probably people that have mental health problems probably do drink a lot, or they do a lot of other things because they're not coping. But they don't really address drinking or doing the

other things, it's more just about your mental health" P11 (female, at-risk drinker)

9.4.5.3 Sub-theme 3: Awareness and support available

In contrast, some participants were aware of available support and knew how to seek support from within their police force, should they need it. The improved emphasis on police employee wellbeing was apparent. One participant described a range of avenues to seek official internal help for alcohol problems, such as "internal counselling network" and "occupational health" (P12, male, at-risk drinker), as well as confidential help which may be off the record.

> "I think the police in the last- certainly pre- you know, maybe 10 years ago- had a very bad reputation for its officer welfare and that's something that it is trying it improve... It's not great still, but it's better than it was, but there are definitely outlets both confidential and official that an officer that was struggling with alcohol issues could go down" - P12 (male, at-risk drinker)

9.5 Discussion

9.5.1 Key Findings

This is the first study to explore police employees' experiences of at-risk drinking or abstinence. Sixteen participants, from diverse age groups and roles, described a shift in policing drinking culture, which was partly attributed to the removal of bars in police stations (Theme 1). Although drinking is no longer encouraged, participants regarded heavy drinking as normal. Moreover, using alcohol to cope with the distressing and demanding aspects of policing was common (Theme 2). Contrastingly, alcohol was also used to socialise with colleagues, particularly amongst the older employees, but again, it was apparent that this is shifting (Theme 3). Abstinence was motivated by observations from working in the night-time economy or because of the negative impacts of alcohol (Theme 4). Finally, the awareness of available support

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differed across participants, with some being aware of support and how to access it, whereas others were unaware or believed alcohol problems would be met with disciplinary procedures (Theme 5).

9.5.2 Drinking Culture

The drinking culture within policing is no longer prominent, but heavy drinking is still perceived as normal, and discussed positively or in relation to dark humour (Brough et al., 2016), as opposed to the harms. This aligns with the social norms theory, whereby misperceptions of others' consumption leads to increases in one's own consumption (Berkowitz, 2003; Perkins, 2003), which often occurs in workplaces (Barrientos-Gutierrez et al., 2007). Alcohol is still commonly used to socialise within some teams, particularly amongst older employees, and this can cause some abstainers to feel left out (Bartram, Eliott, & Crabb, 2017; Bartram, Eliott, Hanson-Easey, & Crabb, 2017). However, a cultural shift was clear, as younger abstainers described more positive experiences of socialising without alcohol, which may relate to the increase in abstinence among young people in the UK general population (Fat et al., 2018). These findings also highlight differences in the organisational culture of drinking between abstaining police officers (feeling left out) and staff (feeling accepted). Linking with epidemiological findings (Irizar, Gage, et al., 2021), staff were more likely to report abstinence than officers, and older employees were more likely to report at-risk drinking than younger employees. The removal of police bars appears to have contributed to the cultural shift, but worryingly, there were concerns that this could lead to hidden alcohol problems and reduced peer support (Turner & Jenkins, 2019). However, planning alcohol-free team-building activities may help to change the culture whilst encouraging bonding and improving mental health (Wheeler et al., 2020).

9.5.3 Drinking to Cope

Participants experienced traumatic incidents and reported poor mental health, with some needing time off work, as a result. Epidemiological data of UK police employees suggests a J-shaped relationship, as poor mental health was associated with both abstinence and harmful drinking (Irizar, Gage, et al., 2021). The present findings are harmonious with this, as the at-risk drinkers described using alcohol to cope with distressing incidents or the demands of the job, and a notable motivation for abstaining was the detrimental impact of alcohol on mental health. Taken together, these findings are congruent with the self-medication hypothesis (Khantzian, 1997), indicating that UK police employees suffering from a mental health problem may be more likely to use alcohol as a coping mechanism, which could lead to harmful use (Holahan, Moos, Holahan, Cronkite, & Randall, 2001; Irizar et al., 2020). This could be driven by the machismo culture, whereby seeking peer support is made easier with alcohol (Edwards & Kotera, 2020). Alternatively, the present findings indicate that some individuals may abstain from alcohol because of declining mental health, supporting the sick quitter hypothesis (Shaper et al., 1988).

9.5.4 Availability of Support

The contrasting perceptions of available support for alcohol problems may highlight discrepancies across forces or roles. Some participants knew how to access confidential and official support, internally through occupational health or counselling services. Others were unaware of support for alcohol problems, contrasting the widespread support for mental health problems. Concerningly, some thought disciplinary procedures resulted from problematic alcohol use, which could prevent employees from seeking help (Jones, Agud, & McSweeney, 2020). The availability of support for mental health problems highlights advances in reducing mental health

related stigma, though research shows that it is still prevalent in policing (Bell & Eski, 2015; Edwards & Kotera, 2020). The stigma surrounding problematic alcohol use is apparent and there is a misperception that heavy drinking is not problematic unless extreme (Parke et al., 2018; Schomerus, Matschinger, & Angermeyer, 2013). This binary classification can prevent help-seeking through beliefs that their drinking is not 'bad enough' (Morris, Albery, Heather, & Moss, 2020), and delayed help-seeking can exacerbate problems (Chapman, Slade, Hunt, & Teesson, 2015). Workplace psychoeducation may increase awareness on what problematic alcohol use is and how to recognise it in oneself or others.

9.5.5 Strengths & Limitations

A strength of this research is that both warranted police officers and non-warranted police staff, across a diverse range of roles, were recruited nationally, increasing the generalisability of the findings. Despite recruiting a sufficient number of at-risk drinkers for data saturation, only four abstainers were recruited, though this may be because only 9% of the UK Police Service are abstinent (Irizar, Gage, et al., 2021). A further limitation is the self-selected sample, as these individuals may have strong opinions or negative experiences that they wish to share and may not reflect the views of others (Robinson, 2014). For example, those choosing to abstain because of problems caused by alcohol may be more likely to speak negatively about the drinking culture in the police. Social desirability bias is a concern (Bergen & Labonté, 2020), given that the Police Service is often subject to public scrutiny (Delsol & Shiner, 2006), meaning participants may be more likely to report desirable behaviour (e.g., no prominent drinking culture and support is available).

9.6 Implications

Understanding the current drinking culture and availability of support in the UK Police Service is vital for reducing alcohol-related harm. The practical implications of the study findings are threefold. First, the acceptability of heavy drinking and misperceptions of problematic use highlight a need for education, within the workplace, on 'low-risk' levels of drinking and the harms of regularly drinking above government guidelines (Ames, Bennett, & Health, 2011; Sieck & Heirich, 2010). Second, these findings provide further support for the integration of mental health and alcohol services, and routine screening for comorbidity (Debell et al., 2014b), especially within high-risk occupations, such as policing, where employees may be more likely to use alcohol to cope (Irizar, Puddephatt, et al., 2021). Finally, support for problematic alcohol use should be available and accessible within all forces.

9.7 Conclusions

Overall, these findings suggest a shift in the drinking culture within the UK Police Service, coinciding with the removal of police bars. Heavy drinking is no longer encouraged but is still normalised. Police employees appear to be an occupational group at risk of using alcohol to cope, given the frequent trauma exposure and intensive demands, and increased single crewing has reduced social support from colleagues. Alcohol awareness training should be implemented within the workplace; support must be accessible for all police employees; and managers must be aware of how to identify and signpost those needing support. Future research should investigate the effectiveness of workplace education and interventions targeting at-risk drinking within the Police Service.

Chapter 10: Triangulation of quantitative and qualitative findings.

10.1 Foreword

What is already known from the previous Chapters?

- Chapter 5 identified the prevalence of hazardous (33%) and harmful (3%) alcohol use (and abstinence, 9%) in the UK Police Service. Those with poor mental health had significantly greater odds of reporting harmful alcohol use, and abstinence. Those reporting high strain had decreased odds of reporting hazardous drinking.

- In separate analyses, Chapters 6 and 7 found similar levels of probable PTSD but higher levels of harmful drinking (and comorbidity) in male and female military personnel, compared to male and female police employees, respectively.

- Chapter 8 determined five classes of health (risk) behaviours in police employees, finding that those with poor mental health had at least double the odds of being assigned to the "high health risk behaviours" class. Men and women with probable depression were more likely to be in the "healthy abstainers" class. For both genders, high strain was associated with the "low risk drinkers with other health risk behaviours" class.

- Chapter 9 identified five themes relating to police employees' experiences of drinking or abstaining. Participants described the 'organisational culture of drinking and changes over time'. Motivations for drinking were reflected across two themes, 'alcohol as a coping mechanism' and 'alcohol and socialising', with another theme representing 'motivations for

abstinence/cutting down'. The final theme highlighted the 'contrasting perceptions of available support' for alcohol problems.

What does the current Chapter aim to do?

- This Chapter triangulated the quantitative and qualitative findings to enhance the credibility of the results and provide a more comprehensive understanding of alcohol use and abstinence in the UK Police Service.

- The quantitative findings from Chapter 5 and Chapter 8 were triangulated with the qualitative findings from Chapter 9, to disentangle the complementary and dissonant findings. The quantitative findings from Chapters 6 and 7 were not included in the triangulation as the qualitative Chapter did not include military personnel.

What new findings does this Chapter add?

- The triangulated findings indicate a J-shaped relationship between mental health and alcohol consumption in UK police employees, whereby poor mental health is associated with both abstinence and harmful drinking.

- The triangulated findings also indicate that older police employees (who have served for many years), and police officers, are more likely to engage in harmful behaviours than younger employees (new recruits), and police staff.

10.2 Summary of findings

This thesis took a sequential multi-method approach, whereby multiple methods of data collection were used in related studies. This Chapter integrates the findings from the related quantitative and qualitative studies to make inferences. This Chapter first summarises the quantitative and qualitative findings, then presents the

triangulated quantitative and qualitative findings, separated into the complementary findings and the dissonant findings.

An epidemiological study was first conducted, identifying the prevalence of hazardous and harmful alcohol use (and abstinence) in the UK Police Service (Chapter 5), and their associations with mental health and job strain. Chapter 5 showed that poor mental health was associated with harmful drinking (and abstinence), and this informed the development of Chapter 8, as evidence shows that health risk behaviours often cluster together (e.g., harmful drinking, poor diet, smoking) (Noble, Paul, Turon, & Oldmeadow, 2015). Chapter 8 examined the classes of health risk behaviours in the UK Police Service and determined their associations with mental health and job strain. The quantitative findings from Chapter 5 and Chapter 8 then informed aspects of the qualitative interview study (Chapter 9), such as the eligibility criteria (e.g., including abstainers) and the topic guides (e.g., asking about impact on physical health). The interview study explored UK police employees' experiences of hazardous/harmful drinking or abstinence, including their motivations for use (e.g., in relation to mental health) and the organisational culture of drinking within the Police Service.

10.2.1 Summary of quantitative findings (Chapter 5)

In a sample of approximately 40,000 UK serving police officers and staff, 33% met criteria for hazardous drinking (40% of men, 19% of women) and 3% met criteria for harmful drinking (3.4% of men, 2.5% of women). A total of 9% of the sample reported abstinence (7.6% of men, 11.9% of women). Compared to those without a mental health problem, those meeting criteria for probable depression, anxiety or PTSD were twice as likely to drink harmfully and/or frequently binge drink. Other participants with a mental health problem were also more likely abstain, compared to those without a mental health problem. Compared to abstainers who had never drank

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alcohol, former drinkers were more likely to meet criteria for depression. High job strain was associated with a lower likelihood of reporting hazardous alcohol use, compared to low job strain, and this was moderated by mental health status as this association was only significant in police employees without a mental health problem, when the sample was stratified by mental health.

This study identified the characteristics of police employees with greater odds of meeting criteria for hazardous drinking, harmful drinking, and abstinence. Men were more likely than women to report hazardous and harmful drinking, whereas women were more likely to report abstinence. Those aged over 40 years old, compared to those under 40 years old, were more likely to drink hazardously or harmfully. In terms of occupational characteristics, having served for over 10 years (versus less than 10 years) and holding a police officer role (versus staff) were associated with greater odds of hazardous or harmful drinking. Police staff were more likely to abstain.

10.2.2 Summary of quantitative findings (Chapter 8)

Chapter 8 examined the latent classes of health (risk) behaviours in the same sample of 40,000 police employees and explored their associations with mental health and job strain. Five classes were identified, with the smallest representing "high health risk behaviours" and the most common reflecting "low risk drinking but other health risk behaviours", for both men and women. Both genders also had two healthy classes ("healthiest" and "healthy abstainers", which can be distinguished from each other, as the "healthiest" class included more low risk drinkers, with the highest probabilities across all other health behaviours, such as non-smoking and high physical activity). The final class reflected "some health risk behaviours but physically active" for men, and "moderate health risk behaviours" for women. For both genders, poor mental health was associated with at least double the odds of being assigned to the "high health

risk behaviours" class. Men and women reporting probable depression were also more likely to be in the "healthy abstainers" class (this was also true for men with probable anxiety or PTSD). For both genders, reporting high strain (versus low strain) was associated with increased odds of being assigned to the "low risk drinking but other health risk behaviours" class suggesting that even though they weren't drinking to cope with the strain they were undertaking other unhealthy behaviours.

Chapter 8 also explored the sociodemographic and occupational characteristics of the classes. For both men and women, police employees aged over 40 had double the odds of being in the "high health risk behaviour" class (compared to those under 29 years old), whereas those under 29 years old had increased odds of being in the "low risk drinkers but other risks" class. In terms of occupational characteristics, male and female police employees who had served for more than 10 years had increased odds of being in the "high health risk behaviours" class.

10.2.3 Summary of qualitative findings (Chapter 9)

A total of 12 police employees who met criteria for hazardous or harmful drinking and four police employees who reported current abstinence from drinking, were interviewed. Their experiences were captured across five themes and several sub-themes. The central theme reflected the organisational culture of drinking and changes over time, which outlined the positive normative beliefs about heavy drinking. This theme also indicated a cultural shift, as drinking is no longer encouraged within the Police Service, with the drinking culture subsiding since the removal of police bars.

Many participants described their experiences with trauma exposure and the intensive demands of the job. Some stated that they needed to take time off work due to poor mental health. The hazardous and harmful drinkers discussed using alcohol as

a crutch to cope with traumatic incidents or to 'switch off' after a demanding day and suggested that alcohol helped colleagues to talk with each other. Alcohol was also used for social reasons, especially amongst the older officers, who held the misperception that younger officers were continuing the heavy drinking culture, but this was not apparent from the younger participants. There were also differences between abstaining officers and staff, as staff described more positive experiences and engaging in work events that did not include alcohol, whereas officers reported feeling left out. Abstainers were motivated to stop drinking because of their experiences working in the night-time economy, regularly witnessing drunk people, or because of the negative effects of alcohol on their mental or physical health. Some hazardous and harmful drinkers stated that they were motivated to cut down their drinking when they noticed that it was impacting their mental health, and to be physically healthier.

10.3 Complementary findings

10.3.1 Mental health associations

Several key findings from the quantitative and qualitative studies complement each other, enhancing the credibility. Most notably, the findings allude to a J-shaped relationship between alcohol consumption and mental health, whereby poor mental health is associated with both abstinence and harmful drinking, but positive reports of mental health are associated with low-risk drinking (El-Guebaly, 2007; Puddephatt et al., 2021). In Chapter 5, police employees reporting a probable mental health problem had greater odds of reporting harmful drinking and abstinence, compared to those without a mental health problem. Chapter 8 extended those findings as police employees with a probable mental health had increased odds of engaging in multiple health risk behaviours (i.e., harmful drinking, smoking, insufficient fruit and vegetable intake), whereas others with a mental health problem were more likely to abstain from

drinking *and* engage in health behaviours such as physical activity and a good diet. In Chapter 9, those meeting criteria for hazardous or harmful drinking described using alcohol to cope with witnessing traumatic incidents (e.g., to make it easier to talk to peers) and to cope with the demands of the job (e.g., intensive workload). In addition, one of the motivations for abstaining from drinking related to the negative effects of alcohol on mental and physical health. The latter finding also complements the exploratory findings from Chapter 5, whereby former drinkers (now abstinent) were more likely to meet criteria for depression than abstainers who had never drunk alcohol.

10.3.1.1 Self-medication hypothesis

There are a few existing explanations for the J-shaped relationship. Regarding harmful behaviours and poor mental health, the primary explanation is the self-medication hypothesis (Khantzian, 1987, 1997), suggesting that individuals use substances (or behaviours, such as eating or gambling) to reduce negative affective states, and the present findings support this hypothesis. Given the social acceptability and availability of alcohol, and because police employees are regularly drug tested (Home Office, 2012), police employees are more likely to use alcohol to cope with poor mental health, than other substances. Similarly, the findings are in line with one of Cooper's four dimensions of drinking motivations, 'drinking to cope' (Cooper, 1994), which suggests that a key motivation for drinking is to cope with stress or to forget problems. The findings from this thesis show that UK police employees with poor mental health were more likely to engage in harmful drinking and other health risk behaviours, such as smoking, compared to police employees without a mental health problem. The qualitative findings indicated that police employees often used alcohol after experiencing a traumatic incident, with some stating that alcohol makes

it easier to talk through the experience with colleagues. In addition, police employees described using alcohol to cope more broadly with routine stressors and the demands of the job.

10.3.1.2 Sick quitter hypothesis

In terms of abstinence and poor mental health, a key explanation is the sick quitter hypothesis (Shaper et al., 1988), which proposes that higher levels of poor mental health are observed in former drinkers than lifetime abstainers, as former drinkers become abstinent due to the mental health consequences of drinking, or because alcohol interacts with prescribed medication (Skogen et al., 2011). Similarly, this hypothesis suggests that individuals may stop drinking due to poor physical health, and it may be that police employees in the "healthy abstainers" class stopped drinking and started engaging in healthy behaviours to improve their physical health. Therefore, the quantitative and qualitative findings are in line with the sick quitter hypothesis, by demonstrating that police employees with poor mental health are more likely to abstain from drinking, with a key reason being the negative impact of alcohol on their mental health.

10.3.1.3 Social consequences of abstinence

Another explanation of the relationship between poor mental health and abstainers, is that the social consequences of abstinence may lead to poor mental health (Lucas, Windsor, Caldwell, Rodgers, & Alcoholism, 2010). For example, in the qualitative study, some police employees who were abstinent described feeling left out of social situations. Though they did not explicitly state that this contributed to worsened mental health, it is a possibility. Moreover, Chapter 5 and Chapter 8 showed that police employees from ethnic minority groups were more likely to be abstinent (or "healthy

abstainers"), compared to White police employees. Existing evidence has demonstrated ethnic inequalities in mental health problems (Bamford, Klabbers, Curran, Rosato, & Leavey, 2021), and these inequalities may be exacerbated within the UK Police Service, given that only 7% of police employees are from ethnic minority backgrounds (Allen & Audickas, 2020). However, further research is required to understand the experiences of ethnic minority groups within policing, as they were not represented in the present qualitative research.

10.3.2 Sociodemographic and occupational characteristics

Many of the exploratory sociodemographic and occupational associations observed in Chapter 5 and Chapter 8 are supported by findings from the qualitative study. For example, Chapters 5 and 8 showed higher levels of harmful drinking and other health risk behaviours in older police employees and those who had been in service for over 10 years. In the qualitative study, the older participants who had served for many years described the previous heavy drinking culture within the UK Police Service, as they joined before the removal of bars in stations, and they reported using alcohol to socialise with colleagues or to help talk through problems. These experiences were less apparent in younger participants, who had been in service for fewer than five years. It may be that older police employees continue the heavy drinking that was the norm when they first joined the Police Service. These findings also support current trends in the general population, whereby rates of harmful drinking are highest in people aged between 55-64 years old (McManus et al., 2016), with youth drinking declining (Oldham et al., 2020). Qualitative research of older adults in the general population explored reasons for harmful drinking, finding that it was viewed as normal behaviour for those in good health (Wilson et al., 2013). Taken together, these findings conform with the social norms theory (Berkowitz, 2003;

Perkins, 2003), whereby misperceptions of others' heavy drinking encourage one's own heavy drinking. Although this theory was originally applied in students, there is evidence that social norms occur within workplaces (Barrientos-Gutierrez et al., 2007).

The quantitative and qualitative studies identified differences between police officers and police staff. The quantitative findings showed that police officers had greater odds of drinking hazardously or harmfully, compared to police staff, and police staff had greater odds of reporting abstinence (specifically males, in Chapter 8). In the qualitative study, police staff reported more positive experiences of abstinence, stating that abstinence was becoming more common and not just for religious or cultural reasons. In contrast, police officers who were abstinent reported feeling left out and described not being invited to social events. Again, this could reflect age differences, as the police staff were younger, and abstinence is becoming much more common amongst younger adults in the general population (NHS Digital, 2018b). This links with the social norms theory (Berkowitz, 2003; Perkins, 2003), as younger police staff may have more positive experiences of abstinence because it is normative amongst their colleagues and peers, with the opposite being true for older police officers. In terms of hazardous or harmful drinking, it was primarily the police officers who described drinking to socialise with colleagues, or to help talk through traumatic experiences. Therefore, the differences in hazardous or harmful drinking between police officers and police staff may reflect differential experiences from their roles.

10.4 Dissonant findings

10.4.1 Job strain associations

Despite many of the quantitative and qualitative findings supporting each other, there were some dissonant findings. For example, Chapter 5 found that police

employees reporting low job strain were more likely to drink hazardously than those reporting high job strain (with Chapter 8 indicating that those reporting high strain engage in other health risk behaviours, such as smoking or insufficient physical activity). When stratifying the sample by mental health status, the relationship between low job strain and hazardous drinking was only apparent in police employees without a mental health problem. Contrasting this, the interviews found that job stain was a motive for alcohol use, as participants described using alcohol to 'switch off' after work and to cope with the intensive job demands, such as long hours, reduced officer numbers, and single crewing. Participants in the qualitative study discussed the detrimental impact of the 2010 budget cuts, which resulted in substantially fewer officers (Allen & Audickas, 2020), increasing demands, and leading to dangerous practices such as single crewing (Houdmont et al., 2019).

It is possible that because the quantitative data was collected between 2006 and 2015 (Elliott et al., 2014), and the budget cuts occurred in 2010, the impact of increased demands on drinking behaviours may only be apparent in recent years. Alternatively, the drinking behaviours of those reporting high job strain could be polarised, with some police employees drinking hazardously/harmfully to cope with the organisational stressors, whereas others reduced their consumption, possibly due to alcohol affecting their ability to manage the stressors (which could be why high job strain was associated other health risk behaviours, such as smoking, which are less likely to negative affect their ability to work). This may explain the mixed findings from existing literature (Kohan & O'connor, 2002). However, it is difficult to determine conclusions, as the interview study did not explicitly measure the level of strain or explore the reasons why those experiencing high strain may drink less.

10.4.2 Sociodemographic and occupational characteristics

Chapters 5 and 8 explored the sociodemographic and occupational characteristics of police employees meeting criteria for the categories of alcohol consumption and the classes of health (risk) behaviours, respectively. In addition, the screening questionnaire used in the qualitative study requested data on several sociodemographic and occupational variables, which was used to explore differences in experiences across certain groups. The previous section outlined the complementary findings relating to the sociodemographic and occupational characteristics across the triangulated quantitative and qualitative findings. However, there were no clear dissonant findings. This may be because only a small number of participants were recruited for the qualitative study, making it difficult to establish differences across groups. For example, the quantitative findings showed that police employees from ethnic minority groups were more likely to abstain from alcohol, yet in the qualitative study, all participants in the abstinence group were of White ethnicity.

10.5 Conclusions

To conclude, the triangulated findings indicate a J-shaped relationship between mental health and harmful behaviours in UK police employees, whereby poor mental health is associated with both abstinence and harmful drinking (as well as other health risk behaviours). Plausible explanations include the sick quitter hypothesis and the self-medication hypothesis, which are supported by the triangulated evidence. In relation to job strain and harmful behaviours, there were mixed findings across the studies, though the two quantitative chapters complement each other. The triangulated findings also indicate that older police employees (who have served for many years), and police officers, are more likely to engage in harmful behaviours than younger employees (who are likely to be new recruits), and police staff. These

sociodemographic and occupational associations with harmful behaviours may relate to older officers feeling more engrained in the previous culture of drinking within policing, and differences across age groups reflects what is observed in the UK general population.

Chapter 11: General Discussion.

11.1 Foreword

What is already known from the previous Chapters?

- Chapter 4 pooled the existing evidence from 55 studies with a systematic review and meta-analysis, identifying higher levels of hazardous drinking in first responders and Armed Forces personnel, compared to healthcare workers. Studies with a higher proportion of males and a younger mean age had higher prevalence estimates for hazardous and harmful alcohol use, respectively. The review identified no UK studies of police employees.

- Chapter 5 used epidemiological data on approximately 40,000 UK police employees to estimate prevalence estimates, finding that 33% met criteria for hazardous drinking and 3% for harmful drinking. Poor mental health was associated with greater odds of reporting harmful drinking or abstinence. High job strain (vs low strain) was associated with reduced odds of reporting hazardous drinking.

- Chapters 6 and 7 compared the level of alcohol use and poor mental health in police employees and military personnel, analysing men and women separately (due to sample differences in gender composition and gender differences in types of roles held). Police employees and military personnel showed similar levels of probable PTSD (approx. 4%, for both genders), but military personnel showed higher levels of harmful alcohol use (for both genders).

- Previous evidence shows that health risk behaviours cluster together (e.g., harmful drinking and smoking) so Chapter 8 examined the how health (risk) behaviours cluster together, in the same sample of 40,000 UK police

employees (separately for men and women). For both genders, there was a class reflecting "high health risk behaviours" and a class reflecting the "healthiest", with the remaining classes representing a mixture of behaviours. Those with poor mental health had at least double the odds of being assigned to the "high health risk behaviours" class.

- Qualitative interviews were used in Chapter 9 to gain a comprehensive understanding of UK police employees' experiences of hazardous or harmful alcohol use and abstinence. The five identified themes detailed the organisational culture of drinking within the Police Service, motivations for drinking (to cope, or to socialise), motivations to abstain, and the contrasting perceptions of available support for alcohol problems.

- Chapter 10 triangulated the quantitative findings from Chapter 5 and Chapter 8, with the qualitative findings from Chapter 9, outlining the complementary and dissonant results.

What does the current Chapter aim to do?

- The current Chapter provides an overview of the empirical chapters, integrating the findings from all chapters (expanding on the previous triangulation Chapter which only focussed on Chapters 5, 8 and 9) and discussing the theoretical implications in line with the aims.

- This Chapter outlines the implications of the findings from this thesis and provides recommendations for policy and practice.

- The strengths and limitations are described, including the remaining gaps in the literature following the research conducted for this thesis, and suggestions for future work.

What new findings does this Chapter add?

- This Chapter highlights the novel contributions to the theoretical literature and implications for practice, policy, and future research.

- It is suggested that the UK Police Service are an occupational group in need of support to reduce alcohol-related harm, though the level of harmful drinking is lower in police employees than military personnel.

- There is a J-shaped relationship between alcohol use and mental health, as probable depression, anxiety, and PTSD are associated with both abstinence and harmful drinking. These findings support the self-medication hypothesis and the sick-quitter hypothesis, highlighting the need for integrated alcohol and mental health support within the UK Police Service.

- UK police employees with a mental health problem are also more likely to engage in multiple health risk behaviours, highlighting the importance of holistic interventions which target more than one behaviour.

11.2 Overview and theoretical implications of findings

11.2.1 Aim one: review of the existing literature

The overarching purpose of this thesis was to determine the level of hazardous and harmful alcohol use in the UK Police Service and to understand the relationship with mental health and job strain. The first step in addressing this aim involved collating the broader existing literature on a range of trauma-exposed occupations, to make comparisons across the occupational groups and provide a frame of reference for police employees. Chapter 4 reports the findings from the systematic review and meta-analysis which identified 55 studies of hazardous and/or harmful alcohol use in trauma-exposed occupations, with a pooled prevalence of 22% for hazardous alcohol

use and 11% for harmful alcohol use. These pooled estimates for hazardous and harmful alcohol use are higher than UK general population estimates (17% and 3%, respectively) (Drummond et al., 2016; NHS Digital, 2018b), particularly for harmful alcohol use. This suggests that individuals working in trauma-exposed occupations are more likely to drink to hazardous or harmful levels and may have an increased risk of alcohol-related harm.

Studies of Armed Forces personnel showed the highest prevalence estimates for hazardous and harmful alcohol use. Studies of Armed Forces personnel and studies of first responders (including police officers) showed higher levels of hazardous alcohol use than studies of health care professionals. It is well known that US and UK Armed Forces personnel show higher levels of hazardous and harmful alcohol use than either general population (Fear et al., 2007; Jacobson et al., 2008). As described in Chapter 1, the Armed Forces are a unique occupation characterised by intensive demands from periods of deployment and combat exposure. Nevertheless, there are some similarities with first responders, especially police employees, such as the male dominated culture, which may encourage risk taking behaviours (Roche et al., 2015). However, no studies have directly compared the level of alcohol use or mental health problems in Armed Forces personnel or police employees (controlling for demographic differences), and this informed the aims for Chapters 6 and 7.

Meta-regressions examined the impact of participant and study characteristics, and mental health status on prevalence estimates, finding that studies with a higher proportion of males, and studies with a younger mean age showed higher estimates for hazardous and harmful alcohol use, respectively. These characteristics were related to the type of occupational group, as studies of Armed Forces personnel and first responders had a higher proportion of males and a younger mean age than studies of

health care professionals. These findings informed Chapters 6 and 7, whereby male and female military personnel and police employees were compared in separate analyses, and the samples were balanced on age, as there were distinct differences in gender and age composition between military personnel and police employees. However, the meta-regressions could not address all questions of interest, as there were insufficient and inconsistent data to determine the impact of mental health status on prevalence estimates. For example, although depression and PTSD were included in the meta-regressions, different measures and cut-offs were used, reducing the comparability across the studies. Further, only nine studies measured anxiety, despite anxiety often co-occurring with alcohol problems (Smith & Randall, 2012). This review identified a lack of mental health data in studies of alcohol use in trauma-exposed occupations. Therefore, Chapter 5 aimed to explore the relationship between mental health and alcohol use in police employees.

The review also identified only two UK studies across all trauma-exposed occupations. The 13 studies of hazardous or harmful drinking in police officers had all been conducted in different countries, showing a pooled prevalence of 27% for hazardous alcohol use and 8% for harmful alcohol use. The pooled estimates for hazardous use are similar to those identified in a recent review of mental health problems in police employees (27% vs 26%) (Syed et al., 2020), and the pooled estimates for harmful alcohol use are slightly higher (8% vs 5%) (Syed et al., 2020). This may be because Chapter 4 identified at least three additional papers of police employees with estimates above 10% for harmful alcohol use (Burnhams, Parry, Laubscher, & London, 2014; Violanti et al., 2011; Ward et al., 2006). However, this is likely related to study quality, as only four studies of police employees (out of 13) had a sample size above 1000, reducing the reliability of the estimates (Hajian-Tilaki,

2011). In addition, two studies used lower and non-validated cut-offs for the AUDIT (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001; Davey et al., 2001; Sterud et al., 2007b), possibly overestimating the level of hazardous or harmful alcohol use. Taken together, the lack of UK research and limitations of existing literature indicate a need for representative research into UK police employees' alcohol use, informing the aims of Chapter 5.

11.2.2 Aim two: estimating the level of the problem

As both the literature review in Chapter 1 and the systematic review in Chapter 4 identified no UK studies of alcohol use in police employees, Chapter 5 sought to determine the prevalence of hazardous and harmful alcohol use in a representative sample of 40,000 police employees, finding that 33% met criteria for hazardous drinking and 3% for harmful drinking. Poor mental health (probable depression, anxiety, and PTSD) was strongly associated with both harmful drinking and abstinence. High job strain was associated with reduced odds of hazardous drinking, but when stratified by mental health status, this finding was only observed in those without a mental health problem (in those with a mental health problem there was not a significant association between job strain and drinking). The previous triangulation chapter summarised the key findings for Chapter 5 and discussed them in view of the qualitative findings from Chapter 9, as Chapter 5 informed aspects of Chapter 9, such as the eligibility criteria and the topic guides. This chapter will review the key findings from Chapter 5 and theoretical implications in relation to the whole thesis.

The proportion of UK police employees drinking to hazardous levels is higher than for adults in the general population. In a UK general population study using the same measure of alcohol use, 17% of adults met criteria for hazardous alcohol use (NHS Digital, 2018b). When looking at these estimates separated by gender, the level of

hazardous alcohol use in police employees was higher than the general population for both men (40% of police employees vs 24% of the general population) and women (19% of police employees vs 11% of the general population) (NHS Digital, 2018b). In contrast, police employees are not more likely to drink harmfully than the general population (approximately 3% in both studies), and the level of frequent binge drinking is similar in police employees (30%) and the general population (27%), although the latter estimates were obtained using different measures (NHS Digital, 2018b). However, this is not a direct comparison, and there are variations in participant and study characteristics which may contribute to the differences in prevalence estimates, such as age distribution or the year of data collection.

The findings from Chapter 5 can be compared with the meta-analysis from Chapter 4. Chapter 5 found that 33% of UK police employees met criteria for hazardous alcohol use, and the meta-analysis identified a pooled prevalence of 27% for police employees. However, the prevalence of harmful alcohol use was lower in Chapter 5 (3%) than the estimates obtained in the meta-analysis (8%). The meta-analysis identified several US and Australian studies of alcohol use in police officers, with the Australian data showing similar prevalence estimates to Chapter 5, with 30% meeting criteria for hazardous alcohol use and 3% for harmful alcohol use (Davey, Obst, et al., 2000a). In contrast, most US studies showed much lower prevalence estimates (Ballenger et al., 2011; Lindsay, 2008; Violanti et al., 2011), though the sample sizes were small across these studies. These differences may be explained by cross-cultural differences in drinking behaviours, as global statistics on heavy episodic drinking show higher estimates in Australasia (34%) and Western Europe (31%) than North America (25.7%). Moreover, there are cross-cultural occupational differences in law enforcement, as the UK and Australia takes a 'policing by consent' approach (police

powers come from common consent of the public), whereas the US Police Service takes a more 'militant' approach (police powers come from consent of the state). In the UK, police officers rarely carry firearms, in contrast to Australia and the US, though the number of civilians fatally shot by police officers is much greater in the US than Australia (which is similar to the number in the UK) (Farmer & Evans, 2021). Further research should explore whether these occupational differences are related to differences in drinking.

Chapter 5 also found that poor mental health was associated with both harmful drinking and abstinence, remaining after controlling for covariates. It was important to examine this relationship, as the literature review and systematic review showed a lack of mental health data in studies of alcohol use in trauma-exposed occupations. These findings provide new knowledge, demonstrating a J-shaped relationship between alcohol consumption and mental health in police employees, which is consistent with evidence using general population data (El-Guebaly, 2007; Puddephatt et al., 2021). The theoretical implications of these findings were outlined in detail in Chapter 9, as the triangulated quantitative and qualitative evidence provided support for the self-medication hypothesis (Khantzian, 1987, 1997) and were in line with one of Cooper's four dimensions of drinking motivations, 'drinking to cope' (Cooper, 1994). The reasons for abstaining were qualitatively explored in Chapter 9 and the findings were triangulated with the quantitative findings in Chapter 10. The triangulated findings support the sick quitter hypothesis, whereby those with poor mental health stop drinking because of the negative consequences of alcohol on their physical or mental health (Shaper et al., 1988). Other explanations from the qualitative data, which is congruent with existing evidence, related to alcohol interacting with

mental health medication (Bernards, Graham, Kuendig, Hettige, & Obot, 2009) and reduced social contact from not drinking (Bartram, Eliott, & Crabb, 2017).

A further key finding from Chapter 5, was that police employees who reported high job strain had reduced odds of drinking hazardously than those who reported low job strain, which opposed the hypothesis. When the sample was stratified by mental health status, this association was only significant in those without a mental health problem. Chapter 1 reported limited evidence surrounding the relationship between job strain (organisational stressors) and alcohol use in police employees (Davey, Obst, et al., 2000a; Gershon et al., 2002; Swatt et al., 2007). However, an additional UK study has since been published, finding that organisational stressors (such as lack of job control or role clarity) were associated with increased alcohol consumption in male police employees, but not female police employees (Houdmont & Jachens, 2021). Regarding theories of job strain and alcohol use, a biphasic (stimulant and sedative) self-medication model has been proposed (Frone, 2016), whereby high job strain first increases negative affect and fatigue, which encourages the initial use of alcohol to cope. Subsequently, using alcohol to cope with job strain then increases fatigue and negatively impacts work (e.g., not being able work to the same standard due to adverse effects of being hungover), making it difficult to sustain heavy alcohol use (Frone, 2016). The findings from this thesis are in line with this model, as police employees reporting high strain may not be able to sustain high levels of alcohol use as it could negatively impact their work. From these findings, it can be argued that poor mental health is more strongly linked to hazardous/harmful drinking than job strain.

The findings from Chapter 5 informed several aspects of the subsequent empirical chapters. Finding an association between poor mental health and harmful alcohol use led to the comparison of the level of comorbid PTSD and harmful alcohol use in

Chapters 6 and 7. Similarly, finding an association between poor mental health and abstinence led to the inclusion of police employees who were currently abstaining from alcohol, in the interview study (Chapter 9). In addition, previous evidence has shown that hazardous or harmful alcohol use often co-occurs with other health risk behaviours (such as smoking) (Noble et al., 2015), and so, Chapter 8 examined how several health risk behaviours cluster together in police employees, and whether certain clusters had associations with poor mental health and job strain.

11.2.3 Aim three: comparing occupational groups

Chapters 6 and 7 compared the level of harmful alcohol use, probable PTSD, and their comorbidity, among male and female UK police employees and military personnel. Due to small numbers in the female samples (Chapter 7), hazardous and harmful alcohol use were combined when exploring their comorbidity with PTSD. Men and women were analysed separately as there were large differences in the gender composition of the police sample and military sample (30% of the police sample were women, compared with only 10% of the military sample), and there are differences in the types of roles held by women (e.g., policewomen are more likely to hold a staff role, and military women are less likely to hold a combat role). Both analyses showed comparable levels of probable PTSD (approximately 4% for men and women from both occupations), but higher levels of harmful alcohol use in male and female military personnel compared to male and female police employees. Military personnel from both genders also showed higher levels of comorbidity than police employees.

The findings from Chapters 6 and 7 can be compared with the findings from the meta-analysis, described in Chapter 4, which identified the highest levels of hazardous (34%) and harmful (14%) alcohol use in studies of Armed Forces personnel. The meta-analysis estimates are similar to those observed in male personnel (35% for hazardous

use and 10% for harmful use), yet much higher than in female personnel (16% for hazardous use and 5% for harmful use). Given that women make up only 10% of the UK Armed Forces (Jones, Jones, et al., 2020), the meta-analysis estimates were likely driven by male personnel. Nevertheless, these collated findings demonstrate higher levels of harmful alcohol use in military personnel compared to police employees, which could relate to the Armed Forces being more male-dominated than the UK Police Service (where women make up 40% of police employees (Allen & Audickas, 2020), as risk-taking behaviours such as binge drinking are more common in men (Office for National Statistics, 2018). Moreover, it is likely that there are differences in the drinking patterns of police employees and military personnel. For example, police employees are considered unfit for duty if they have a blood alcohol concentration level of 29mg (the legal limit for driving is 80mg) (Home Office, 2012), meaning they may be more likely to drink more frequently but less heavily. In contrast, military personnel face 'dry periods' during employment, where they cannot drink, which may encourage heavier drinking when they return (Fear et al., 2007).

Several studies have explored the reasons for such high levels of alcohol consumption in military personnel, with literature evidencing historical accounts of a heavy drinking culture, whereby alcohol was encouraged (e.g., the rum ration in the world wars (Horsley, 1915)), to boost morale, enhance unit cohesion, and to debrief after group traumatic experiences (Jones & Fear, 2011). In recent years, military personnel can face 'dry periods', during deployment or combat, which may influence heavy use upon return (Fear et al., 2007). Although there are some historic accounts of a drinking culture within the Police Service (Abdollahi, 2002; Richmond et al., 1999), the qualitative findings from Chapter 9 illustrate that this has changed in recent decades, which can be attributed to the removal of police bars and section houses, or

may relate to the stricter disciplinary procedures for police employees (Home Office, 2012). Further exploration of the reasons for the shift in the policing drinking culture could be useful for changing the military drinking culture. One plausible reason why the historic accounts of drinking cultures within the Police Service and the Armed Forces are similar, could be a result of ex-serving military personnel later becoming police employees. This may also be a limitation of the comparison chapters, as it was not possible to determine whether participants in the police sample had previously served in the military.

11.2.4 Aim four: exploring clusters of health behaviours

Chapter 8 examined how health (risk) behaviours cluster together and identified groups of police employees (male and females, separately) with common behaviours. Chapter 8 also explored whether certain clusters of health (risk) behaviours were associated with poor mental health and job strain. Five classes were identified, with the smallest class representing "high health risk behaviours" and the most common class reflecting "low risk drinking but other health risk behaviours", for both men and women. Both genders also had two healthy classes ("healthiest" and "healthy abstainers", with the former having the highest probabilities for all health behaviours). The final class reflected a mixture of health and health risk behaviours. Poor mental health was associated with at least double the odds of being in the "high health risk behaviours" class, for both men and women. Men and women reporting probable depression were also more likely to be in the "healthy abstainers" class, and this was also observed for men with probable anxiety or PTSD. Those reporting high strain were more likely to be in the "low risk drinking but other health risk behaviours" class, compared to men and women reporting low strain.

The findings from Chapter 8 complement the findings from Chapter 5, and provide novel knowledge, by now demonstrating that UK police employees experiencing poor mental health have increased odds of engaging in multiple health risk behaviours, compared to those without a mental health problem. Chapter 5 demonstrated the relationship between poor mental health and harmful drinking, with Chapter 8 highlighting the relationship between poor mental health and additional health risk behaviours (e.g., smoking, insufficient fruit and vegetable intake). In addition, Chapter 5 showed that probable depression, anxiety, and PTSD were associated with abstaining from alcohol in some UK police employees. In line with this, Chapter 8 found that probable depression was associated with the "healthy abstainers" class (compared to the "healthiest" class, which included more low risk drinkers), for both men and women. Probable anxiety and PTSD were associated with the "healthy abstainers" class, for men only. It is difficult to compare the gender differences observed in Chapter 8 to the findings from Chapter 5, as the latter did not stratify the sample by gender when exploring the associations between mental health and alcohol use.

A further novel finding is that the "healthy abstainers" class (abstainers who engaged in other health behaviours, such as high fruit and vegetable intake, low red meat consumption, non-smoking, and high physical activity) showed increased odds of reporting poor mental health, particularly depression. Evidence suggests that health behaviours are associated with good mental health in the general population (Conry et al., 2011; Oftedal et al., 2019; Vermeulen-Smit, Ten Have, Van Laar, & De Graaf, 2015), so it is unexpected that healthy abstainers were more likely to report poor mental health. However, this association was in comparison to the "healthiest" individuals. There may be certain characteristics of the healthy abstainers which could contribute to their poor mental health. For example, police employees in this class were

more likely to be from Black, Asian, or Mixed ethnicity backgrounds, than White ethnicity. Ethnic inequalities in mental health outcomes are evidenced, as individuals from ethnic minority backgrounds may be more likely to report some mental health problems (Bamford et al., 2021; Weich et al., 2004), and are less likely to receive mental health treatment than people from a White ethnicity (Cooper et al., 2013).

The findings from Chapter 8 may help to understand the unexpected finding from Chapter 5, whereby those reporting high strain (versus low strain) had reduced odds of reporting hazardous alcohol use, as Chapter 8 showed that those reporting high strain (versus low strain) had increased odds of being in the "low risk drinking but other health risk behaviours" class. Police employees who experience high job strain may lack the time to drink frequently or heavily, or the effects of a hangover may make it difficult to manage job demands (Frone, 2016). Lacking time outside of work may contribute to the low levels of physical activity and poor diet (Kirk & Rhodes, 2011). Similarly, smoking may be used to cope with job demands without negatively impacting ones' ability to work (Heikkilä et al., 2012). The "low risk drinkers but other health risk behaviours" class had increased odds of reporting probable depression (and anxiety, for men), and may be self-medicating by smoking instead of drinking (Jane-Llopis & Matytsina, 2006; Lawrence, Mitrou, & Zubrick, 2009). The collated evidence from Chapters 5 and 8 supports the biphasic self-medication model of work stress, whereby high job strain first increases negative affect and fatigue which encourages the initial use of alcohol to cope, but alcohol then increases fatigue and negatively impacts work, making it difficult to sustain (Frone, 2016). The evidence from this thesis suggests that police employees experiencing high job strain may not drink hazardously but instead engage in health risk behaviours which are less likely to induce sedentary effects.

The sociodemographic and occupational characteristics of some of the classes, identified in Chapter 8, can also be compared with the findings from Chapter 5. For example, police employees aged over 40 (versus under 29) had increased odds of hazardous/harmful drinking and being assigned to the "high health risk behaviours" class, whereas those under 29 years old had increased odds of being in the "low risk drinkers but other health risk behaviours" class. Police employees with lower educational attainment showed strong associations with harmful drinking (versus those with a university degree) and being assigned to the "high health risk behaviours" class (for men, this was compared to all other categories, and for women, this was compared to those with a university degree), in line with a systematic review of European general population surveys (Meader et al., 2016a). Having more than 10 days of sickness absence in the past year was strongly associated with harmful drinking and being in the "high health risk behaviours" class, which is expected given that health risk behaviours are major causes of physical illness (World Health Organization, 2008). In terms of occupational characteristics, police employees who had served for more than 10 years and those with an income between £38k to £60k had increased odds of reporting harmful alcohol use and being in the "high health risk behaviours" class. Despite the restricted categories for 'role', these findings allude to quite senior ranking police employees (e.g., inspectors or chief inspectors) being more likely to engage in multiple health risk behaviours. Collectively, these findings can be used to identify police employees who are more likely to engage in health risk behaviours and who may require interventions or support.

11.2.5 Aim five: understanding experiences

Chapter 9 qualitatively explored the experiences of police employees who met criteria for hazardous or harmful drinking, or who were currently abstaining from

alcohol. Chapter 9 specifically aimed to understand the motivations for drinking, and abstinence, and to investigate the organisational culture of drinking and the attitudes towards those who abstain from drinking. The key findings from Chapter 9 are summarised in Chapter 10, where they were triangulated with the quantitative findings from Chapter 5. This chapter will discuss the key findings and theoretical implications from Chapter 9 with reference to the whole thesis.

The qualitative findings showed that, although there has been a cultural shift and the drinking culture is no longer as prominent, police employees (particularly police officers) perceived heavy drinking to be the norm amongst colleagues. Despite all participants in the 'at-risk' group meeting criteria for hazardous or harmful alcohol use, many did not believe that they needed to cut down their drinking or only believed that alcohol use was harmful if it was very extreme (Parke et al., 2018; Schomerus et al., 2013), suggesting a lack of awareness regarding alcohol-related harms or stigma towards alcohol problems. This binary classification of alcohol problems has been shown to prevent help-seeking, if individuals do not believe that their drinking is 'bad enough' (Morris et al., 2020), and delayed help-seeking can exacerbate problems (Chapman et al., 2015). Moreover, the qualitative findings indicated that not all police employees were aware of how to access support for alcohol problems within the Police Service. This contrasted with mental health support, as participants described widespread and accessible support for mental health problems in the Police Service. Participants also outlined that the increase in mental health support has helped to reduce stigma, as mental health problems are talked about more openly. Therefore, increasing the availability and accessibility of support for alcohol problems may help to reduce alcohol-related stigma.

The normative beliefs about heavy drinking may explain why one third of police employees met criteria for hazardous drinking. Moreover, data from US military personnel demonstrated that positive normative beliefs and misperceptions of others' drinking behaviours were related to heavy drinking (Ames et al., 2007), linking with the findings from the meta-analysis (Chapter 4) and the comparison studies (Chapters 6 and 7). These findings may be understood in terms of social norms theory, whereby misperceptions or overestimations of others' alcohol consumption may contribute to ones' own high levels of alcohol consumption (Berkowitz, 2003; Perkins, 2003). The social norms theory was originally used to explain heavy alcohol use in student populations but has since been shown to be relevant in occupational settings, as positive normative believes about heavy drinking, within work groups, are associated with heavy drinking (Barrientos-Gutierrez et al., 2007). Interventions such as alcohol-awareness training within the workplace may help to target these misperceptions by educating on the harms of drinking above the 'low risk' guidelines.

An additional theory that may be useful for understanding these occupational drinking cultures is social practice theory (Meier et al., 2018). Social practice theory suggests that practices are routine human activities that involve the intertwining of several elements (Nicolini, 2016). Alcohol is often embedded within multiple social practices, such as drinking and eating, or after-work drinks (Meier et al., 2018). Members of both the Armed Forces and the Police Service may drink heavily due to drinking practices being embedded in their social activities with colleagues, such as police employees having after-work drinks to informally debrief after a stressful day (Richmond et al., 1999), or military personnel using alcohol to encourage unit cohesion (Jones & Fear, 2011). There are likely differences in drinking practices across the two occupations, given that some military personnel live on bases which may

provide more routine drinking opportunities, whereas police employees may only drink with colleagues after working on shift together. This theory has implications for public health interventions, by highlighting the need to target elements of practices which can be modified (Meier et al., 2018).

As discussed in the previous chapter, the triangulated findings have important theoretical implications, providing evidence to support the self-medication hypothesis (Khantzian, 1987, 1997) and the sick quitter hypothesis (Shaper et al., 1988) as explanations for alcohol use and abstinence, in the UK Police Service. The findings of this thesis suggest that police employees who are experiencing poor mental health may use alcohol to cope with their symptoms. From the qualitative findings, this coping appears to relate to both the operational stressors, such as exposure to traumatic incidents, and the organisational stressors, such as the intensive job demands and lack of job control. However, the latter finding was not observed in the quantitative findings, as high job strain (high demands, low control) was associated with reduced odds of drinking hazardously. However, it may be that the effects of the budget cuts on the relationship between drinking behaviours and job strain were not yet apparent when the Airwave Health Monitoring Study was conducted, or there may be polarised drinking behaviours in those reporting high job strain. Regarding the sick quitter hypothesis (Shaper et al., 1988), the quantitative and qualitative findings of this thesis indicate that some police employees who are abstaining from alcohol, are more likely to experience poor mental health, and their reasons for abstaining may relate to the negative impact of alcohol on their mental or physical health.

11.3 Implications and recommendations

11.3.1 The UK Police Service

The findings of this thesis have important implications for ensuring support for alcohol problems are available and accessible within the UK Police Service. Given that over one third of UK police employees met criteria for hazardous or harmful alcohol use, they appear to be an occupational group in need of support to reduce the risk of alcohol-related harm, yet the present findings indicate contrasting perceptions of available support and how to access it. There is a lack of available information regarding how alcohol problems are handled within the UK Police Service. The only official documentation refers to testing police officers for 'alcohol misuse', stating that an officer is considered unfit for duty if they have a blood alcohol concentration level of 29mg (the legal limit for driving is 80mg), and that some misuse of alcohol can be an offence (e.g., if an officer is drunk in a public place or attempts to drive a vehicle) (Home Office, 2012). However, this document does state that 'self-declaration of a drink problem is a matter that should be managed through occupational health services, rather than being regarded as a disciplinary matter' (Home Office, 2012). Given the lack of existing guidance relating to alcohol problems, the recommendations for the UK Police Service are as follows:

- In 2021, the National Police Chiefs Council, the College of Policing, and Oscar Kilo, worked with academics and Public Health England to develop a Blue Light Wellbeing Framework, which is tailored to the needs of emergency services personnel, and outlines a standard for employers to self-assess wellbeing and determine where evidence-based interventions may be needed (College of Policing, 2021). The evidence from this thesis supports the

following recommendations (developed from the Blue Light Wellbeing Framework):

- Employees should be supported in seeking help to treat alcohol problems, which includes the provision of readily available support.

- Managers must be provided with information on how to identify the signs of alcohol problems and be aware of how to signpost those needing support. For example, managers must know whether an individual needs signposting to internal occupational health services, external health care services, or specialised treatment services.

- All employees should have access to alcohol awareness training. For example, the Blue Light training programme, designed by Alcohol Change UK, provides training within police forces to improve recognition and management of alcohol problems in individuals who encounter the police (Alcohol Change UK, 2014). Although this training programme is designed to help officers recognise problems in civilians, it may be useful for improving problem-recognition for themselves or colleagues.

- Occupational health services within police forces should routinely screen for comorbid mental health and alcohol problems. If a police employee presents to occupational health services with one problem, they should be screened for the presence of the other problem, and then provided with appropriate pathways of support. However, evidence shows low levels of help-seeking in first responders, with barriers relating to career concerns and fears of confidentiality breaches (Haugen et al., 2017; Jones, Agud, et al., 2020; Rikkers & Lawrence,

2021). Therefore, occupational health services must attempt to mitigate these concerns.

- Police forces should provide resources to employees, which outline the harms of using alcohol to cope, as drinking to cope is associated with harmful drinking behaviours alcohol-related harms (Holahan et al., 2001; Irizar et al., 2020). These resources could also provide examples of healthier coping strategies, which could be used for individual coping or group coping (e.g., group hiking trip). Raising awareness on the risks associated with using alcohol to cope may increase help-seeking by removing the assumption that alcohol use is only problematic if extreme.

- Although the present qualitative findings suggest improvements in mental health related stigma, alcohol related stigma is still very prevalent. Stigma is a barrier to help-seeking (Haugen et al., 2017), and delayed help-seeking can worsen problems (Chapman et al., 2015). The improvements in mental health related stigma appear to be linked to the increased availability of support. The Police Federation launched a framework in 2017 to help forces prioritise wellbeing (Police Federation, 2017), and organisations such as the College of Policing, Oscar Kilo, and the National Police Wellbeing Service, provide independent support for police employees experiencing mental health difficulties. Improving mental health support may prevent employees from trying to cope on their own, e.g., through drinking. It is recommended that these organisations include a focus on harmful drinking and other health risk behaviours within their existing frameworks.

11.3.2 Health care

The findings of this thesis also have wider implications for health care services. These findings provide further evidence to show that mental health problems often co-occur with alcohol problems (Bell & Britton, 2014; Lai et al., 2015; Puddephatt et al., 2021), whilst also providing novel evidence to show that those with poor mental health are more likely to engage in multiple health risk behaviours. The recommendations for health care services are outlined:

- The present findings further support the need for integrated mental health and alcohol support within health care services, such as in primary care (e.g., GP services) or emergency services (e.g., when presenting in A&E with either a mental health or alcohol problem) (Public Health England, 2017). In health care services, if an individual is identified as having a past or present problem (either alcohol or mental health), practitioners must routinely screen for the other problem. The existing PHE guidance indicates a 'no wrong door' policy for individuals trying to access support, and states that service providers have a joint responsibility to meet the complex needs of an individual (Public Health England, 2017).

- Police employees, and potentially other high-risk occupations (e.g., other first responders), may need more regular screening for both mental health and alcohol problems, either within health care or occupational health settings. For example, once a practitioner is aware that an individual works in a high-risk occupation, they could administer brief screening tests. Support from external health care services may be more desirable than internal occupational health services, as evidence suggests that first responders may not seek help due to fears of confidentiality breaches or concerns about how it may impact their

career (Jones, Agud, et al., 2020; Rikkers & Lawrence, 2021). Therefore, there must be clear risk management protocols in place for first responders who disclose an alcohol problem in health care settings, to ensure they are supported and are safe to work.

- This thesis identified that police employees with poor mental health are more likely to engage in multiple health risk behaviours. More broadly, it is important to address co-occurring health risk behaviours, as this increases the risk of premature death (Khaw et al., 2008). Within the general population, services have previously been set up to target individual behaviours, but a more holistic approach is needed, to develop interventions which address multiple health risk behaviours (Evans & Buck, 2018).

11.3.3 Policy makers

The present findings have implications for those involved in policy decisions, in the UK. As outlined in Chapter 1, government funding cuts to the Police Service in 2010 led to a reduction of approximately 40,000 police officers across England and Wales, by 2020 (Allen & Audickas, 2020). Recent surveys conducted by the Police Federation found that 90% of participants reported that there were not enough officers to manage demands (Elliott-Davies, 2019; Houdmont & Elliot-Davies, 2016). In addition, over 75% of frontline officers stated that they were often or always single-crewed (Houdmont & Elliot-Davies, 2016), which is problematic, as single crewing is associated with violence towards officers and injuries (Houdmont et al., 2019). The findings of this thesis support the following recommendations:

- The detrimental impact of the 2010 budget cuts has led to increased demands, single crewing, cancelled annual leave, and regularly working overtime. There is a need for increased government funding for the UK Police Service, to

reduce the demands placed on employees and to ensure they can work safely. With increased funding and additional officers, the UK Police Service must work towards the removal of single crewing, which is linked to physical harm and possible mental health harm, as there are no opportunities for peer risk assessments following a traumatic incident (a principal component of Trauma Risk Management, i.e., TRiM, which is recommended within the UK Police Service (Hesketh & Tehrani, 2019)).

- The government have proposed an additional £415 million to police funding, to recruit an additional 20,000 officers (Home Office, 2020a). However, there must be additional funding specifically for occupational health services within the UK Police Service, to ensure they can provide adequate support for employees.

- Policy makers must ensure that all occupational settings incorporate clearer alcohol workplace policies, that clarify rules and expectations of employees with regards to alcohol consumption at work. Evidence suggests that these policies can contribute to reducing employee excessive consumption, yet up to 40% of workplaces do not have these policies in place (Alfred, Limmer, & Cartwright, 2020).

- Policy makers should consider encouraging widespread alcohol awareness training amongst first responders and health care workers (similar to existing mental health first aid training), including how to conduct risk assessments and provide brief alcohol interventions to individuals who come into contact with emergency services. As previously stated, the Blue Light training programme, designed by Alcohol Change UK, provides training to emergency services and other relevant services (e.g., homelessness services, substance use services) to

help them support individuals with alcohol problems (Alcohol Change UK, 2014). This training aims to alter attitudes and reduce stigma towards alcohol problems, whilst also improving problem-recognition.

11.4 Strengths and limitations

11.4.1 Strengths

This thesis took a multi-methods approach, which has several advantages when exploring a phenomenon. Multi-methods approaches compensate for the limitations of solely using quantitative or qualitative methods (Noble & Heale, 2019), as often the answers to research questions which are masked by one method (e.g., epidemiological data) can be uncovered through a different method (e.g., in-depth interviews) (Kaur, 2016). In addition, the findings are strengthened through triangulation (Tashakkori & Teddlie, 2003). Identifying complementary findings through triangulation increases the degree of confidence and robustness in the results, providing more compelling findings that studies which use single methods (Kaur, 2016; Noble & Heale, 2019). Moreover, the sequential design allowed the earlier findings to inform the subsequent studies, to answer emerging research questions (Tashakkori & Creswell, 2007). Multi-methods approaches are useful in public health research, as public health issues are often complex and require holistic approaches to understanding phenomenon (Kaur, 2016).

Throughout this thesis, two large datasets were used, and both had good response rates (above 50%) (Elliott et al., 2014; Fear et al., 2010; Stevelink et al., 2018). The AHMS included a sample of approximately 40,000 UK serving police employees, which represented 16% of the entire UK Police Service (Hargreaves et al., 2016). In addition, the ethnicity and gender composition of the sample was representative of the

overall Police Service, with 95% being of White ethnicity and approximately 40% female (Allen & Audickas, 2020). The KCMHR study included a random stratified sample of deployed and non-deployed, serving and ex-serving personnel (only serving personnel were included in the present thesis), who represented the UK Armed Forces during the Iraq and Afghanistan conflicts (i.e., between 2003 and 2015). The age, gender, and rank distribution of the sample were similar to the composition of the whole UK Armed Forces (Fear et al., 2010). There are several advantages to using large secondary datasets, such as having sufficient power to determine precise group differences (Biau, Kernéis, & Porcher, 2008), whilst controlling for multiple covariates, and ensuring whether a sample is representative, which allows the findings to be generalised (Biau et al., 2008).

This thesis used robust statistical techniques to increase confidence in the findings. For example, in Chapter 4, sub-group analyses and meta-regressions were used to determine reasons for the high heterogeneity across studies (Thompson & Higgins, 2002). Chapter 5 first conducted exploratory regression analyses to examine which sociodemographic and occupational variables were strongly associated with alcohol consumption, and then those variables were adjusted for in the main analyses, when identifying the associations between alcohol consumption with mental health and job strain. Chapters 6 and 7 used a statistical reweighting method, known as entropy balancing (Hainmueller, 2012), to balance the samples on pre-specified covariates which may have influenced the level of alcohol use or probable PTSD. Finally, Chapter 8 used Latent Class Analysis, whereby a range of model fit criteria were used to determine the best fitting model. In addition, the probabilities for class membership were transferred to STATA and used as a weight (as not all participants would have

equal probability of being in a class) when conducting the regression analyses. These robust statistical techniques are essential for producing accurate results.

11.4.2 Limitations

The datasets used throughout this thesis relied on self-report data. Self-report data is advantageous as it is relatively inexpensive, large quantities of data can be collected on a magnitude of measures (Demetriou et al., 2014). However, self-report data can lead to systematic errors (biases), reducing the validity of findings, such as response bias. Social desirability bias is a type of response bias whereby participants consciously or unconsciously respond in a way that may be viewed more socially acceptable than their true answer (Paulhus, 1984). This is particularly important when measuring alcohol consumption in police employees, as the UK Police Service is in the public eye and subject to public scrutiny (Awan, Brookes, Powell, & Stanwell, 2019). Further, strict regulations relating to alcohol or substance use and fitness for duty (Home Office, 2012), may reduce the likelihood of police employees disclosing harmful drinking behaviours. Self-report data can also lead to measurement error, which occurs when the information collected is inaccurate (Bound et al., 2001). Alcohol consumption is often under-reported in research (Devaux & Sassi, 2016; Livingston & Callinan, 2015). In the AHMS, alcohol consumption was measured by asking participants to recall their alcohol consumption from the past seven days. However, this measure can cause recall bias, and can lead to lower levels of reported consumption compared to recall consumption of 1 day (Gmel & Daeppen, 2007).

Though secondary data is advantageous as large epidemiological datasets are readily available, there are several disadvantages. For example, there is no control over which variables were measured or which instruments were used, meaning several potential covariates could not be controlled for. Due to limitations with the secondary

data in Chapter 5, the measure of alcohol use (past weekly unit consumption) is not directly comparable with the measures of alcohol use in Chapter 4. In Chapter 4, the inclusion criteria stated that only studies which included a standardised measure of alcohol use would be relevant for inclusion (such as the AUDIT (Saunders et al., 1993)), excluding studies which used government guidelines. However, the Airwave Health Monitoring Study did not include a standardised measure of alcohol use, and the only validated option was to apply the government guidelines to past weekly unit consumption. Nevertheless, studies using government guidelines and the AUDIT identify similar levels of hazardous and harmful alcohol use in the UK general population (Drummond et al., 2016; NHS Digital, 2018b). Across the empirical chapters, the differences in tools used to measure alcohol use and mental health prevented reliable comparisons. This highlights the need for core outcome sets, i.e., an agreed standardised set of outcomes that should be measured and reported, within occupational epidemiology, such as those that have been developed for clinical trials (including alcohol brief interventions) (Shorter et al., 2021).

In addition, there were secondary data limitations relating to the measure of PTSD. The Trauma Screening Questionnaire (TSQ) items were used, but included a Likert scale for response options, as opposed to the typical binary outcome. Further, as participants only completed the TSQ if they reported being bothered by a disturbing incident in the past six months, the measure of PTSD may have excluded participants who had an earlier experience of a traumatic event. For Chapters 6 and 7, despite extensive efforts to harmonise the variables, the measures of depression and anxiety could not be compared across the two samples. In addition, although PTSD and alcohol consumption could be compared, different measures were used which was a major limitation. A final limitation of using secondary data, is not being involved in the data

cleaning and exploration of missing data. For example, 9% of the data was missing for 'police role' and was given the contingency code of 'not found'. Despite contacting the AHMS team, no further information is available as to why this data is missing.

11.5 Future directions

This thesis used cross-sectional data to estimate the prevalence of hazardous and harmful alcohol use in the UK Police Service, and to examine the associations between alcohol use (or abstinence) with mental health and job strain. This thesis found strong significant associations between probable depression, anxiety, and PTSD, with harmful drinking, and alongside the qualitative findings, this suggests that some UK police employees are using alcohol to self-medicate an existing mental health problem. Furthermore, this thesis also showed a significant association between poor mental health and abstinence, and with the addition of complementary qualitative findings, this indicates that some UK police employees, who are currently abstaining from alcohol, do so because alcohol negatively impacts their mental health. However, longitudinal research is needed to establish the temporal associations between alcohol use or abstinence and mental health (Caruana, Roman, Hernández-Sánchez, & Solli, 2015). From the current findings, it is not possible to determine whether probable mental health problems precede harmful drinking, which would suggest self-medication, or whether harmful drinking leads to worsened mental health. Though, existing longitudinal evidence suggests that declining mental health leads to increased alcohol consumption in the general population (Bell & Britton, 2014). Similarly, it is not possible to truly know whether abstinence is a result of mental health consequences, or whether abstinence leads to poor mental health through other pathways (e.g., reduced socialising). This thesis originally aimed to use follow up data from the AHMS to assess these temporal associations, but due to financial

complications and further delays resulting from the COVID-19 pandemic, the AHMS team were not able to provide the data. It is hoped that this important work will be completed in the future.

The findings of this thesis highlighted several gaps in the literature and possible directions for future research. The systematic review (Chapter 4) identified only two UK studies into the level of hazardous or harmful alcohol use in trauma-exposed occupations, and both were studies of Armed Forces personnel. Given that over one third of UK police employees, and an even greater proportion of UK military personnel, met criteria for hazardous or harmful alcohol use, there is a need to determine whether other trauma-exposed occupations also show high levels, such as paramedics and firefighters. A recent UK biobank study estimated that 33% of first responders met criteria for hazardous alcohol use, but it was not possible to separate this group into the specific occupations (i.e., police employees, firefighters, paramedics) (Stevelink, Pernet, et al., 2020). The occupations which were eligible for inclusion in the review were based on a previous review which outlined occupations with an increased risk of work-related PTSD (Skogstad et al., 2013), which included war journalists and train drivers. However, Chapter 4 identified no studies of war journalists and only one study of train drivers, indicating that international research is needed to determine the level of hazardous or harmful alcohol use across these occupational groups.

This thesis identified contrasting perceptions of support for alcohol problems, through qualitative research, suggesting that not all UK police employees are aware of available support or how to access it. However, the current level of help-seeking for alcohol problems or mental health problems is unknown. Research in UK military personnel has examined the factors affecting help-seeking for alcohol problems and

mental health problems, finding personnel were less likely to seek help for an alcohol problem than a mental health problem, and that self-stigma was a barrier to care (Hines et al., 2014; Jones, Keeling, Thandi, & Greenberg, 2015; Stevelink, Jones, Jones, Dyball, Khera, Pernet, MacCrimmon, Murphy, Hull, Greenberg, et al., 2019). In addition, a meta-analysis identified 14 studies of help-seeking in first responders, finding stigma concerns relating to fears of confidentiality or negative impact on career, and barriers such as not knowing where to access support (Haugen et al., 2017). Moreover, a qualitative study of Canadian police officers found that the main barriers to help-seeking for mental health problems were stigma, worries about confidentiality, and experiences with individuals in the community in distress (Newell, Ricciardelli, Czarnuch, & Martin, 2021). Further research is needed to determine the level of help-seeking for alcohol and mental health problems amongst UK police employees, and to explore barriers to care.

The Blue Light Wellbeing Framework states that employees should be able to access readily available support for alcohol problems and that managers must be provided with the information on how to identify and signpost those needing support (College of Policing, 2021). Similarly, the Blue Light Wellbeing Framework suggests that most police employees should receive alcohol awareness training (College of Policing, 2021). However, there is no guidance as to how to ensure support is available and accessible, or how to implement the alcohol awareness training within Police Forces. The charity, Alcohol Change UK, provide a range of training and services for workplaces, such as working with occupational health teams to develop a workplace alcohol policy, and training for managers to support employees with an alcohol problem (Alcohol Change UK, 2021). In addition, Alcohol Change UK offer an interactive webinar for 'Alcohol Awareness Week', which can be booked by

workplaces (Alcohol Change UK, 2021). Future research could explore whether this training and these services are effective for the following: increasing police employees' awareness of 'low-risk' levels of alcohol consumption and the harms of regularly consuming above those levels; improving managers knowledge of how to identify those needing support, and their ability to signpost these individuals.

11.6 Conclusions

This thesis took a sequential multi-methods approach to determine the level of hazardous and harmful alcohol use in the UK Police Service and to understand the relationship with mental health and job strain. The findings provide novel contributions to the theoretical literature and have important implications for practice, policy, and future research. There are several key conclusions that can be drawn. First, over one third of the UK Police Service met criteria for hazardous or harmful alcohol use, suggesting that they are an occupational group in need of support to reduce alcohol-related harm. However, the level of harmful drinking is lower in UK police employees than UK military personnel. Second, there is a J-shaped relationship between mental health and alcohol use, as probable depression, anxiety, and PTSD were associated with both abstinence and harmful drinking. These findings support the self-medication hypothesis, as police employees reported using alcohol to cope with poor mental health, providing evidence for the need to integrate alcohol and mental health support within the UK Police Service. These findings also support the sick-quitter hypothesis, as a key motivation for abstinence related to the mental health consequences of heavy drinking. Third, health risk behaviours cluster together in UK police employees, and those engaging in multiple health risk behaviours have significantly greater odds of reporting a probable mental health problem, highlighting the importance of holistic interventions which target multiple behaviours. Finally, this

thesis identified several gaps in the literature and directions for future research, including the need for longitudinal data to determine the temporal associations between alcohol use and mental health in police employees. Representative research into the level of hazardous and harmful alcohol use in other high-risk occupational groups, such as paramedics, is also necessary. Future research should examine the level of help-seeking, and barriers to care, for alcohol and mental health problems, within the UK Police Service, and investigate whether police forces are adhering to the Blue Light Wellbeing Framework.

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Appendices

Appendix 1. Table of core outcomes, the measures used, and their reliability and validity statistics

Outcome	Measure	Internal reliability [a]	Criterion validity		
			Sensitivity	*Specificity*	*Reference*
Alcohol Use	AUDIT (Saunders et al., 1993)	$\omega = 0.95$	0.92	0.94	(Saunders et al., 1993)
Depression	PHQ-9 (Kroenke & Spitzer., 2002)	$\omega = 0.93$	0.88	0.88	(Kroenke et al., 2001)
Anxiety	HADS (Zigmond & Snaith, 1983)	$\omega = 0.90$	0.90	0.78	(Bjelland et al., 2002)
PTSD	TSQ (Brewin et al., 2002)	$\omega = 0.99$	0.86	0.93	(Brewin et al., 2002)
	PCL-C (Blanchard et al., 1996)	$\omega = 0.97$	0.82	0.86	(Blanchard et al., 1996)

McDonald's omega (ω)

[a] Internal reliability determined using data from this thesis (Airwave Health Monitoring Study, Health and Wellbeing Cohort Study)

AUDIT: Alcohol Use Disorder Identification Test; PHQ-9: Patient Health Questionnaire; HADS: Hospital Anxiety and Depression Scale; PTSD: Post-traumatic Stress Disorder; TSQ: Trauma Screening Questionnaire; PCL-C: PTSD Checklist-Civilian; JCQ: Job Content Questionnaire.

Appendix 2. Prisma 2009 checklist (Chapter 4)

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3 & 4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Table 1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	5 & 6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	7
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	8

Section/topic	#	Checklist item	Reported on page #	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	8	Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	9
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	8 & 9
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	10
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Appendix A
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	13
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	10-12
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	10-12
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	13
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	13 & 14
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	14
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	16-18
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	15-17
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	19

Appendix 3. Joanna Briggs Institute critical appraisal checklist for studies reporting prevalence data – modified (Chapter 4)

<u>JBI Critical Appraisal Checklist for Studies Reporting Prevalence Data - Modified</u>

1. Was the sample frame appropriate to address the target population?

Yes (1) – sample has appropriate age range and gender split which is representative of target population (e.g. if general population then approximately 50/50 gender split, or if in a more predominantly male population, approximately 80/20 gender split)

No (0) – sample does not include appropriate age range, gender split, etc

Unclear (0) – authors do not report the necessary sample characteristics (e.g. mean age/age range, gender split)

Not applicable (remove item) – authors report that the sample is described in a different paper

2. Were study participants sampled in an appropriate way?

Yes (1) – stratified or random sampling

No (0) – opportunity or self-selected sampling

Unclear (0) – does not explicitly report sampling method or it is not clear what the sampling method is

Not applicable (remove item) – sampling method is described elsewhere

3. Was the sample size adequate?

Yes (1) - >500 or includes a power calculation showing sample size needed

No (0) - <500

Unclear (0) – study does not report sample size or final sample size is not clear

4. Were the study subjects and the setting described in detail?

Yes (1) – authors describe geographical location (i.e., country/region) and population of interest (i.e., male/female) in enough detail that it could be used in comparison to other studies

No (0) – the location and population of the study is not clearly described

Unclear (0) – the location/population is somewhat described but not in enough detail that it could be used in comparison to other studies

Not applicable (remove item) – study subjects and setting are described elsewhere, i.e., another paper

5. Was the data analysis conducted with sufficient coverage of the identified sample?

Yes (1) – the authors account for non-response in certain groups, e.g. with survey weights or something similar

No (0) – the authors acknowledge that there was a response bias but do not account for it

Unclear (0) – it is not clear if there was a response bias or it is unclear whether the authors account for non-response

Not applicable (remove item) – random/stratified sampling with 99/100% response rate

6. Were valid methods used for the identification of the condition?

Yes (1) – standardised measures used for primary outcome with validated or justified cut-off

No (0) – standardised measures not used/validated cut-off not used for primary outcome

Unclear (0) – it is not clear what measure is used or what cut off was used

Not applicable (remove item) – there are no standardised measured for the condition of interest

7. Was the condition measured in a standard, reliable way for all participants?

Yes (1) – the same measure was used for all participants (self-report). If multiple researchers administered the instrument (not self-report), they were similar in terms of level of skill/experience

No (0) – the same measure was not administered for all participants/different researchers with different levels of skill administered the instrument

Unclear (0) – it is not clear if different researchers administered the instrument

8. Was there appropriate statistical analysis?

Yes (1) – the study is a prevalence study, prevalence estimates should be given with confidence intervals / the study is not designed to examine prevalence estimates but just happens to give n and % of people with condition of interest

No (0) – the study is a prevalence study; prevalence estimates are reported but no confidence intervals are given

Unclear (0) – the authors do not report how prevalence estimates are obtained

9. Was the response rate adequate, and if not, was the low response rate managed appropriately?

Yes (1) – response/follow up rate >60%, or if response rate is lower, the authors have accounted for this and discussed reasons for non-response

No (0) – response/follow up rate <60%

Unclear (0) – authors do not report response rate

Not applicable (remove item) – authors report that sampling method and response rate is described elsewhere, i.e., different paper

Study	Subjects	Design [a]	Country (Continent)	Mean Age (SD)	% Male	% White Ethnicity	Response Rate	Primary Outcome Measure		Prevalence N (%)		Secondary Outcome	Quality
								Hazardous	Harmful	Hazardous	Harmful	Mental Health	
	Health Care Workers												
Obadeji et al., (2018)	Doctors, nurses, pharmacists (n = 256). Recruited from State Teaching Hospital. Sampled based on similarities in shift work.	Cross-sectional	Nigeria (Africa)	34.71 (±12.72)	50.78	NR	89%	AUDIT 5+	AUDIT 15+	11 (4.3)	4 (1.6)	Psychological distress. GHQ 12, cut-off 2. Prevalence = 17.2% (n = 44).	High
Kim et al., (2018)	Health care workers (clinical officers, nurses and medical assistants) (n = 250). Recruited from 89 public health facilities. Convenience sampling.	Cross-sectional	Malawi (Africa)	34.00 (±10.20)	31.35	NR	99%	AUDIT 8+	-	33 (6)	-	Depression. WHO's self-report questionnaire for depression, cut-off 8. Prevalence = 7% (n = 36)	High
Thrasher et al., (2016)	Hospital workers (physicians excluded) (n = 664). Secondary data from "Gradients in Occupational Health in Hospital Workers Study."	Cross-sectional (baseline data from cohort study)	USA (North America)	46.00 (±10.00)	29.00	39%	NR	-	CAGE 2+	-	947 (31.2)	-	Medium
Hodgins et al., (2009)	Hospital workers (n = 1517). Recruited via stratified sample of randomly selected households.	Cross-sectional	Canada (North America)	NR	NR	NR	39.9%	AUDIT 8+	-	61 (4)	-	-	Medium
Patel et al., (2017)	Surgeons (n = 36). Recruited from the Labasa, Laukota and Colonial War Memorial hospital.	Cross-sectional	Fiji (Oceania)	NR	88.90	NR	83.7%	AUDIT 8+	AUDIT 15+	12 (27.8)	2 (5.6)	Psychological distress. GHQ 12, cut off 4. Prevalence = 44.4% (n = 16)	Medium
Talih et al., (2016)	Doctors in residency (n = 118).	Cross-sectional	Lebanon (Asia)	NR	53.00	NR	38%	AUDIT 8+	-	7 (5.9)	-	Depression. PHQ 9, cut off 10.	Medium

	Recruited from the American University of Beirut Medical Center. Convenience sampling.											Prevalence = 22% (n = 26)	
Oreskovich et al., (2012)	Surgeons (n = 7197). Recruited from the American College of Surgeons 2010 survey. Convenience sampling.	Cross-sectional	USA (North America)	NR	84.47	NR	28.7%	AUDIT C 4+	-	1908 (26.5)	-	-	Medium
Kuerer et al., (2007)	Surgical oncologists (n = 549). Recruited from the Society of Surgical Oncology. Convenience sampling.	Cross-sectional	USA (North America)	NR	80.30	NR	36%	AUDIT 8+	-	39 (7)	-	Depression. PRIME-MD for depression. Prevalence = 30% (n = 165)	Medium
Mahmood et al., (2017)	Doctors (n = 1052). Secondary data from two national cohorts of Norwegian medical students 15 years after graduation (Medical Student Cohort and Young Doctor Cohort).	Longitudinal cohort	Norway (Europe)	28.00 (±2.83)	44.00	NR	42%	AUDIT 8+	-	158 (15)	-	-	High
Bazargan et al., (2009)	Doctor (physicians) (n = 763). Randomly selected from the California Medical Board of licenced physicians.	Cross-sectional	USA (North America)	53.00 (±14.60)	75.10	69%	40.7%	AUDIT 8+	-	43 (5.7)	-	Depression. CES-D, cut off 16. Prevalence = 7% (n = 53)	High
Pforringer et al., (2018)	Doctors (physicians) (n = 920). Web-based survey, recruited by contacting physicians and university hospitals. Random sampling.	Cross-sectional	Germany (Europe)	NR	54.67	NR	NR	AUDIT C 5+	-	212 (23)	-	-	High
Toral-Villanueva et al., (2009)	Junior doctors (n = 312).	Cross-sectional	Mexico (North America)	28.00 (±2.50)	57.00	NR	65%	AUDIT 8+	-	67 (21)	-	Depression. PRIME-MD, cut off 1.	Medium

	Recruited from a speciality hospital, general zone hospital and national health institute.											Prevalence = 56% (n = 175)	
Rosta et al., (2008)	Doctors (physicians) (n = 1917). Part of the national mail survey "Work Life, Lifestyle and Health among Hospital Doctors in Germany". Random sampling.	Cross-sectional	Germany (Europe)	NR	61.60	NR	58%	AUDIT C 5+	-	337 (17.6)	-	-	High
Sebo et al., (2007)	Doctors (general practitioners, general internists, paediatricians, physicians) (n = 2576). Recruited via a postal survey.	Cross-sectional	Switzerland (Europe)	51.00 (±8.00)	84.00	NR	65%	AUDIT C 5+	-	773 (30)	-	-	High
Nash et al., (2010)	Doctors (all major speciality groups, trainees and general practitioners) (n = 2999). Recruited via a postal survey to all Australian doctors insured with an Australian medical insurance company. Convenience sampling.	Cross-sectional	Australia (Oceania)	NR	69.52	NR	36%	AUDIT 8+	-	450 (15)	-	Psychological distress. GHQ 12, cut off 4. Prevalence = 28% (n = 840)	High
Sorensen et al., (2015)	Doctors (physicians) (n = 1943). Randomly selected from the Danish Medical Association.	Cross-sectional	Denmark (Europe)	NR	47.71	NR	49%	AUDIT 8+	AUDIT 15+	368 (18.9)	46 (2.4)	-	High
Rosta et al., (2013)	Doctors (n = 959). Recruited from the Research Institute of the Norwegian Medical Association via postal questionnaires. Random sampling.	Longitudinal cohort	Norway (Europe)	48.60 (SD NR)	61.60	NR	67%	AUDIT 8+	-	63 (6.6)	-	-	High

Study	Sample / Recruitment	Design	Country	Age				Measure	Measure			Outcomes	Quality
Lheureux et al., (2016)	General practitioners (n = 1890). Recruited from a sample of general practitioners will to participant in research. Randomly sampled from a nationally representative database.	Cross-sectional	France (Europe)	50.6 (±7.60)	74.00	NR	94.5%	AUDIT C 5+	-	218 (13)	-	-	High
Wurst et al., (2013)	Doctors (physicians) (n = 456). Recruited via email or standard postal service. Convenience sampling.	Cross-sectional	Austria (Europe)	45.02 (±10.50)	53.51	NR	18.4%	AUDIT 8+	-	62 (13.5)	-	-	Medium
Unrath et al., (2012)	Doctors (general practitioners) (n = 790). Recruited via anonymous survey. Convenience sampling.	Cross-sectional	Germany (Europe)	NR	69.75	NR	38.6%	-	CAGE 2+	-	149 (18.9)	-	High
First Responders													
Carleton et al., (2018)	Fire fighters (n = 701) Police officers (n = 1196) Paramedics (n = 633) Correctional workers (n = 615) Recruited via a web-based survey. Convenience sampling.	Cross-sectional	Canada (North America)	NR	67.50	NR	NR	AUDIT 8+	AUDIT 15+	177 (25.2) 242 (20.2) 119 (18.8) 122 (19.8)	63 (8) 73 (5.8) 40 (6.1) 47 (6.8)	Depression (PHQ 9; cut off 9). Anxiety (GAD 7; cut off 9). PTSD (PCL-5; cut off 32). Firefighters: PHQ 9 = 29.6%; GAD 7 = 23.6%; PCL 5 = 24.5%. Police officers: PHQ 9 = 19.6%; GAD 7 = 14.6%; PCL 5 = 19.5%. Paramedics: PHQ 9 = 29.6%; GAD 7 = 20.5%; PCL 5 = 24.5%.	High

												Correctional workers: PHQ 9 = 31.1%; GAD 7 = 23.6%; PCL 5 = 29.1%.	
Ward et al., (2006)	Paramedics (n = 807) Rescue workers (n = 540) Firefighters (n = 938) Police (n = 853) Questionnaire set to all emergency response functions in Western Cape Province. Convenience sampling.	Cross-sectional	South Africa (Africa)	32.80 (SD NR)	86.00	NR	26.6 – 47.8%	-	CAGE 2+	-	182 (22.5) 90 (16.7) 225 (24) 160 (18.8)	Psychological distress (GHQ 12; cut off 5). PTSD (IES-R). Paramedics: GHQ 12 = 45.1%. IES-R = 2.4%. Rescue workers: GHQ 12 = 21.11%. IES-R = 0.79%. Firefighters: GHQ 12 = 40.68%. IES-R = 2.31%. Police: GHQ 12 = 40.68%. IES-R = 2.06%.	High
Martin et al., (2017)	Firefighters and paramedics (n = 3036). Recruited via a self-report survey within one firefighter and paramedic department, where roles are combined. Convenience sampling.	Cross-sectional	USA (North America)	NR	97.00	62%	76%	-	RAPS4 1+	-	947 (31.2)	Depression. PHQ 9 (cut off not reported). PTSD. PCL C (cut off not reported). Prevalence depression = 11.25% (n = 342) Prevalence PTSD = 26.24% (n = 797)	Medium
Kaufmann et al., (2013)	Firefighters and paramedics (n = 474). Secondary data from the National Epidemiologic Survey on Alcohol and Related Conditions. Weighted stratified sampling.	Longitudinal	USA (North America)	NR	72.00	42%	87%	-	DSM IV (AUDADIS)	-	176 (37)	Depression. DSM IV. Anxiety. DSM IV. Prevalence depression = 15% (n = 71).	High

												Prevalence anxiety = 1.3% (n = 6).	
Slaymaker et al., (2000)	Firefighters and paramedics (n = 155). Randomly sampled from both rural and urban Departments of Health and Emergency Medical Services.	Cross-sectional	USA (North America)	41.90 (±9.09)	65.80	95%	13.8%	AUDIT 8+	-	19 (12.4)	-	PTSD. Symptom Checklist-90-Revised (cut off not reported). Prevalence = 8.4% (n = 13)	Medium
De Barros et al., (2013)	Firefighters (n = 303). Recruited at the Fourth Military Firefighters Battalion, as part of the study "Firefighters' mental health evaluation".	Cross-sectional	Brazil (South America)	NR	91.00	53%	55.9%	AUDIT 8+	AUDIT 15+	94 (31)	29 (9.6)	Depression. BDI, cut off 19. Anxiety. BAI, cut off 16. Prevalence depression = 10% (n = 30). Prevalence anxiety = 9% (n = 27).	Low
Haddock et al., (2012)	Firefighters (n = 656). Secondary data from cohort study examining risk factors for injury among firefighters.	Cross-sectional	USA (North America)	38.20 (±9.90)	100.00	NR	97%	-	CAGE 2+	-	71 (10.8)	-	Medium
Gallyer et al., (2018)	Firefighters (n = 944). Recruited via email lists and social media outlets maintained by fire service organisations. Convenience sampling.	Cohort study	USA (North America)	38.94 (±10.68)	88.50	88%	NR	AUDIT C 4+	-	596 (63.6)	-	-	High
Smith et al., (2018)	Firefighters (n = 652). Secondary data from a cohort study examining stress and health-related behaviours among firefighters.	Cohort study	USA (North America)	38.40 (±8.60)	93.70	78%	NR	AUDIT 8+	AUDIT 15+	153 (23.5)	41 (6.3)	-	High

Author	Sample	Study design	Country	Age				AUDIT (hazardous)	AUDIT (harmful)	Hazardous n (%)	Harmful n (%)	Other outcomes	Quality
Mumford et al., (2015)	Police (n = 184). Recruited via 15 law enforcement agencies. Convenience sampling.	Pilot study	USA (North America)	39.30 (±8.40)	85.00	82%	69.4%	AUDIT C 4+	-	151 (82.1)	-	Depression. PHQ 2 (cut off 3). PTSD. PC-PTSD (cut off 3). Prevalence depression = 7.2% (n = 182). Prevalence PTSD = 9% (n = 181).	Medium
Donnelly et al., (2015)	Police (n = 934). Recruited as part of the Law Enforcement Families Partnership studies. Convenience sampling.	Cross-sectional	USA (North America)	NR	70.10	55%	NR	AUDIT 8+	AUDIT 15+	545 (58.3)	91 (9.7)	PTSD. PCL M (cut off 50). Prevalence = 65.95% (n = 616).	Medium
Davey et al., (2001)	Police (n = 749). Recruited from two divisions of an Australian state police service. Stratified sampling.	Cross-sectional	Australia (Oceania)	NR	86.00	NR	55%	AUDIT 8+	AUDIT 13+	274 (36.5)	27 (3.6)	-	High
Violanti et al., (2011)	Police (n = 105). Recruited via mid-sized urban police department. Random sampling.	Cross-sectional	USA (North America)	39.30 (±7.60)	61.90	74%	100%	AUDIT 8+	AUDIT 15+	32 (30.5)	18 (17.1)	-	High
Murtagh (2010)	Police (n = 686). Recruited via numerous police departments in Massachusetts. Convenience sampling.	Cross-sectional	USA (North America)	NR	88.00	94%	36.2 – 68.6%	AUDIT 8+	AUDIT 15+	193 (28)	7 (3.6)	-	High
Lindsay (2008)	Police (n = 1328). Recruited via various law enforcement agencies within Mississippi.	Cross-sectional	USA (North America)	39.02 (±2.50)	86.60	71%	49.9%	AUDIT 8+	AUDIT 15+	224 (16.8)	7 (0.5)	-	High

Stratified sampling.													
Burnhams et al., (2014)	Police (n = 325). Recruited via a safety and security sector of a local municipality in the Western Cape province of South Africa. Random sampling.	Cross-sectional	South Africa (Africa)	36.60 (±6.60)	87.00	NR	NR	-	CAGE 2+	-	64 (19.6)	-	High
Ballenger et al., (2010)	Police (n = 712). Recruited via the Oakland, San Jose, California and New York City police departments as part of a larger study examining critical incident and work stressors.	Cross-sectional	USA (North America)	37.10 (±6.80)	78.50	44%	62.2%	-	SUI 14+	-	96 (13.45)	-	Medium
Obst et al., (2001)	Police (n = 177). Two groups recruited in training, one group of new recruits and one group of trainee officers. Convenience sampling.	Cross-sectional	Australia (Oceania)	NR	58.19	NR	NR	AUDIT 8+	AUDIT 13+	65 (26)	25 (14.1)	-	Low
Davey et al., (2000)	Police (n = 4193). Recruited from a state-wide police organisation. Convenience sampling.	Cross-sectional	Australia (Oceania)	NR	87.90	NR	67%	AUDIT 8+	AUDIT 13+	1342 (32)	126 (3)	-	High
Sterud et al., (2007)	Police (n = 2372). Paramedics (n = 1096). Recruited via questionnaire distributed by Norwegian police union and ambulance chiefs in 19 ambulance regions.	Cross-sectional	Norway (Europe)	37.20 (±9.30) 36.80 (±8.10)	82.40 76.80	NR	51% 41%	AUDIT 6+ AUDIT 8+	-	323 (13.65) 167 (14.75)	-	-	Medium

Random sampling.

Author	Population	Design	Country	Age				AUDIT cut-off 1	AUDIT cut-off 2			Outcomes	Quality
Fjeldheim et al., (2014)	Paramedics (first year trainees) (n = 131). Recruited from a university in the Western Cape. Convenience sampling.	Cross-sectional	South Africa (Africa)	22.05 (SD NR)	63.60	47%	NR	AUDIT 8+	AUDIT 15+	32 (24)	11 (8.4)	Depression. CES-D, cut off 16. PTSD. Davidson Trauma Scale, cut off 40. Prevalence depression = 28% (n = 37). Prevalence PTSD = 16% (n = 21).	High
Strohmeier et al., (2018)	Aid workers (n = 277). Recruited based on participation in 2017 South Sudan Humanitarian Response plan or Humanitarian Country Team membership. Convenience sampling.	Cross-sectional	South Sudan (Africa)	NR	78.00	NR	10%	AUDIT C 4+	-	99 (35.5)	-	Depression and Anxiety. Hopkins Symptoms Checklist 25, cut off 1.75. PTSD. PCL 5, cut off 33. Prevalence depression = 39% (n = 108). Prevalence anxiety = 28% (n = 78). Prevalence PTSD = 24% (n = 65).	Medium
Loo et al., (2016)	Aid workers (n = 549). Recruited via National Disaster Medical System. Convenience sampling.	Cross-sectional	Worldwide	48.20 (SD NR)	60.00	93%	35.5%	AUDIT 8+	AUDIT 15+	31 (5.7)	4 (0.7)	Depression. PHQ 9, cut off 5. Anxiety. GAD 7, cut off 5. PTSD. PCL-C, cut off 44. Prevalence depression = 27% (n = 148). Prevalence anxiety = 25.5% (n = 140).	High

												Prevalence PTSD = 35.3% (n = 195).	
Armed Forces Personnel													
Rona et al., (2010)	Military personnel (n = 8561). Recruited from a cohort study of UK Armed Forces personnel. Stratified sampling.	Cross-sectional	UK (Europe)	NR	91.41	NR	61%	AUDIT 8+	AUDIT 15+	4220 (49)	1357 (15.9)	Psychological distress. GHQ 12, cut off 4. PTSD. PCL-C, cut off 50. Prevalence psychological distress = 19.85% (n = 1699). Prevalence PTSD = 6.18% (n = 529).	High
Hammer et al., (2017)	Military personnel (including national guard, active duty service members and reserves) (n = 493). Secondary data collected as part of SERVe.	Cross-sectional	USA (North America)	39.09 (SD NR)	83.30	NR	33.2%	AUDIT 8+	AUDIT 15+	105 (21.13)	28 (5.7)	PTSD. PCL M, cut off 12. Prevalence = 13.37% (n = 66).	Medium
Holliday et al., (2017)	Military personnel (young adult veterans) (n = 734). Recruited via Facebook advertisements as part of a larger study examining drinking behaviours in young adult veterans. Convenience sampling.	Cross-sectional	USA (North America)	36.55 (±3.30)	87.10	NR	NR	AUDIT 8+	-	262 (48.37)	-	Depression. PHQ 2, cut off 3. Anxiety. GAD 7, cut off 10. PTSD. PC PTSD, cut off 3. Prevalence depression = 51.36% (n = 377). Prevalence anxiety = 52.27% (n = 384). Prevalence PTSD = 65.5% (n = 481).	Medium

Bartone et al., (2012)	Military personnel (n = 1076). Secondary data obtained from the National Defence Health Survey administered by the Norwegian Armed Forces Health Registry.	Cross-sectional	Norway (Europe)	NR	94.00	NR	49.3%	-	CAGE 2+		20 (1.9)	-	Medium
Orme et al., (2011)	Military personnel (regulars and reservists) (n = 184). Data was extracted from two standard psychological screens of Army personnel at the end of deployment. Convenience sampling.	Cross-sectional	Australia (Oceania)	25.90 (±5.25)	100.00	NR	83%	AUDIT 8+	-	70 (38)	-	PTSD. PCL C, cut off 30. Prevalence = 11% (n = 20.24).	Medium
Sekulic et al., (2014)	Military personnel (n = 73). Recruited via different locations of Croatian Special Armed Forces. Semi-random sampling.	Cross-sectional	Croatia (Europe)	33.41 (±6.42)	100.00	NR	98%	-	AUDIT 11+	-	40 (55)	-	Low
Fuehrlein et al., (2016)	Military personnel (n = 3175). Secondary data from the National Health and Resilience in Veterans Study. Stratified sampling.	Cross-sectional	USA (North America)	60.58 (SD NR)	89.32	84%	NR	AUDIT C 5+	-	-	823 (26.2)	Depression and anxiety. PHQ 4, cut off not reported. PTSD. PCL M, cut off 50. Prevalence depression = 18.25% (n = 579). Prevalence anxiety = 8.5% (n = 270). Prevalence PTSD = 8.6% (n = 273).	High

Study	Sample	Design	Country	Age				AUDIT	AUDIT			Mental health outcome	Quality
Green et al., (2014)	Military personnel (active duty, national guard, reserves) (n = 1090). Secondary data from the National Post-Deployment Adjustment Study. Stratified sampling.	Longitudinal	USA (North America)	37.00 (±9.57)	84.00	78%	56%	AUDIT 8+	AUDIT 15+	235 (21.5)	150 (13.8)	PTSD. Davidson Trauma Scale, cut off 48. Prevalence = 18% (n = 196).	High
Hoopsick et al., (2020)	Military personnel (national guard, reserves) (n = 445). Recruited for Operation: SAFETY. Opportunity sampling.	Longitudinal	USA (North America)	31.60 (±6.4)	79.40	81%	78%	AUDIT 8+	-	47 (10.6)	-	-	High
Henderson et al., (2009)	Navy (n = 1333). Recruited via 12 royal navy ships. Random sampling.	Cross-sectional	UK (Europe)	NR	100.00		70%	AUDIT C 4+	-	1227 (92)	-	-	High
Bryan et al., (2018)	Air force (intelligence and cyber warfare personnel) (n = 7550). Recruited via 25th Air Force, 24th Air Force and RPA personnel.	Cross-sectional	USA (North America)	NR	79.60		11 - 36.8%	AUDIT C 4+	-	993 (20.7)	-	Psychological distress. Outcome Questionnaire-45, cut off 63. Prevalence 12.75% (n = 963).	High
Train Drivers													
Baek et al., (2017)	Train drivers (n = 4624). Secondary data from the nationwide survey, Human Error Study for Korean Train Drivers.	Cross-sectional	South Korea (Asia)	46.00 (±9.38)	99.20	84.6%	-	-	AUDIT 20+	-	224 (4.8)	PTSD. MINI. Prevalence = 2.23% (n = 103).	Medium

a For longitudinal studies, statistics from the most recent wave were extracted.

SD; standard deviation. NR; not reported. USA; United States of America. UK; United Kingdom. AUDIT (C); Alcohol Use Disorder Identification Test (Consumption). CAGE; Cut-Annoyed-Guilty-Eye.

RAPS4; Rapid Alcohol Problems Screen. DSM IV; Diagnostic and Statistical Manual of Mental Disorders 4th Edition. AUDAIS; Alcohol Use Disorder and Associated Disabilities Interview Schedule. SUI;

Substance Use Inventory. PTSD; Post-traumatic stress disorder. GHQ; General Health Questionnaire. WHO; World Health Organisation. PHQ; Patient Health Questionnaire. GAD; General Anxiety Disorder;

MINI; Mini International Neuropsychiatric Interview. PRIME-MD; Primary Care Evaluation of Mental Disorders. CES-D; Centre for Epidemiologic Studies Depression Scale. PCL C; PTSD Checklist Civilian.

PLC M; PTSD Checklist Military. PC PTSD; Primary Care PTSD Screen.

Appendix 5. *Figure S4.1.* **Forest plot showing the pooled prevalence estimates for hazardous alcohol use, separated by measure used (Chapter 4)**

Hazardous alcohol use separated by measure used

Study	ES (95% CI)
AUDIT	
Slaymaker (2000)	12.26 (7.99, 18.35)
Davey (2000)	32.01 (30.61, 33.43)
Davey (2001)	36.58 (33.21, 40.09)
Obst (2001)	22.60 (17.06, 29.30)
Kuerer (2007)	7.10 (5.24, 9.56)
Sterud (2007)	13.62 (12.30, 15.06)
Sterud (2007)	15.24 (13.23, 17.49)
Lindsay (2008)	16.87 (14.95, 18.98)
Hodgins (2009)	4.02 (3.14, 5.13)
Bazargan (2009)	5.64 (4.21, 7.51)
Toral-Villanueva (2009)	21.00 (16.85, 25.86)
Nash (2010)	15.01 (13.77, 16.33)
Murtagh (2010)	28.13 (24.90, 31.61)
Rona (2010)	49.29 (48.23, 50.35)
Violanti (2011)	30.48 (22.49, 39.84)
Orme (2011)	38.04 (31.34, 45.24)
Rosta (2013)	6.57 (5.17, 8.32)
Wurst (2013)	13.60 (10.75, 17.05)
De Barros (2013)	31.02 (26.08, 36.44)
Fjeldheim (2014)	24.43 (17.87, 32.44)
Green (2014)	21.56 (19.22, 24.10)
Sorensen (2015)	18.94 (17.26, 20.74)
Donnelly (2015)	11.58 (9.33, 14.29)
Talih (2016)	5.93 (2.90, 11.74)
Loo (2016)	4.92 (3.40, 7.06)
Patel (2017)	27.78 (15.85, 43.99)
Mahmood (2017)	15.02 (12.99, 17.30)
Hammer (2017)	21.30 (17.91, 25.13)
Holliday (2017)	35.69 (32.31, 39.23)
Baek (2017)	4.84 (4.26, 5.50)
Obadeji (2018)	4.30 (2.42, 7.53)
Kim (2018)	13.20 (9.56, 17.96)
Carleton (2018)	25.25 (22.17, 28.59)
Smith (2018)	23.47 (20.37, 26.87)
Carleton (2018)	20.23 (18.05, 22.60)
Carleton (2018)	18.80 (15.95, 22.03)
Carleton (2018)	19.84 (16.88, 23.17)
Hoopsick (2020)	10.56 (8.04, 13.76)
Subtotal (I^2 = 99.41%, p<0.001)	17.83 (13.23, 22.95)
AUDIT C	
Sebo (2007)	30.01 (28.27, 31.81)
Rosta (2008)	17.58 (15.94, 19.35)
Henderson (2009)	92.05 (90.47, 93.38)
Oreskovich (2012)	15.41 (14.59, 16.26)
Mumford (2015)	82.07 (75.88, 86.93)
Lheureux (2016)	11.53 (10.17, 13.05)
Fuehrlein (2016)	25.92 (24.43, 27.47)
Pforringer (2018)	23.04 (20.44, 25.87)
Gallyer (2018)	63.14 (60.01, 66.15)
Strohmeier (2018)	35.74 (30.33, 41.54)
Bryan (2018)	13.15 (12.41, 13.93)
Subtotal (I^2 = 99.81%, p<0.001)	36.46 (23.49, 50.51)
SUI	
Ballenger (2010)	18.96 (16.25, 22.00)
Heterogeneity between groups: p = 0.024	
Overall (I^2 = 99.58%, p<0.001);	21.60 (17.05, 26.53)

Prevalence %

Appendix 6. *Figure S4.2.* **Forest plot showing the pooled prevalence estimates for harmful alcohol use, separated by measure used (Chapter 4)**

Harmful alcohol use separated by measure used

Study	ES (95% CI)
AUDIT	
Davey (2000)	3.01 (2.53, 3.57)
Davey (2001)	3.60 (2.49, 5.19)
Obst (2001)	14.12 (9.75, 20.02)
Lindsay (2008)	0.53 (0.26, 1.08)
Murtagh (2010)	1.02 (0.50, 2.09)
Rona (2010)	15.85 (15.09, 16.64)
Violanti (2011)	17.14 (11.13, 25.48)
De Barros (2013)	9.57 (6.75, 13.41)
Fjeldheim (2014)	8.40 (4.75, 14.41)
Sekulic (2014)	54.79 (43.42, 65.69)
Green (2014)	13.76 (11.84, 15.93)
Sorensen (2015)	2.37 (1.78, 3.14)
Donnelly (2015)	14.24 (11.74, 17.16)
Loo (2016)	0.73 (0.28, 1.86)
Patel (2017)	5.56 (1.54, 18.14)
Hammer (2017)	5.68 (3.96, 8.09)
Obadeji (2018)	1.56 (0.61, 3.95)
Carleton (2018)	8.99 (7.09, 11.33)
Smith (2018)	6.29 (4.67, 8.42)
Carleton (2018)	6.10 (4.88, 7.61)
Carleton (2018)	6.32 (4.67, 8.49)
Carleton (2018)	7.64 (5.80, 10.01)
Subtotal (I^2 = 98.61%, p<0.001)	7.39 (4.65, 10.68)
CAGE	
Ward (2006)	23.99 (21.36, 26.82)
Ward (2006)	18.76 (16.28, 21.51)
Ward (2006)	22.55 (19.80, 25.56)
Ward (2006)	16.67 (13.76, 20.04)
Unrath (2012)	18.86 (16.29, 21.74)
Haddock (2012)	10.82 (8.67, 13.43)
Bartone (2012)	1.86 (1.21, 2.85)
Burnhams (2014)	19.69 (15.73, 24.36)
Thrasher (2016)	9.04 (7.08, 11.46)
Subtotal (I^2 = 98.10%, p<0.001)	14.85 (9.16, 21.62)
RAPS	
Martin (2017)	31.19 (29.57, 32.86)
DSM	
Kaufmann (2013)	37.13 (32.90, 41.57)
SUI	
Ballenger (2010)	13.48 (11.17, 16.19)
Heterogeneity between groups: p<0.001	
Overall (I^2 = 99.00%, p<0.001);	10.65 (7.54, 14.23)

Prevalence %

Appendix 7. *Figure S4.3.* **Forest plot showing the pooled prevalence estimates for hazardous alcohol use, separated by continent (Chapter 4)**

Sensitivity analysis for hazardous alcohol use

Appendix 8. *Figure S4.4.* **Forest plot showing the pooled prevalence estimates for harmful alcohol use, separated by continent (Chapter 4)**

Appendix 9. Table S5.1. Frequencies and percentages for low risk, hazardous and harmful drinking, separated by binge drinking (Chapter 5)

	Total = 40,986		Does not frequently binge drink (N = 28,577)		Frequent binge drinking (N = 12,390)	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Non-drinker	3,764	9.18 (8.91 to 9.47)	3,764	100.00	-	-
Up to 14 units (low risk)	22,612	55.17 (54.69 to 55.65)	19,362	85.63 (85.16 to 86.08)	3,250	14.37 (13.92 to 14.83)
Between 14 and 35/50 units (hazardous)	13,365	32.61 (32.16 to 33.06)	5,313	39.75 (38.93 to 40.59)	8,052	60.25 (59.41 to 61.07)
35+ units for women, 50+ units for men (harmful)	1,245	3.04 (2.87 to 3.20)	138	11.08 (9.46 to 12.95)	1,107	88.92 (87.05 to 90.54)

[a] frequent binge drinking defined as 6 or more units, at least 2 to 4 times a month

Appendix 10. Table S5.2. Exploratory logistic regression analyses examining differences in depression, anxiety and PTSD in abstainers who were former drinkers, versus abstainers who have never drank (Chapter 5)

Characteristic	Never drinker	Former drinker		
	N (%)	N (%)	OR (95% CI)	AOR (95% CI)
Depression non-case	988 (89.49)	2,258 (86.31)	1.00	1.00
Depression case	116 (10.51)	358 (13.69)	1.35 (1.08 to 1.69)*	1.34 (1.06 to 1.70)*
Anxiety non-case	1,009 (91.39)	2,325 (88.88)	1.00	1.00
Anxiety case	95 (8.61)	291 (11.12)	1.33 (1.04 to 1.70)*	1.21 (0.94 to 1.57)
PTSD non-case	1,019 (96.40)	2,404 (95.36)	1.00	1.00
PTSD case	38 (3.60)	117 (4.64)	1.30 (0.90 to 1.90)	1.25 (0.84 to 1.86)

*$p < .05$, **$p < .01$, ***$p < .001$

Adjusted for age, gender, education, ethnicity, income, marital status, children under 18, and smoking status.

Appendix 11. Table S5.3. Multinomial logistic regression analysis, adjusted for age and gender, showing the associations between sociodemographic, occupational and health factors with alcohol consumption as the outcome. Low-risk drinking is the reference group. Row frequencies and percentages, with adjusted multinomial odds ratios (AMOR) are shown (Chapter 5)

Characteristic	Non-drinker		Low risk	Hazardous use		Harmful use	
	N (%)	AMOR (95% CI)	N (%)	N (%)	AMOR (95% CI)	N (%)	AMOR (95% CI)
Gender							
Women	1,814 (11.94)	1.00	10,054 (66.15)	2,953 (19.43)	1.00	377 (2.48)	1.00
Men	1,950 (7.56)	0.85 (0.80 to 0.92)***	12,558 (48.70)	10,412 (40.38)	2.74 (2.61 to 2.87)***	868 (3.37)	1.75 (1.54 to 1.98)***
Age							
40 to 49	1,311 (8.24)	1.00	8,205 (51.54)	5,824 (36.59)	1.00	579 (3.64)	1.00
<29	531 (9.39)	0.91 (0.81 to 1.01)	3,572 (63.19)	1,440 (25.47)	0.66 (0.61 to 0.71)***	110 (1.95)	0.48 (0.39 to 0.59)***
30 to 39	1,348 (9.95)	1.09 (1.00 to 1.18)*	7,679 (53.35)	4,162 (30.72)	0.81 (0.77 to 0.86)***	358 (2.64)	0.69 (0.60 to 0.79)***
50 to 59	496 (9.53)	1.12 (1.00 to 1.25)	2,778 (53.35)	1,752 (33.65)	0.90 (0.84 to 0.96)**	181 (3.48)	0.93 (0.78 to 1.10)
>60	78 (11.82)	1.29 (0.98 to 1.66)	378 (57.27)	187 (28.33)	0.70 (0.59 to 0.84)***	17 (2.58)	0.64 (0.39 to 1.05)
Marital status							
Married/Cohabiting	2,844 (8.97)	1.00	17,268 (54.46)	10,645 (33.57)	1.00	953 (3.01)	1.00
Divorced/Separated	292 (8.80)	0.93 (0.82 to 1.06)	1,835 (55.32)	1,074 (32.38)	1.06 (0.98 to 1.15)	116 (3.50)	1.17 (0.95 to 1.42)
Single	530 (10.92)	1.13 (1.02 to 1.26)*	2,868 (59.09)	1,314 (27.07)	1.06 (0.99 to 1.14)	142 (2.93)	1.27 (1.05 to 1.53)*
Other	87 (9.19)	0.96 (0.76 to 1.20)	552 (58.29)	279 (29.46)	1.12 (0.96 to 1.30)	29 (3.06)	1.28 (0.87 to 1.88)
Country							
England	2,806 (9.86)	1.00	15,782 (55.44)	9,031 (31.73)	1.00	846 (2.97)	1.00
Scotland	461 (7.17)	0.73 (0.66 to 0.81)***	3,595 (55.93)	2,198 (34.19)	1.02 (0.96 to 1.09)	174 (2.71)	0.88 (0.75 to 1.04)
Wales	431 (8.07)	0.86 (0.77 to 0.96)**	2,816 (52.70)	1,895 (35.47)	1.25 (1.17 to 1.34)***	201 (3.76)	1.41 (1.21 to 1.66)***
Education							
GSCE/O-Level or below	1,298 (9.49)	1.00	7,297 (53.36)	4,595 (33.60)	1.00	485 (3.55)	1.00
Vocational qualifications	285 (9.94)	0.99 (0.86 to 1.14)	1,622 (56.57)	896 (31.25)	0.94 (0.86 to 1.03)	64 (2.23)	0.65 (0.50 to 0.86)**
A levels or equivalent	1,149 (8.87)	0.91 (0.83 to 0.99)*	7,199 (55.55)	4,199 (32.40)	1.00 (0.95 to 1.05)	413 (3.19)	0.96 (0.84 to 1.10)
Bachelor Degree/Postgraduate	1,021 (9.01)	0.90 (0.82 to 0.99)*	6,405 (56.55)	3,622 (31.98)	1.00 (0.94 to 1.06)	278 (2.45)	0.76 (0.65 to 0.89)***
Ethnicity							
White	3,151 (8.15)	1.00	21,396 (55.37)	12,889 (33.35)	1.00	1,207 (3.12)	1.00
Asian	317 (45.94)	7.35 (6.25 to 8.66)***	297 (43.04)	69 (10.00)	0.37 (0.28 to 0.48)***	7 (1.01)	0.42 (0.20 to 0.90)*
Black	134 (30.59)	3.39 (2.74 to 4.19)***	261 (59.59)	39 (8.90)	0.26 (0.18 to 0.36)***	4 (0.91)	0.26 (0.10 to 0.71)**
Mixed Race	53 (11.62)	1.35 (1.01 to 1.82)*	271 (59.43)	122 (26.75)	0.74 (0.59 to 0.92)**	11 (2.19)	0.67 (0.35 to 1.26)
Other	88 (15.74)	2.21 (1.73 to 2.82)***	279 (49.91)	180 (32.20)	0.91 (0.75 to 1.10)	12 (2.15)	0.68 (0.38 to 1.21)
Children Under 18							

0	1,906 (9.19)	1.00	11,541 (55.65)	6,623 (31.94)	1.00	667 (3.22)	1.00
1	797 (9.79)	1.08 (0.98 to 1.18)	4,567 (56.11)	2,560 (31.45)	0.82 (0.77 to 0.87)***	215 (2.64)	0.69 (0.58 to 0.81)***
2	813 (8.51)	0.98 (0.89 to 1.07)	5,170 (54.12)	3,279 (34.33)	0.85 (0.81 to 0.90)***	290 (3.04)	0.76 (0.66 to 0.89)***
3 or more	237 (9.88)	1.20 (1.03 to 1.40)*	1,245 (51.88)	850 (35.42)	0.86 (0.78 to 0.95)**	68 (2.83)	0.70 (0.54 to 0.91)**
Years in police force							
11 to 20	1,130 (8.91)	1.00	6,783 (53.50)	4,343 (34.25)	1.00	423 (3.34)	1.00
Less than 5	839 (9.91)	1.02 (0.92 to 1.14)	5,398 (62.17)	2,207 (26.07)	0.81 (0.76 to 0.88)***	157 (1.85)	0.57 (0.46 to 0.70)***
6 to 10	1,047 (11.34)	1.20 (1.09 to 1.32)***	5,263 (58.48)	2,555 (27.68)	0.81 (0.76 to 0.86)***	231 (2.50)	0.75 (0.63 to 0.89)**
More than 20	740 (7.01)	0.84 (0.76 to 0.94)**	5,144 (48.74)	4,238 (40.15)	1.17 (1.10 to 1.25)***	433 (4.10)	1.22 (1.04 to 1.42)*
Role							
Police Officer	2,050 (7.88)	1.00	13,645 (52.42)	9,476 (36.40)	1.00	954 (3.66)	1.00
Police Staff	1,270 (12.26)	1.31 (1.21 to 1.43)***	6,333 (61.12)	2,504 (28.16)	0.79 (0.74 to 0.84)***	266 (2.57)	0.77 (0.65 to 0.90)***
Other	91 (12.38)	1.44 (1.14 to 1.83)**	411 (55.92)	207 (24.17)	0.88 (0.74 to 1.05)	28 (3.81)	1.10 (0.73 to 1.66)
Income							
£26000 - £37999	1,593 (9.47)	1.00	9,438 (56.11)	5,306 (31.55)	1.00	483 (2.87)	1.00
Less than £25999	1,065 (12.06)	1.08 (0.99 to 1.19)	5,703 (64.57)	1,898 (21.49)	0.83 (0.78 to 0.89)***	166 (1.88)	0.65 (0.54 to 0.79)***
£38000 - £59999	1,018 (7.34)	0.89 (0.81 to 0.97)*	6,775 (48.85)	5,527 (39.85)	1.18 (1.12 to 1.24)***	549 (3.96)	1.32 (1.16 to 1.51)***
More than £60000	77 (5.89)	0.75 (0.58 to 0.96)*	607 (46.44)	607 (44.45)	1.32 (1.17 to 1.49)***	42 (3.21)	1.05 (0.75 to 1.46)
Days of sickness							
None	1,614 (8.510	1.00	10,255 (54.10)	6,532 (34.46)	1.00	555 (2.93)	1.00
1 to 5	1,176 (8.71)	0.95 (0.88 to 1.03)	7,742 (57.33)	4,192 (31.04)	0.97 (0.93 to 1.02)	394 (2.92)	1.06 (0.93 to 1.22)
6 to 10	376 (10.15)	1.13 (1.00 to 1.28)	2,073 (55.98)	1,147 (30.97)	1.01 (0.94 to 1.10)	107 (2.89)	1.08 (0.87 to 1.34)
More than 10	596 (12.51)	1.47 (1.32 to 1.63)***	2,514 (52.76)	1,468 (30.81)	1.07 (1.00 to 1.15)	187 (3.92)	1.52 (1.28 to 1.81)***
Smoking status							
Not smoker	3,384 (9.17)	1.00	20,704 (56.11)	11,798 (31.97)	1.00	1,016 (2.75)	1.00
Current smoker	375 (9.30)	1.21 (1.08 to 1.36)**	1,876 (46.53)	1,553 (38.52)	1.62 (1.51 to 1.74)***	228 (5.65)	2.71 (2.33 to 3.16)***

*p < .05, **p < .01, ***p < .001

Appendix 12. Table S5.4. Multinomial logistic regression analysis, adjusted for age and gender, showing the associations between sociodemographic, occupational and health factors with frequent binge drinking as the outcome. Row frequencies and percentages, with adjusted odds ratios (AOR) are shown (Chapter 5)

Characteristic	Does not frequently binge drink	Frequent binge drinking	
	N (%)	N (%)	AOR (95% CI)
Gender			
Women	11,979 (78.82)	3,219 (21.18)	1.00
Men	16,598 (64.36)	9,190 (35.64)	2.08 (1.98 to 2.18)***
Age			
40 to 49	10,779 (67.71)	5,140 (32.29)	1.00
<29	3,911 (69.18)	1,742 (30.82)	1.06 (0.99 to 1.13)
30 to 39	9,598 (70.85)	3,949 (29.15)	0.91 (0.86 to 0.96)***
50 to 59	3,762 (72.25)	1,445 (27.75)	0.81 (0.76 to 0.87)***
>60	527 (79.85)	133 (20.15)	0.53 (0.44 to 0.65)***
Marital status			
Married/Cohabiting	22,333 (70.43)	9,377 (29.57)	1.00
Divorced/Separated	2,271 (68.47)	1,046 (31.53)	1.24 (1.14 to 1.34)***
Single	3,211 (66.15)	1,643 (33.85)	1.49 (1.39 to 1.59)***
Other	651 (68.74)	296 (31.26)	1.29 (1.12 to 1.49)**
Country			
England	20,410 (71.70)	8,055 (28.30)	1.00
Scotland	4,143 (64.45)	2,285 (35.55)	1.35 (1.27 to 1.43)***
Wales	3,502 (65.54)	1,841 (34.46)	1.36 (1.28 to 1.45)***
Education			
GSCE/O-Level or below	9,378 (68.58)	4,297 (31.42)	1.00
Vocational qualifications	2,018 (70.39)	849 (29.61)	0.92 (0.84 to 1.01)
A levels or equivalent	9,004 (69.48)	3,956 (30.52)	0.95 (0.90 to 1.00)*
Bachelor Degree/Postgraduate	8,066 (71.22)	3,260 (28.78)	0.88 (0.83 to 0.93)***
Ethnicity			
White	26,663 (69.00)	11,980 (31.00)	1.00
Asian	620 (89.86)	70 (10.14)	0.24 (0.19 to 0.31)***
Black	402 (91.78)	36 (8.22)	0.22 (0.15 to 0.31)***
Mixed Race	339 (74.34)	117 (25.66)	0.74 (0.60 to 0.92)**
Other	404 (72.27)	155 (27.73)	0.76 (0.63 to 0.92)**
Children Under 18			
0	14,169 (68.33)	6,568 (31.67)	1.00
1	5,900 (72.49)	2,239 (27.51)	0.72 (0.67 to 0.76)***
2	6,731 (70.47)	2,821 (29.53)	0.75 (0.71 to 0.79)***
3 or more	1,666 (69.42)	734 (30.58)	0.75 (0.68 to 0.83)***
Years in police force			
11 to 20	8,759 (69.08)	3,920 (30.92)	1.00
Less than 5	6,072 (71.72)	2,394 (28.28)	0.86 (0.82 to 0.95)**
6 to 10	6,789 (73.55)	2,442 (26.45)	0.80 (0.75 to 0.85)***
More than 20	6,921 (65.57)	3,634 (34.43)	1.18 (1.11 to 1.25)***
Role			

Police Officer	17,435 (66.98)	8,596 (24.74)	1.00
Police Staff	7,798 (75.26)	2,563 (33.02)	0.96 (0.81 to 1.14)
Other	536 (72.93)	199 (27.07)	0.89 (0.84 to 0.94)***
Income			
£26000 - £37999	11,740 (69.80)	5,080 (30.20)	1.00
Less than £25999	6,791 (76.89)	2,041 (23.11)	0.88 (0.83 to 0.94)***
£38000 - £59999	9,088 (65.53)	4,781 (34.47)	1.11 (1.05 to 1.17)***
More than £60000	847 (64.80)	460 (35.20)	1.14 (1.01 to 1.28)*
Days of sickness			
None	13,095 (69.08)	5,861 (30.92)	1.00
1 to 5	9,502 (70.36)	4,002 (29.64)	1.01 (0.97 to 1.07)
6 to 10	2,583 (69.75)	1,120 (30.25)	1.07 (0.99 to 1.18)
More than 10	3,360 (70.51)	1,405 (29.49)	1.05 (0.98 to 1.13)
Smoking status			
Not smoker	26,185 (70.96)	10,717 (29.04)	1.00
Current smoker	2,349 (58.26)	1,683 (41.74)	1.87 (1.75 to 2.00)***

*p < .05, **p < .01, ***p < .001

Exploratory descriptive statistics for key demographic variables, alcohol, mental health, and job strain, separated by year of data collection, to explore trends over time (Chapter 5)

	2006-2009 N = 16,995 (41.47%)	2010-2012 N = 13,748 (33.54%)	2013-2015 N = 10,243 (24.99%)	Total N = 40,986
Mean age (±SD)	39.98 (±9.13)	40.51 (±8.92)	41.52 (±8.49)	40.55 (±8.93)
Proportion White ethnicity	96.46%	96.45%	87.77%	94.28%
Proportion of men	62.02%	61.69%	65.68%	62.92%
Alcohol consumption				
Non-drinkers	1,343 (7.90%)	1,213 (8.82%)	1,208 (11.79%)	3,764 (9.18%)
Low-risk	9,132 (53.73%)	7,822 (56.90%)	5,658 (55.24%)	22,612 (55.17%)
Hazardous	5,908 (34.76%)	4,350 (31.64%)	3,107 (30.33%)	13,365 (32.61%)
Harmful	612 (3.60%)	363 (2.64%)	270 (2.64%)	1,245 (3.04%)
Mental health case-ness				
Depression case	1,666 (10.14%)	1,299 (9.46%)	993 (9.72%)	3,958 (9.80%)
Anxiety case	1,494 (9.09%)	1,116 (8.13%)	797 (7.80%)	3,407 (8.44%)
PTSD case [a]	606 (4.15%)	513 (3.87%)	383 (3.75%)	1,520 (3.95%)
Job strain				
Low	4,590 (27.94%)	4,064 (29.61%)	2,361 (23.11%)	11,015 (27.28%)
High	3,830 (23.32%)	3,052 (22.23%)	2,840 (27.79%)	9,722 (24.08%)
Passive	5,017 (30.54%)	3,612 (26.31%)	2,617 (25.61%)	11,246 (27.86%)
Active	2,990 (18.20%)	2,999 (21.85%)	2,400 (23.49%)	8,389 (20.78%)

[a] PTSD items not asked in 2006 version of protocol.

Exploratory cross-sectional analysis of trends in prevalence estimates over the period of data collection.

Participants from the Airwave Health Monitoring Study were recruited over a nine year period, meaning there may be changes in prevalence estimates over time, due to changes such as budget cuts which reduced officer numbers from 2010, or in line with the downward trend of alcohol consumption observed in the general population (Office for National Statistics, 2018). Supplementary table 5 shows exploratory descriptive statistics for key demographic variables of interest, as well as the main outcome and explanatory variables (categories of alcohol consumption, probable mental health problems, and job strain), separated by year of data collection (in 3-4 year bands).

Supplementary table 5 shows a decrease in prevalence estimates for hazardous and harmful drinking, and an increase in the proportion of abstainers. The changes in alcohol consumption could relate to the changing demographics of the sample, as the proportion of participants from ethnic minority backgrounds, and the proportion of women, increased substantially during 2013-2015. Supplementary table 3 shows that participants from ethnic minority backgrounds had significantly higher odds of abstaining, compared to those of White ethnicity. Women were also significantly more likely to report abstinence than men. This could also reflect the trends observed in the general population, as there has been an increase in the proportion of adults reporting

abstinence, in the past decade (Office for National Statistics, 2018). Further, the reduction in the proportion of hazardous and harmful drinkers could relate to changes to the drinking culture within policing, but further qualitative research is needed to explore this.

Supplementary table 5 also shows a slight increase in the proportion of police employees meeting criteria for high job strain (high demands, low control) and active strain (high demands, high control), but a decrease in participants reporting low strain (low demands, high control) in 2013-2015, which may reflect increasing levels of demands following the budget cuts which occurred in 2010.

There are considerable sampling and demographic differences which could influence prevalence estimates, meaning the cross-sectional trends should be interpreted cautiously. The original study protocol includes a supplementary table providing substantial detail regarding the recruitment procedure, showing that entire regions were recruited during certain timepoints. For example, all participants from the Metropolitan police service were recruited after 2011 (Elliott et al., 2014). There may be regional differences in the outcomes of interest (Robinson, Shipton, Walsh, Whyte, & McCartney, 2015), therefore, the prevalence estimates separated by year of data collection may not be reliable. Nevertheless, the prevalence estimates for the full sample, for the categories of alcohol consumption and probable mental health problems, do not largely differ from the prevalence estimates across each of the year groups.

Appendix 14. Table S6.1. Demographic, physical health, mental health and alcohol characteristics for police employees before and after entropy balancing (Chapter 6)

		Police (representative estimates)		Police (entropy balanced)	
Characteristic	N	%	95% CI	%	95% CI
Age (years)					
< 29	2,469	10.36	9.98 to 10.76	35.71	34.63 to 36.79
30 to 39	7,394	31.03	30.45 to 31.62	40.55	39.66 to 41.45
40 to 49	10,193	42.78	42.15 to 43.41	21.09	20.56 to 21.63
≥ 50	3,770	15.82	15.37 to 16.29	2.66	2.55 to 2.76
Marital status					
Married/Cohabiting	19,747	84.97	84.50 to 85.42	79.06	78.19 to 79.92
Divorced/Separated	1,619	6.97	6.64 to 7.30	15.76	14.94 to 16.61
Single	1,874	8.06	7.72 to 8.42	5.18	4.83 to 5.55
Education					
Low (GSCE/O level or below)	8,167	34.53	33.93 to 35.14	42.77	41.79 to 43.76
High (Vocational/A levels or higher)	15,484	65.47	64.86 to 66.07	57.23	56.24 to 58.21
Smoking status					
Non-smoker	21,681	91.12	90.76 to 91.48	89.98	89.36 to 90.56
Current smoker	2,111	8.87	8.52 to 9.24	10.02	9.44 to 10.64
Income (police only)					
Less than £25999	2,096	8.86	8.51 to 9.23	14.17	13.42 to 14.95
£26000 - £37999	9,655	40.82	40.20 to 41.45	50.51	49.55 to 51.47
£38000 – £59999	10,832	45.80	45.17 to 46.43	33.37	32.54 to 34.20
£More than £60000	1,068	4.52	4.26 to 4.79	1.95	1.80 to 2.12
Role (police only)					
Police staff	3,627	16.91	16.41 to 17.41	15.28	14.53 to 16.07
Police constable/sergeants	15,645	72.92	72.32 to 73.51	79.81	79.00 to 80.60
Inspector or above	2,182	10.17	9.77 to 10.58	4.91	4.62 to 5.21
PTSD					
Non-case	22,721	96.01	95.75 to 96.25	96.05	95.66 to 96.42
Case	944	3.99	3.75 to 4.25	3.95	3.58 to 4.34
Alcohol use (UK government guidelines)					
Low risk (0 to 14 units)	11,656	49.26	48.62 to 49.90	52.03	51.07 to 52.99
Non-drinker	1,810	7.65	7.32 to 8.00	8.52	7.98 to 9.10
Hazardous (15 to 50 units)	9,429	39.85	39.23 to 40.47	36.57	35.67 to 37.48
Harmful (above 50 units)	767	3.24	3.02 to 3.47	2.87	2.59 to 3.19
Binge drinking					
No	23,169	97.92	97.73 to 98.09	98.50	98.31 to 98.68
Yes	493	2.08	1.91 to 2.27	1.50	1.32 to 1.69
Comorbidity					
PTSD non-case <u>and</u> non-case harmful alcohol use	21,924	92.99	92.66 to 93.31	93.41	92.93 to 93.86
PTSD case <u>only</u>	888	3.77	3.53 to 4.02	3.71	3.37 to 4.10
Harmful alcohol use <u>only</u>	709	3.01	2.80 to 3.23	2.63	2.36 to 2.92
PTSD case <u>and</u> harmful alcohol use case	55	0.23	0.18 to 0.30	0.25	0.15 to 0.39

Appendix 15. Table S6.2. Logistic and multinomial logistic regression analyses showing the differences in PTSD and alcohol consumption characteristics among police and military personnel, without entropy balancing weights applied. The police sample is the reference group (Chapter 6)

Outcome variable	Total N in adjusted model	Police N (%)	Military N (%)	OR (95% CI)	AOR (95% CI)[a]
PTSD	30,360				
Non-case		22,721 (96.01)	7,009 (96.34)	1.00	1.00
Case		944 (3.99)	266 (3.66)	0.91 (0.80 to 1.05)	0.87 (0.76 to 1.01)
				N = 30,940	*N = 30,360*
Alcohol use (UK government guidelines)	30,285				
Low risk (0 to 14 units)		11,656 (49.26)	3,754 (51.74)	1.00	1.00
Non-drinker		1,810 (7.65)	294 (4.05)	0.50 (0.44 to 0.57)***	0.47 (0.41 to 0.54)***
Hazardous (15 to 50 units)		9,429 (39.85)	2,524 (34.79)	0.83 (0.78 to 0.88)***	077 (0.73 to 0.82)***
Harmful (above 50 units)		767 (3.24)	683 (9.41)	2.76 (2.48 to 3.08)***	2.15 (1.92 to 2.41)***
				N = 30,917	*N = 30,285*
Binge drinking [b]	30,304				
No		23,169 (97.92)	7,075 (97.03)	1.00	1.00
Yes		493 (2.08)	216 (2.97)	2.06 (1.71 to 2.48)***	1.22 (1.03 to 1.45)*
				N = 30,935	*N = 30,304*
Comorbidity	30,224				
PTSD non-case <u>and</u> non-case harmful alcohol use		21,924 (92.99)	6,327 (87.86)	1.00	1.00
PTSD case <u>only</u>		888 (3.77)	199 (2.76)	0.78 (0.66 to 0.91)**	0.76 (0.65 to 0.89)**
Harmful alcohol use <u>only</u>		709 (3.01)	614 (8.53)	3.00 (2.68 to 3.36)***	2.43 (2.16 to 2.74)***
PTSD case <u>and</u> harmful alcohol use case		55 (0.23)	61 (0.85)	3.84 (2.67 to 5.54)***	3.01 (2.05 to 4.42)***
				N = 30,777	*N = 30,224*

***p<.001, **p<.01, *p<.05

[a] adjusted for marital status and smoking status.

[b] Binge drinking defined as drinking 6 or more units daily or almost daily.

Appendix 16. Table S6.3. Sensitivity analysis showing the demographic, occupational and health associations with PTSD caseness, harmful alcohol use and daily binge drinking, in police employees, excluding police staff (N = 20,235) (Chapter 6)

	PTSD Case		*Harmful Alcohol Use*		*Daily binge drinking*	
Explanatory variable	*N (%)*	*OR (95% CI)*	*N (%)*	*OR (95% CI)*	*N (%)*	*OR (95% CI)*
Age (years)						
< 29	68 (3.41)	0.80 (0.60 to 1.09)	48 (2.35)	0.73 (0.51 to 1.04)	10 (0.45)	0.25 (0.12 to 0.49)***
30 to 39	259 (4.21)	1.00	180 (2.90)	1.00	107 (1.79)	1.00
40 to 49	433 (4.34)	1.03 (0.87 to 1.22)	329 (3.54)	1.32 (1.08 to 1.62)**	231 (2.53)	1.43 (1.11 to 1.83)**
≥ 50	80 (3.32)	**0.78 (0.59 to 1.03)**	102 (4.47)	1.66 (1.26 to 2.19)***	78 (3.27)	1.86 (1.34 to 2.57)***
Marital status						
Married/Cohabiting	691 (3.86)	1.00	548 (2.76)	1.00	371 (1.67)	1.00
Divorced/Separated	60 (4.63)	1.21 (0.85 to 1.72)	50 (3.94)	0.94 (0.68 to 1.28)	33 (2.28)	1.38 (0.85 to 2.23)
Single	67 (3.87)	1.00 (0.70 to 1.44)	48 (3.37)	1.30 (0.99 to 1.69)	14 (0.59)	0.35 (0.18 to 0.66)**
Education						
Low (GSCE/O level or below)	285 (4.29)	1.00	271 (3.36)	1.00	195 (2.10)	1.00
High (Vocational/A levels or higher)	552 (3.69)	**0.85 (0.69 to 1.06)**	383 (2.51)	0.71 (0.56 to 0.90)**	228 (1.07)	0.50 (0.39 to 0.66)***
Smoking status						
Non-smoker	777 (3.99)	1.00	544 (2.58)	1.00	350 (1.26)	1.00
Current smoker	63 (3.60)	0.90 (0.60 to 1.35)	114 (5.71)	2.95 (2.15 to 4.05)***	76 (3.87)	3.15 (2.19 to 4.52)***
Income (police only)						
Less than £25999	36 (3.38)	0.82 (0.52 to 1.29)	14 (1.33)	0.51 (0.26 to 1.00)	4 (0.38)	0.31 (0.10 to 0.93)*
£26000 - £37999	363 (4.11)	1.00	237 (2.57)	1.00	153 (1.20)	1.00
£38000 – £59999	409 (3.86)	0.94 (0.76 to 1.15)	376 (3.71)	1.60 (1.25 to 2.03)***	251 (2.22)	1.86 (1.40 to 2.46)***
More than £60000	29 (3.47)	0.84 (0.47 to 1.48)	27 (2.75)	**1.29 (0.79 to 2.11)**	15 (1.89)	**1.58 (0.76 to 3.31)**
Role (police only)						
Police constable/sergeants	661 (4.07)	1.00	539 (3.02)	1.00	341 (1.59)	1.00
Inspector or above	94 (4.32)	1.06 (0.78 to 1.45)	544 (2.24)	0.82 (0.56 to 1.20)	47 (2.01)	1.27 (0.83 to 1.94)

***p<.001, **p<.01, *p<.05. Percentages are weighted with entropy balancing (e.g. year of data collection, age and educational attainment).

Appendix 17. Table S6.4. Sensitivity regression analyses showing the differences in PTSD and alcohol consumption, stratified among police and military personnel (excluding police staff). The police sample is the reference group (Chapter 6)

Outcome variable	Police N (%)	Military N (%)	OR (95% CI)	AOR (95% CI) [b]
PTSD				
Non-case	19,222 (96.05)	7,009 (96.33)	1.00	1.00
Case	840 (3.94)	266 (3.67)	0.93 (0.79 to 1.09)	0.84 (0.71 to 0.99)*
			N = 27,149	*N = 26,695*
Alcohol use (UK government guidelines)				
Low risk (0 to 14 units)	9,822 (51.81)	3,754 (51.63)	1.00	1.00
Non-drinker	1,418 (8.01)	294 (3.93)	0.49 (0.42 to 0.57)***	0.49 (0.42 to 0.57)***
Hazardous (15 to 50 units)	8,166 (37.30)	2,524 (34.84)	0.94 (0.88 to 1.00)	0.87 (0.81 to 0.93)***
Harmful (above 50 units)	659 (2.88)	683 (9.59)	3.35 (2.90 to 3.87)***	2.71 (2.34 to 3.14)***
			N = 27,075	*N = 26,639*
Binge drinking [c]				
No	19,639 (98.49)	7,075 (96.96)	1.00	1.00
Yes	426 (1.51)	216 (3.04)	2.04 (1.69 to 2.47)***	1.65 (1.34 to 2.02)***
			N = 27,091	*N = 26,656*
Comorbidity				
PTSD non-case <u>and</u> non-case harmful alcohol use	18,547 (93.41)	6,327 (87.58)	1.00	1.00
PTSD case <u>only</u>	791 (3.72)	199 (2.77)	0.79 (0.66 to 0.95)*	0.75 (0.62 to 0.89)**
Harmful alcohol use <u>only</u>	608 (2.63)	614 (8.69)	3.51 (3.04 to 4.06)***	2.95 (2.55 to 3.42)***
PTSD case <u>and</u> harmful alcohol use case	48 (0.24)	61 (0.87)	3.82 (2.14 to 6.80)***	2.91 (1.65 to 5.10)***
			N = 27,011	*N = 26,581*

***p<.001, **p<.01, *p<.05. Percentages are weighted with entropy balancing (e.g. year of data collection, age and educational attainment).

[a] Age and education were not adjusted for as these variables were used in the entropy balancing to match the samples.

[b] Adjusted for marital status and smoking status. [c] Binge drinking defined as drinking 6 or more units daily or almost daily.

Appendix 18. Table S8.1. Descriptive statistics for the sociodemographic and occupational variables (N = 40,986) (Chapter 8)

Variable	Complete N / % Missing	N	%	95% CI
Sociodemographic variables				
<u>Age</u>	40,986 (0.00)			
<29		5,653	13.79	13.46 to 14.13
30 to 39		13,547	33.05	32.60 to 33.51
40 to 49		15,919	38.84	38.37 to 39.31
>50		5,867	14.31	13.98 to 14.66
<u>Gender</u>	40,986 (0.00)			
Men		25,788	62.92	62.45 to 63.39
Women		15,198	37.08	36.61 to 37.55
<u>Country</u>	40,236 (1.83)			
England		28,465	70.75	70.30 to 71.19
Scotland		6,428	15.98	15.62 to 16.34
Wales		5,343	13.28	12.95 to 13.61
<u>Educational attainment</u>	40,828 (0.39)			
GSCE/O-Level or below		13,675	33.49	33.04 to 33.95
A-levels/Highers or equivalent		12,960	31.74	31.29 to 32.20
Bachelor's degree/Postgraduate		11,326	27.74	27.31 to 28.18
Vocational qualifications		2,867	7.02	6.78 to 7.27
<u>Ethnicity</u> [a]	40,786 (0.49)			
White		38,643	94.75	94.52 to 94.96
Asian		690	1.69	1.57 to 1.82
Black		438	1.07	0.98 to 1.18
Mixed Ethnic Group		456	1.12	1.02 to 1.22
Other		559	1.37	1.26 to 1.49
<u>Marital status</u>	40,828 (0.39)			
Married/Cohabiting		31,710	77.67	77.26 to 78.07
Divorced/Separated		3,317	8.12	7.86 to 8.39
Single		4,854	11.89	11.58 to 12.21
Other (e.g. widowed)		947	2.32	2.18 to 2.47
<u>Children under 18</u>	40,828 (0.39)			
0		20,737	50.79	50.31 to 51.28

	N (%)	n	%	95% CI
1		8,139	19.93	19.55 to 20.33
2		9,552	23.40	22.99 to 23.81
3 or more		2,400	5.88	5.65 to 6.11
Occupational variables				
<u>Police role</u>	37,127 (9.42)			
Police Officer		26,031	70.11	69.65 to 70.58
Police Staff		10,361	27.91	27.45 to 28.37
Other Ranks		735	1.98	1.84 to 2.13
<u>Years in police force</u>	40,931 (0.13)			
Less than 5		8,466	20.68	20.29 to 21.08
6 to 10		9,231	22.55	22.15 to 22.96
11 to 20		12,679	30.98	30.53 to 31.43
More than 20		10,555	25.79	25.37 to 26.21
<u>Income</u>	40,828 (0.39)			
Less than £25999		8,832	21.63	21.24 to 22.03
£26000 - £37999		16,820	41.20	40.72 to 41.68
£38000 - £59999		13,869	33.97	33.51 to 34.43
More than £60000		1,307	3.20	3.03 to 3.38
<u>Days of sickness absence in past year</u>	40,928 (0.14)			
None		18,956	46.32	45.83 to 46.80
1 to 5		13,504	32.99	32.54 to 33.45
6 to 10		3,703	9.05	8.77 to 9.33
More than 10		4,765	11.64	11.34 to 11.96
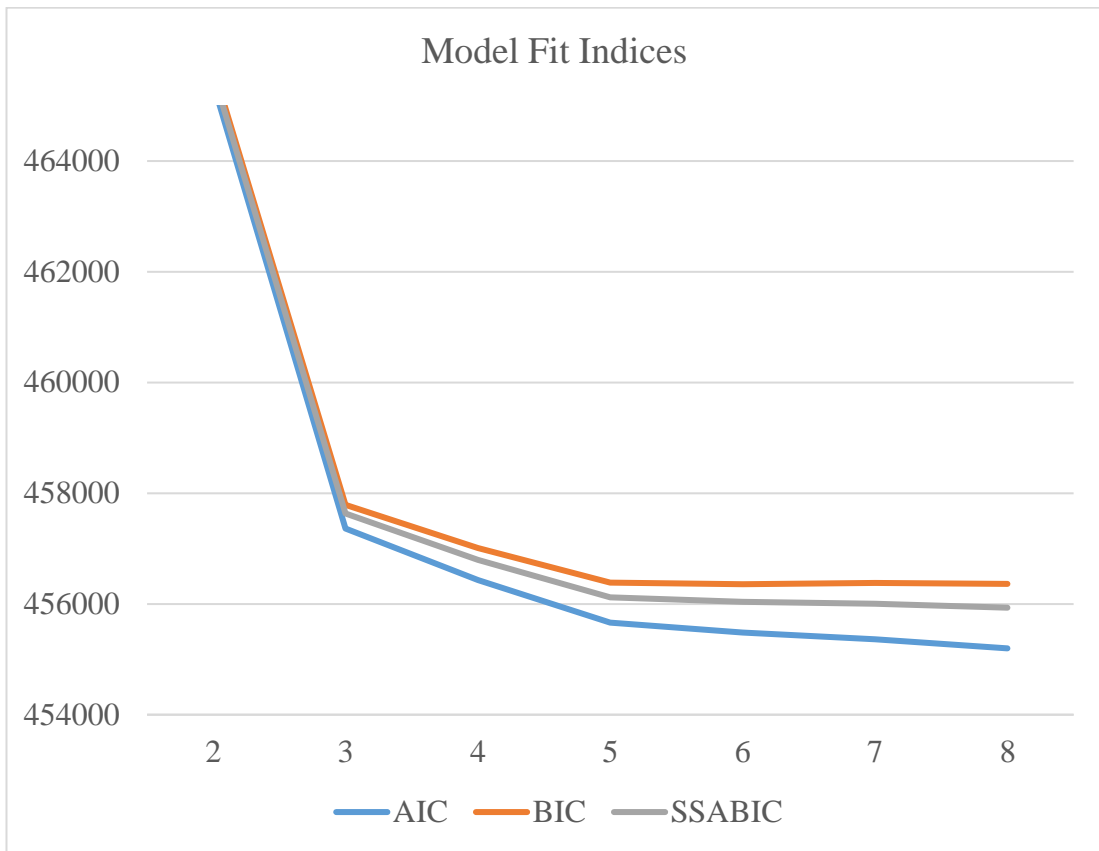
Appendix 20. Table S8.2. Multinomial logistic regressions exploring the sociodemographic and occupational associations with the identified classes of health (risk) behaviours for men (N = 25,788). Percentages are weighted with conditional probability weights. Unadjusted multinomial odds ratios (MOR) with 95% confidence intervals (CIs) are shown (Chapter 8)

Men (N = 25,788)	Class 1 N = 5,307 Healthiest (Ref.) N (%)	Class 2 N = 3,560 Healthy abstainers N (%)	MOR (95% CI)	Class 3 N = 7,092 Health risks but physically active N (%)	MOR (95% CI)	Class 4 N = 8,839 Low risk drinkers but other risks N (%)	MOR (95% CI)	Class 5 N = 990 High health risk behaviours N (%)	MOR (95% CI)
Age									
<29	601 (11.88)	309 (9.74)	1.00	719 (10.22)	1.00	1,158 (13.85)	1.00	65 (6.36)	1.00
30 to 39	1,755 (33.58)	1,044 (30.73)	1.12 (0.95 to 1.31)	2,168 (30.65)	1.06 (0.93 to 1.21)	2,946 (33.87)	0.86 (0.77 to 0.97)*	274 (27.67)	1.54 (1.15 to 2.05)**
40 to 49	2,137 (39.76)	1,479 (40.81)	1.25 (1.07 to 1.46)**	3,202 (45.14)	1.32 (1.17 to 1.49)***	3,574 (39.98)	0.86 (0.77 to 0.97)*	468 (47.55)	2.23 (1.69 to 2.95)***
>50	814 (14.78)	728 (18.72)	1.54 (1.30 to 1.84)***	1,003 (14.00)	1.10 (0.95 to 1.27)	1,161 (12.29)	0.71 (0.62 to 0.82)***	183 (18.42)	2.33 (1.71 to 3.16)***
Country									
England	3,695 (70.56)	2,701 (76.65)	1.00	4,666 (66.86)	1.00	6,077 (69.66)	1.00	662 (68.01)	1.00
Scotland	810 (15.83)	450 (13.39)	0.78 (0.68 to 0.89)***	1,299 (18.86)	1.26 (1.14 to 1.39)***	1,638 (19.34)	1.24 (1.12 to 1.36)***	145 (14.95)	0.98 (0.80 to 1.19)
Wales	702 (13.60)	344 (9.97)	0.67 (0.58 to 0.79)***	965 (14.28)	1.11 (0.99 to 1.23)	966 (11.00)	0.82 (0.74 to 0.91)***	165 (17.05)	1.30 (1.07 to 1.57)**
Education									
GSCE/O-Level or below	1,665 (35.16)	1,309 (36.56)	1.00	2,479 (35.16)	1.00	3,120 (35.05)	1.00	433 (43.82)	1.00
Vocational qualifications	374 (7.17)	249 (7.17)	0.85 (0.71 to 1.03)	484 (6.84)	0.85 (0.73 to 0.99)*	637 (7.32)	0.91 (0.79 to 1.05)	52 (5.30)	0.53 (0.39 to 0.72)***
A-levels/Highers	1,709 (32.21)	1,073 (30.53)	0.81 (0.73 to 0.90)***	2,287 (32.44)	0.89 (0.82 to 0.98)*	2,887 (33.28)	0.92 (0.84 to 1.00)	293 (30.25)	0.67 (0.57 to 0.79)***
Bachelor's/Postgraduate	1,551 (29.44)	914 (25.73)	0.75 (0.67 to 0.84)***	1,811 (25.56)	0.77 (0.70 to 0.85)***	2,146 (24.35)	0.74 (0.67 to 0.81)***	206 (20.63)	0.50 (0.42 to 0.60)***
Ethnicity									
White	5,046 (95.41)	3,087 (85.46)	1.00	6,809 (96.59)	1.00	8,359 (95.13)	1.00	956 (97.11)	1.00
Asian	49 (1.00)	254 (8.49)	9.47 (6.90 to 12.99)***	45 (0.62)	0.62 (0.41 to 0.93)*	87 (1.02)	1.02 (0.71 to 1.47)	5 (0.45)	0.44 (0.17 to 1.15)
Black	46 (0.85)	74 (2.32)	3.04 (2.08 to 4.46)***	16 (0.22)	0.26 (0.14 to 0.46)***	77 (0.86)	1.01 (0.69 to 1.47)	0 (0.00)	-
Mixed Race	61 (1.20)	39 (1.15)	1.07 (0.71 to 1.62)	72 (1.01)	0.83 (0.59 to 1.18)	113 (1.29)	1.08 (0.78 to 1.49)	8 (0.79)	0.65 (0.31 to 1.38)
Other	83 (1.54)	80 (2.59)	1.88 (1.37 to 2.58)***	112 (1.55)	0.99 (0.74 to 1.33)	148 (1.70)	1.11 (0.84 to 1.47)	16 (1.46)	1.05 (0.61 to 1.81)
Marital status									
Married/Cohabiting	4,510 (84.74)	3,004 (83.58)	1.00	5,803 (82.08)	1.00	7,339 (83.07)	1.00	824 (84.12)	1.00
Divorced/Separated	318 (5.98)	207 (5.95)	1.01 (0.84 to 1.22)	532 (7.54)	1.30 (1.12 to 1.51)***	610 (6.98)	1.19 (1.03 to 1.38)*	81 (8.17)	1.38 (1.06 to 1.78)*
Single	370 (7.24)	284 (8.95)	1.25 (1.06 to 1.48)**	606 (8.68)	1.24 (1.08 to 1.42)**	684 (8.09)	1.14 (1.00 to 1.31)	72 (6.98)	0.97 (0.74 to 1.27)
Other	101 (2.04)	50 (1.52)	0.75 (0.53 to 1.07)	120 (1.70)	0.86 (0.65 to 1.13)	157 (1.86)	0.93 (0.72 to 1.20)	7 (0.73)	0.36 (0.17 to 0.79)*
Children under 18									
0	2,324 (44.03)	1,555 (44.15)	1.00	3,325 (47.23)	1.00	3,876 (44.05)	1.00	453 (45.56)	1.00
1	1,112 (20.99)	741 (20.96)	1.00 (0.89 to 1.12)	1,407 (19.87)	0.88 (0.80 to 0.97)*	1,938 (22.14)	1.05 (0.96 to 1.16)	178 (18.33)	0.84 (0.70 to 1.02)

2	1,467 (27.57)	962 (26.67)	0.98 (0.87 to 1.07)	1,839 (25.92)	0.88 (0.80 to 0.96)**	2,360 (26.82)	0.97 (0.89 to 1.06)	272 (27.87)	0.98 (0.83 to 1.15)
3 or more	396 (7.41)	287 (8.22)	1.07 (0.93 to 1.31)	490 (6.98)	0.88 (0.76 to 1.02)	616 (6.99)	0.94 (0.82 to 1.08)	81 (8.24)	1.07 (0.83 to 1.39)
Police role									
Police Officer	3,881 (82.04)	2,380 (73.87)	1.00	5,454 (83.90)	1.00	6,718 (83.97)	1.00	775 (84.22)	1.00
Police Staff	790 (16.36)	789 (24.38)	1.66 (1.48 to 1.86)***	944 (14.65)	0.88 (0.79 to 0.97)*	1,190 (14.58)	0.87 (0.79 to 0.96)*	128 (13.86)	0.83 (0.69 to 1.01)
Other Ranks	76 (1.45)	54 (1.75)	1.21 (0.84 to 1.86)	95 (1.45)	0.88 (0.65 to 1.21)	120 (1.45)	0.89 (0.66 to 1.19)	18 (1.93)	1.17 (0.69 to 1.98)
Years in police force									
Less than 5	851 (16.53)	543 (16.27)	1.00	1,010 (14.46)	1.00	1,574 (18.43)	1.00	85 (8.39)	1.00
6 to 10	1,079 (20.73)	860 (25.11)	1.23 (1.07 to 1.42)**	1,287 (18.14)	1.00 (0.88 to 1.13)	1,962 (22.66)	0.98 (0.87 to 1.10)	168 (16.98)	1.61 (1.22 to 2.13)***
11 to 20	1,716 (32.33)	1,083 (30.72)	0.97 (0.84 to 1.11)	2,217 (32.66)	1.15 (1.03 to 1.29**	2,789 (31.63)	0.88 (0.79 to 0.97)*	340 (34.25)	2.09 (1.62 to 2.69)***
More than 20	1,650 (30.41)	1,064 (27.90)	0.93 (0.81 to 1.07)	2,463 (34.74)	1.31 (1.17 to 1.46)***	2,508 (27.28)	0.80 (0.72 to 0.90)***	397 (40.38)	2.62 (2.03 to 3.37)***
Income									
Less than £25999	494 (9.30)	466 (13.34)	1.00	573 (8.24)	1.00	835 (9.71)	1.00	60 (5.97)	1.00
£26000 - £37999	2,162 (41.17)	1,481 (42.43)	0.72 (0.62 to 0.83)***	2,794 (39.52)	1.08 (0.95 to 1.24)	3,883 (44.53)	1.04 (0.91 to 1.18)	388 (39.75)	1.50 (1.12 to 2.02)**
£38000 - £59999	2,400 (44.95)	1,462 (40.67)	0.63 (0.54 to 0.73)***	3,332 (47.16)	1.18 (1.04 to 1.35)*	3,733 (42.09)	0.90 (0.79 to 1.02)	496 (50.36)	1.74 (1.31 to 2.33)***
More than £60000	243 (4.58)	136 (3.92)	0.54 (0.42 to 0.70)***	362 (5.08)	1.25 (1.02 to 1.54)*	339 (3.66)	0.77 (0.62 to 0.94)**	40 (3.66)	1.33 (0.86 to 2.06)
Days of sickness absence in past year									
None	2,880 (54.30)	1,777 (40.96)	1.00	3,631 (51.26)	1.00	4,458 (50.52)	1.00	491 (49.75)	1.00
1 to 5	1,573 (29.81)	1,069 (29.56)	1.08 (0.97 to 1.19)	2,197 (31.07)	1.10 (1.02 to 1.20)*	2,780 (31.62)	1.14 (1.05 to 1.23)**	277 (27.93)	1.02 (0.87 to 1.20)
6 to 10	386 (7.16)	305 (8.76)	1.33 (1.12 to 1.57)**	563 (7.96)	1.18 (1.02 to 1.36)*	719 (8.18)	1.23 (1.07 to 1.41)**	85 (8.87)	1.35 (1.05 to 1.75)**
More than 10	468 (8.73)	405 (11.72)	1.46 (1.26 to 1.70)***	686 (9.71)	1.19 (1.04 to 1.34)*	862 (9.68)	1.19 (1.05 to 1.35)**	134 (13.45)	1.68 (1.35 to 2.09)***

Appendix 21. Table S8.3. Multinomial logistic regressions exploring the sociodemographic and occupational associations with the identified classes of health (risk) behaviours for women (N = 15,198). Percentages are weighted with conditional probability weights. Unadjusted multinomial odds ratios (MOR) with 95% confidence intervals (CIs) are shown (Chapter 8)

Women (N =15,198)	Class 1 N = 4,543 Healthiest (Ref) N (%)	Class 2 N = 1,894 Healthy abstainers N (%)	MOR (95% CI)	Class 3 N = 2,072 Moderate health risk behaviours N (%)	MOR (95% CI)	Class 4 N = 6,121 Low risk drinkers but other risks N (%)	MOR (95% CI)	Class 5 N = 568 High health risk behaviours N (%)	MOR (95% CI)
Age									
<29	732 (16.28)	304 (16.17)	1.00	400 (20.15)	1.00	1,306 (22.22)	1.00	59 (10.13)	1.00
30 to 39	1,484 (32.91)	716 (37.85)	1.16 (0.98 to 1.36)	691 (33.63)	0.83 (0.71 to 0.96)*	2,283 (37.67)	0.84 (0.75 to 0.94)**	186 (37.85)	1.58 (1.15 to 2.17)**
40 to 49	1,531 (33.62)	576 (30.24)	0.91 (0.77 to 1.07)	760 (36.08)	0.87 (0.74 to 1.01)	1,937 (30.97)	0.67 (0.60 to 0.76)***	255 (45.55)	2.18 (1.60 to 2.95)***
>50	796 (17.19)	298 (15.73)	0.92 (0.76 to 1.11)	221 (10.13)	0.48 (0.39 to 0.58)***	595 (9.15)	0.39 (0.34 to 0.45)***	68 (11.96)	1.12 (0.77 to 1.62)
Country									
England	3,197 (71.75)	1,431 (76.79)	1.00	1,398 (68.11)	1.00	4,234 (70.00)	1.00	404 (72.91)	1.00
Scotland	583 (13.21)	187 (10.16)	0.72 (0.60 to 0.86)***	309 (15.43)	1.23 (1.05 to 1.44)*	943 (15.89)	1.23 (1.10 to 1.38)***	64 (11.33)	0.84 (0.63 to 1.12)
Wales	678 (15.04)	240 (13.05)	0.81 (0.69 to 0.95)*	330 (16.47)	1.15 (0.99 to 1.34)	834 (14.11)	0.96 (0.86 to 1.08)	89 (15.76)	1.03 (0.80 to 1.33)
Education									
GSCE/O-Level or below	1,303 (28.60)	633 (33.42)	1.00	635 (30.14)	1.00	1,892 (30.60)	1.00	206 (36.76)	1.00
Vocational qualifications	296 (6.53)	146 (7.87)	1.03 (0.83 to 1.29)	145 (7.06)	1.03 (0.82 to 1.28)	447 (7.41)	1.06 (0.90 to 1.25)	37 (6.72)	0.80 (0.55 to 1.17)
A-levels/Highers	1,381 (30.51)	569 (30.02)	0.84 (0.73 to 0.97)	629 (30.53)	0.95 (0.83 to 1.09)	1,944 (32.01)	0.98 (0.89 to 1.08)	188 (33.10)	0.84 (0.68 to 1.05)
Bachelor's/Postgraduate	1,548 (34.37)	540 (28.69)	0.71 (0.62 to 0.82)	655 (32.28)	0.89 (0.78 to 1.02)	1,818 (29.98)	0.82 (0.74 to 0.90)***	137 (23.42)	0.53 (0.42 to 0.67)***
Ethnicity									
White	4,333 (95.89)	1,642 (86.80)	1.00	2,037 (98.61)	1.00	5,823 (95.50)	1.00	551 (97.15)	1.00
Asian	53 (1.17)	107 (5.72)	5.38 (3.84 to 7.54)***	3 (0.14)	0.11 (0.04 to 0.38)***	84 (1.35)	1.15 (0.81 to 1.64)	3 (0.56)	0.47 (0.14 to 1.54)
Black	50 (1.06)	81 (4.41)	4.61 (3.21 to 6.60)***	7 (0.32)	0.30 (0.13 to 0.67)**	83 (1.33)	1.26 (0.88 to 1.80)	4 (0.71)	0.66 (0.23 to 1.91)
Mixed Race	46 (1.01)	30 (1.60)	1.75 (1.10 to 2.80)*	12 (0.54)	0.52 (0.27 to 1.00)*	69 (1.11)	1.11 (0.76 to 1.62)	6 (1.12)	1.09 (0.45 to 2.63)
Other	40 (0.87)	27 (1.47)	1.86 (1.14 to 3.05)*	8 (0.38)	0.43 (0.20 to 0.93)*	42 (0.71)	0.81 (0.52 to 1.26)	3 (0.47)	0.53 (0.15 to 1.83)
Marital status									
Married/Cohabiting	3,164 (69.78)	1,317 (69.85)	1.00	1,320 (63.38)	1.00	4,059 (66.26)	1.00	370 (64.73)	1.00
Divorced/Separated	470 (10.27)	178 (9.47)	0.92 (0.77 to 1.10)	222 (10.68)	1.15 (0.96 to 1.37)	622 (10.17)	1.03 (0.91 to 1.19)	77 (13.67)	1.43 (1.09 to 1.88)**
Single	751 (16.75)	337 (17.70)	1.06 (0.91 to 1.22)	430 (21.50)	1.41 (1.23 to 1.62)***	1,222 (20.34)	1.28 (1.15 to 1.42)***	98 (17.67)	1.14 (0.89 to 1.45)
Other	143 (3.20)	56 (3.23)	0.93 (0.68 to 1.28)	92 (4.43)	1.52 (1.16 to 2.01)**	198 (3.23)	1.06 (0.85 to 1.33)	23 (3.93)	1.32 (0.83 to 2.11)
Children under 18									
0	2,780 (61.55)	1,087 (57.48)	1.00	1,361 (66.66)	1.00	3,625 (59.53)	1.00	351 (62.12)	1.00
1	789 (17.26)	400 (21.36)	1.32 (1.15 to 1.52)***	288 (13.69)	0.73 (0.63 to 0.85)***	1,193 (19.65)	1.18 (1.06 to 1.31)**	93 (16.13)	0.93 (0.72 to 1.19)

2	808 (17.83)	332 (17.43)	1.05 (0.90 to 1.21)	346 (16.13)	0.84 (0.73 to 0.98)*	1,064 (17.43)	1.00 (0.90 to 1.12)	102 (18.08)	1.00 (0.79 to 1.28)
3 or more	151 (3.35)	69 (3.72)	1.19 (0.89 to 1.60)	69 (3.35)	0.92 (0.68 to 1.24)	219 (3.49)	1.08 (0.87 to 1.34)	22 (3.67)	1.08 (0.67 to 1.75)
Police role									
Police Officer	1,976 (49.11)	757 (44.42)	1.00	1,013 (54.70)	1.00	2,802 (50.14)	1.00	275 (54.69)	1.00
Police Staff	1,971 (47.85)	885 (52.06)	1.20 (1.07 to 1.35)**	802 (42.76)	0.80 (0.72 to 0.90)***	2,640 (47.58)	0.97 (0.90 to 1.06)	222 (42.63)	0.80 (0.66 to 0.97)*
Other Ranks	122 (3.04)	59 (3.52)	1.28 (0.93 to 1.77)	49 (2.55)	0.75 (0.53 to 1.07)	127 (2.28)	0.73 (0.57 to 0.95)*	15 (2.67)	0.79 (0.45 to 1.39)
Years in police force									
Less than 5	1,238 (27.37)	515 (27.06)	1.00	593 (29.13)	1.00	1,938 (32.41)	1.00	119 (20.32)	1.00
6 to 10	1,146 (25.41)	533 (28.32)	1.13 (0.97 to 1.31)	453 (21.97)	0.81 (0.70 to 0.94)**	1,627 (26.67)	0.89 (0.80 to 1.00)*	116 (20.28)	1.08 (0.82 to 1.42)
11 to 20	1,346 (29.58)	547 (28.94)	0.99 (0.86 to 1.14)	654 (31.70)	1.01 (0.88 to 1.16)	1,681 (27.19)	0.78 (0.71 to 0.86)***	206 (36.50)	1.66 (1.30 to 2.13)***
More than 20	809 (17.64)	296 (15.67)	0.90 (0.76 to 1.07)	371 (17.19)	0.92 (0.78 to 1.08)	870 (13.73)	0.66 (0.58 to 0.74)***	127 (22.91)	1.75 (1.33 to 2.30)***
Income									
Less than £25999	1,939 (42.61)	847 (44.65)	1.00	790 (38.08)	1.00	2,647 (43.31)	1.00	181 (31.11)	1.00
£26000 - £37999	1,784 (39.48)	755 (40.25)	0.97 (0.86 to 1.10)	816 (39.85)	1.13 (1.00 to 1.27)*	2,511 (41.70)	1.04 (0.95 to 1.13)	246 (44.09)	1.53 (1.24 to 1.88)***
£38000 - £59999	743 (16.54)	266 (14.04)	0.81 (0.69 to 0.95)*	423 (20.48)	1.38 (1.19 to 1.61)***	878 (13.96)	0.83 (0.74 to 0.93)**	136 (23.98)	1.98 (1.55 to 2.54)***
More than £60000	62 (1.59)	20 (1.06)	0.74 (0.44 to 1.23)	35 (1.59)	1.30 (0.84 to 2.00)	65 (1.04)	0.74 (0.52 to 1.07)	5 (0.82)	0.82 (0.32 to 2.09)
Days of sickness absence in past year									
None	1,829 (40.42)	674 (35.41)	1.00	748 (36.39)	1.00	2,271 (36.83)	1.00	197 (34.78)	1.00
1 to 5	1,614 (35.55)	648 (34.23)	1.10 (0.97 to 1.25)	791 (38.25)	1.20 (1.06 to 1.35)**	2,363 (38.86)	1.20 (1.10 to 1.31)***	192 (33.72)	1.10 (0.89 to 1.37)
6 to 10	475 (10.37)	207 (10.97)	1.21 (1.00 to 1.46)*	227 (10.96)	1.17 (0.98 to 1.41)	664 (10.96)	1.16 (1.01 to 1.33)*	72 (12.92)	1.45 (1.08 to 1.95)**
More than 10	623 (13.66)	364 (19.39)	1.62 (1.38 to 1.90)***	299 (14.40)	1.17 (0.99 to 1.38)	817 (13.35)	1.07 (0.95 to 1.21)	107 (18.58)	1.58 (1.22 to 2.05)**

Appendix 22. Ethical approval letter (Chapter 9)

UNIVERSITY OF LIVERPOOL

Central University Research Ethics Committee B

18 December 2020

Dear Dr Goodwin,

I am pleased to inform you that the amendment to your study has been approved. Amendment details and conditions of approval can be found below. If applicable, Appendix A contains a list of documents approved by the Committee.

Amendment details

Reference:	7736 (amendment)
Project Title:	Understanding risky drinking and abstinence in UK police: an interview study
Principal Investigator:	Dr Laura Goodwin
Co-Investigator(s):	Miss Patricia Irizar, Dr Suzanne Gage, Dr Vicky Fallon
Student Investigator(s):	-
Department:	Psychological Sciences
Approval Date:	18/12/2020

The amendment was **APPROVED** subject to the following conditions:

Conditions of approval

Please note: this approval is subject to the University's research restrictions during the pandemic, as laid out on the research ethics webpages. Therefore, wherever possible, research should be conducted via remote means which avoid the need for face-to-face contact with human participants during the pandemic. The process for requesting an exemption to these restrictions is described on the research ethics webpages.

- All serious adverse events must be reported to the Committee (ethics@liv.ac.uk) in accordance with the procedure for reporting adverse events.

- If it is proposed to make further amendments to the study, please create and submit an amendment form within the research ethics system.

- It is the responsibility of the Principal Investigator or Supervisor to inform all the investigators of the terms of the approval.

Kind regards,

Central University Research Ethics Committee B

ethics@liverpool.ac.uk

0151 794 8290

Appendix 23. Participant information sheet (Chapter 9)

Participant Information Sheet

Study Title: Understanding risky drinking and abstinence in UK police: an interview study

You are being invited to participate in a research study. Please take the time to read the following information carefully and feel free to ask us if you would like more information or if there is anything that you do not understand. We would like to stress that you do not have to accept this invitation and should only agree to take part if you want to. Thank you for reading this.

What is the purpose of this study?

The purpose of this study is to develop our understanding of UK police employees' own personal experiences of risky drinking or abstaining from alcohol. We are **not** interested in police employees' experiences of **drinking whilst working**. The study will first involve a short screening questionnaire to see if you are eligible to participate in the interview. If you are eligible to participate, the researcher will contact you to arrange a time and date for the interview.

You are eligible to take part in this study if you:

- Are a fluent English speaker
- Are aged over 18
- Currently serving in a UK police force (any rank)
- Not currently pregnant
- Have not been diagnosed with an alcohol problem in the past year
- Have not received treatment for an alcohol problem in the past year
- **EITHER** (i) currently abstaining from alcohol but previously drank alcohol, or (ii) meet the criteria for risky drinking based on a short questionnaire about your alcohol use.

Do I have to take part?

You are under no obligation to take part in this study. If you do decide to take part, you will be able to retain this information sheet and a copy of the consent form. You are free to stop the questionnaire at any time without giving a reason. If you are taking part in the interview study, you are free to stop at any time and without giving a reason. You can ask for access to the information that you provide (from both the screening questionnaire and the interview) and

can request the destruction of that information at any point, up until the point of analysis. After analysis, you will no longer be able to withdraw the information you provide.

What will happen if I take part?

After 24 hours of receiving this information sheet, you will be able to sign the consent form for the eligibility questionnaire, which will be conducted online.

After consenting, you will complete a short questionnaire, containing questions about your demographic information and some questions about your drinking. The questionnaire will also ask for an email address and telephone number that you wish to be contacted on, should you be eligible for the interview study. This questionnaire will be used to determine whether you are eligible to participate in the interview study.

If you are eligible to participate, the researcher will send you a consent form via email for the interview. The consent form must be signed using an electronic signature before the interview. If you are not eligible to participate, you will receive a response to inform you that you are not eligible.

After consenting, the researcher will contact you by telephone, on a private telephone number which you will have provided during the screening questionnaire, to arrange a suitable time and date to conduct the interview. This initial contact will give you time to ask any questions about the research before participating.

The interview will be conducted via telephone and will take up to one hour. The interview will be recorded and then transcribed by the researcher. The researcher will email you a copy of your transcript. You will then be given time to review your transcript to ensure that you agree it is an accurate portrayal of the interview. After you have approved the transcript, the recording will be deleted.

After the interview, the researcher will debrief you and provide an opportunity for you to ask any further questions. A formal debrief sheet will be sent to you via email, which will include details on how you can withdraw from the study, should you choose to. You will be financially compensated with a £10 Love2Shop voucher.

Are there any risks in taking part?

There are no anticipated risks for taking part in this study. However, there is a possibility that you could find some of the interview questions distressing. You can choose not to answer any question that you feel uncomfortable with. If you do become distressed, the researcher will ask if you would like to pause the interview until you feel able to continue or stop the interview completely. We will also ensure that we do not leave the call until you feel comfortable for the

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call to be stopped. If you have concerns about any issues raised during the interview, contact the student investigator (Patsy Irizar) or the principal investigator (Dr Laura Goodwin) who can signpost to useful services. Alternatively, you may wish to consult your GP if you have any concerns about your drinking or mental health.

Are there any benefits in taking part?

There are no direct benefits from taking part in this study. You will be offered financial compensation of £10 in shopping vouchers (Love2Shop). By sharing your experience, you are supporting other people in the same situation and it is hoped that this research will be used to improve alcohol and mental health services for police employees.

How will my data be used?

The University processes personal data as part of its research and teaching activities in accordance with the lawful basis of 'public task', and in accordance with the University's purpose of "advancing education, learning and research for the public benefit".

Under UK data protection legislation, the University acts as the Data Controller for personal data collected as part of the University's research. Patsy Irizar acts as the Data Processor for this study, and any queries relating to the handling of your personal data can be sent to Patsy Irizar (contact details below). Under the Data Protection Act 2018 you are entitled to request access to the personal data we hold.

How will my data be collected?	Interviews undertaken by telephone will be recorded
How will my data be stored?	Data will be anonymised and stored on a secure server at the University
How long will my data be stored for?	10 years, in line with University data storage policies
What measures are in place to protect the security and confidentiality of my data?	All participant information stored on computer will be kept in a password protected folder, only accessible to the research team and will be identifiable only by a participant number
Will my data be anonymised?	Your data will be fully anonymised at the point of transcription
How will my data be used?	Anonymised data may be used in peer reviewed publications, conference presentations, and PhD theses
Who will have access to my data?	Members of the research team only

Will my data be archived for use in other research projects in the future?	The data will not be archived but may be used by the wider research team of the larger study.
How will my data be destroyed?	Files will be deleted at the end of the 10-year storage.

Will my taking part be covered by an insurance scheme?

Participants taking part in a University of Liverpool ethically approved study will have cover.

Who is organizing and funding the research?

The University of Liverpool is organizing this study. The researcher's PhD studentship is funded by the Economic and Social Research Council (ESRC) and in partnership with Alcohol Change UK. The research is funded the University of Liverpool, and the ESRC.

What will happen to the results of the study?

Once the study is complete, we will analyse the results and publish them in academic journals. We will not identify you in any way when the results are published. You will be anonymised, and any identifiable information will be removed from your interview transcript. We will email you a copy of your anonymised transcript and you can review the transcript to ensure you are happy with it. If you wish, we will send you a short report of the findings.

What will happen if I want to stop taking part?

If you decide that you no longer wish to take part in this study, please inform Patsy Irizar (p.irizar@liverpool.ac.uk). You do not need to provide a reason for withdrawing from the study and can withdraw from both the questionnaire and interview at any time, prior to the point of analysis of the questionnaire data and transcripts (which is typically two weeks after the interview). Following the analysis, you will not be able to request withdrawal.

Disclosure of criminal activity

If disclosure of criminal activity or risk of harm is revealed during the interview, confidentiality may have to be broken to inform the relevant parties. If the researcher believes that there may be a risk of criminal activity or serious harm to yourself or others, as a result of drinking alcohol whilst on duty (e.g. driving whilst under the influence), we may need to disclose this information with the principal investigator and the relevant organisations (e.g. the police or social services).

What if I am unhappy or if there is a problem?

If you are unhappy, or if there is a problem, please feel free to let us know by contacting Patsy Irizar (p.irizar@liverpool.ac.uk) and we will try to help. If you remain unhappy or have a

complaint which you feel you cannot come to us with then you should contact the Research Governance Officer on 0151 794 8290 (ethics@liv.ac.uk). When contacting the Research Governance Officer, please provide details of the name or description of the study (so that it can be identified), the researcher(s) involved, and the details of the complaint you wish to make.

What if I want advice about my drinking?

We are not qualified to offer advice ourselves, but if you are concerned about your drinking or your mental health, we advise you to seek information and advice from your GP. Here is a list of resources which may be useful:

- https://www.nhs.uk/live-well/alcohol-support/
- https://www.drinkaware.co.uk/alcohol-support-services/
- https://alcoholchange.org.uk/help-and-support/get-help-now
- https://www.nhs.uk/conditions/stress-anxiety-depression/mental-health-helplines/
- https://www.mind.org.uk/
- https://www.policecharitiesuk.org/

Appendix 24. Consent form – screening questionnaire (Chapter 9)

Participant Consent Form – Screening Questionnaire

Study title: Understanding risky drinking and abstinence in UK police: an interview study

Name of researcher(s): Patsy Irizar, Suzi Gage, Vicky Fallon and Laura Goodwin

Please initial box

1. I confirm that I have read and understood the information sheet for the above study, or it has been read to me. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

2. I understand that taking part in the study involves completing a questionnaire.

3. I understand that the questionnaire data will be linked to the interview data, should I participate in the interview.

4. I understand that my participation is voluntary and that I am free to stop taking part and can withdraw from the study, prior to the point of analysis, without giving any reason and without my rights being affected. In addition, I understand that I am free to decline to answer any particular question or questions.

5. I understand that I can ask for access to the information I provide and can request the destruction of that information from the questionnaire if I wish, at any time prior to the point of analysis. I understand that following analysis I will no longer be able to request access to or withdrawal of the information I provide.

6. I understand that the information I provide will be held securely and in line with data protection requirements at the University of Liverpool.

7. I understand that consent and questionnaire data will be retained separately on the University of Liverpool secure server for up to 10 years.

8. I agree that my anonymise information may be used in research outputs such as PhD thesis, academic publications, and conferences.

9. I understand that my responses will be kept strictly confidential. I give permission for members of the research team to have access to my fully anonymised response. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research.

10. I agree to participant in the above study.

☐

_____   _____   _____
Participant name   Date   Signature

_____   _____   _____
Name of person taking consent   Date   Signature

Participant Consent Form – Interview

Study title: Understanding risky drinking and abstinence in UK police: an interview study

Name of researcher(s): Patsy Irizar, Suzi Gage, Vicky Fallon and Laura Goodwin

Please initial box

11. I confirm that I have read and understood the information sheet for the above study, or it has been read to me. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

12. I understand that I must not take part if I have had a diagnosis of an alcohol use disorder or have received treatment for an alcohol use disorder in the past year.

13. I understand that taking part in the study involves an audio recorded interview and I am aware of and consent to your use of these recordings for the following purposes: transcription and data analysis.

14. I understand that my participation is voluntary and that I am free to stop taking part and can withdraw from the study, prior to the point of analysis, without giving any reason and without my rights being affected. In addition, I understand that I am free to decline to answer any particular question or questions.

15. I understand that I can ask for access to the information I provide and can request the destruction of that information (both from the questionnaire and the interview) if I wish, at any time prior to the point of analysis, typically two weeks from the interview. I understand that following analysis I will no longer be able to request access to or withdrawal of the information I provide.

16. I understand that the information I provide will be held securely and in line with data protection requirements at the University of Liverpool.

17. I understand that consent and anonymised transcripts will be retained separately in the University of Liverpool secure server for up to 10 years.

18. I agree that my anonymised information can be quoted in research outputs such as PhD thesis, academic publications, and conferences.

19. I understand that my responses will be kept strictly confidential. I give permission for members of the research team to have access to my fully anonymised responses. I understand that my name will not be linked with

the research materials, and I will not be identifiable in the reports or reports that result from the research.

20. I understand that if I disclose information which indicates criminal activity or that there may be a risk of serious harm to myself or others, the researcher will be obliged to share this information with the principal investigator and relevant organisations (e.g. inform the police or social services).

21. I agree to participant in the above study.

_____   _____   _____
Participant name   Date   Signature

_____   _____   _____
Name of person taking consent   Date   Signature

Appendix 26. Qualtrics screening questionnaire, including the Alcohol Use Disorder Identification Test (AUDIT) (Chapter 9)

Contact details

1. Please enter a telephone number that we can contact you on.
2. Please enter an email address that we can contact you on.

Demographic and occupational characteristics

1. What is your gender?
2. What is your age?
3. What is your relationship status?
4. What is your ethnicity?
5. What is your level of education?
6. How many children do you have under the age of 18 (if any)?
7. What is your role in the police service?

Alcohol Use Disorder Identification Test (AUDIT)

1. How often do you have a drink containing alcohol? **If you have never ever drank alcohol, you are not eligible to take part.**
   a. Never
   b. Monthly
   c. Two to four times a month
   d. Two to three times a week
   e. Four or more times a week
2. How many standard drinks containing alcohol do you have on a typical day when you are drinking? A standard drink is half a pint of beer, a single measure of spirits or a small glass of wine.
   a. One or two
   b. Three or four
   c. Five or six
   d. Seven, eight or nine
   e. Ten or more
3. Thinking about your drinking in the last year, how often do you have 6 or more drinks on one occasion?

    a. Never

    b. Less than monthly

    c. Monthly

    d. Weekly

    e. Daily or almost daily

4. How often during the last year have you found that you were not able to stop drinking once you had started?

    a. Never

    b. Less than monthly

    c. Monthly

    d. Weekly

    e. Daily or almost daily

5. How often during the last year have you failed to do what was normally expected from you because of drinking?

    a. Never

    b. Less than monthly

    c. Monthly

    d. Weekly

    e. Daily or almost daily

6. How often during the last year have you need a first drink in the morning to get yourself going after a heavy drinking session?

    a. Never

    b. Less than monthly

    c. Monthly

    d. Weekly

    e. Daily or almost daily

7. How often during the last year have you had a feeling of guilt or remorse after drinking?

    a. Never

    b. Less than monthly

    c. Monthly

    d. Weekly

    e. Daily or almost daily

8. How often during the last year have you been unable to remember what happened the night before because you had been drinking?

    a. Never

    b. Less than monthly

    c. Monthly

    d. Weekly

    e. Daily or almost daily

9. Have you or someone else been injured as a result of your drinking?

    a. No

    b. Yes, but not in the last year

    c. Yes, during the last year

10. Has a relative, a friend, or a doctor or other health worker been concerned about your drinking or suggested you cut down?

    a. No

    b. Yes, but not in the last year

    c. Yes, during the last year

Appendix 27. Topic guides (Chapter 9)

<u>Start of the interview</u>

- Researcher will confirm their name and that they are from the University of Liverpool.
- Researcher will confirm the name of the participant.
- Thank the participant for taking part and ask them if they have any questions before starting.
- Ask if this is still a convenient time for the participant.
- Explain that the interview will be recorded to ensure we capture everything correctly and that their responses will remain anonymous, and the recordings will be deleted once the conversation has been transcribed. Also, that any identifiable information will be removed from the transcript, including any unique experiences.
- Explain that everything is confidential, and no information will be passed on to their employers.

- State clearly that we are not asking about participants' alcohol use whilst working, as the interview is about their own personal experiences of drinking outside of work.
- Explain that some of the questions may be quite personal, state that if they do not want to answer a question or do not want to continue with the interview, that is fine.

<u>General questions</u>

1. Can you give me a little bit of background on your time in the police force?
   a. [prompts] when did you join, how long have you served, different roles
2. Could you describe some positive and negative aspects of being in the police, and what effect it has had on your personal life?
   a. [prompts] any rewarding aspects of the job, or difficulties caused by the job (e.g. relationship difficulties from shift work)
3. Can you describe any positive or negative impacts that working for the police service has had on your physical or mental health?
   a. [prompts] physical fitness, impact on sleep, diet, etc.

Questions for hazardous/harmful drinkers

1. Can you describe your usual weekly drinking pattern?
   a. [prompt] how often, how many drinks, who do you tend to drink with, where do you drink?
2. Have your drinking patterns changed since joining the Police Service?
   a. [follow up] if so, can you tell me a bit more about how and when?
   b. [follow up] why do you think your drinking patterns have changed?
3. In your view, what are some of the factors that encourage you drink alcohol?
   a. [prompt] e.g. enjoy the taste, pressure from others, to cope with stress.
4. Tell me what factors might motivate you to cut down your drinking?
   a. [prompts] e.g. effects on physical or mental health, cost, impact on work/personal life.
5. Can you describe your coping strategies that you use to help with stress?
   a. [prompt] stress from work or personal life? Does not necessarily have to alcohol use.

6. How do you and your colleagues socialise outside of work?

    a. [prompt] without drinking?

7. What are the general attitudes towards drinking, within your part of the Police Service?

    a. [prompt] supportive, unaware of problems, negative, does not get talked about, etc.

8. To your knowledge, within the Police Service, what support is provided to employees who have a problem with alcohol?

9. Would you know where to get help for an alcohol problem, should you ever need to?

10. Thank you for answering these questions. Is there anything that you would like to add to what has already been asked, which you feel would be relevant?

Questions for abstainers

1. Can you describe your weekly drinking patterns before you stopped drinking?

    a. [prompt] how often, how many drinks, who did you tend to drink with, where did you drink?

2. Tell me about when you stopped drinking alcohol?

    a. [prompt] how long ago, whilst in the police, have you drank alcohol at all since?

3. What factors motivated you to stop drinking?

    a. [prompt] physical/mental health, impacting work/personal life, cost.

4. When you used to drink alcohol, what were the factors which encouraged you to drink alcohol?

    a. [prompt] e.g. enjoy the taste, pressure from others, to cope with stress.

5. Can you describe your coping strategies that you use to help with stress?

    a. [prompt] stress from work or personal life?

6. How do you and your colleagues socialise outside of work?

    a. [prompt] does this differ compared to when you used to drink alcohol?

7. What are the general attitudes towards drinking, within your part of the Police Service?

    a. [prompt] supportive, unaware of problems, negative, does not get talked about, etc.

8. To your knowledge, within the Police Service, what support is provided to employees who have a problem with alcohol?

9. Thank you for answering these questions. Is there anything that you would like to add to what has already been asked, which you feel would be relevant?

Appendix 28. Risk protocol (Chapter 9)

Prior to the interview, participants will be provided with a participant information sheet, outlining the aim of the study, which is to gain a deeper understanding of UK police employees' experiences of risky alcohol use, or abstaining from alcohol. The limits of confidentiality will also be discussed and are included on the consent form.

The risk protocol will be implemented if the researcher becomes concerned about a participant during the interview. These circumstances include but are not restricted to:

- If a participant states that they feel uncomfortable answering a question or are experiencing distress
- If a participant discloses drinking alcohol whilst on duty and the researcher is concerned that there is a risk of serious harm
- If a participant discloses harming themselves or plans to harm themselves
- If a participant discloses causing injury or harm to someone else

If any of the above events occur, the researcher will pause the interview and audio-recording and check the welfare of the participant and allow for an initial cool-down period of 5 minutes.

If a participant states that they feel uncomfortable answering a question or are experiencing distress, the following will apply:

- They will be reminded that they do not have to answer any questions they are not comfortable with.
- After an initial cool-down period and if the participant seems more settled, the researcher will ask the participant if they wish to continue with the interview.

- If participant wishes to continue, the interview will reconvene, and the recording will start.
- If the participant does not want to continue, the researcher will terminate the interview, debrief the participant and reimburse them with a £10 Love2Shop voucher for their time.

If the participant chooses to continue and continues to seem uncomfortable or distressed, the researcher will recommend terminating the interview and suggest continuing another day if they wish.

If a participant discloses drinking alcohol whilst on duty and the researcher believes there is a risk of serious harm to themselves or others, the following will apply:

- If the participant discusses drinking whilst on duty, the researcher will remind the participant that the study is not interested in alcohol use whilst on duty and return to the original question, and continue to do this, as long as the researcher is not concerned that there is a risk of serious harm to themselves or others.
- If the participant discloses drinking alcohol whilst on duty and the researcher is concerned that there is a risk of criminal activity or serious harm to themselves or others (e.g. driving whilst under the influence), the researcher will recommend terminating the interview and reimburse the participant with a £10 Love2Shop voucher. The researcher will explain that they are obliged to disclose this information to the Principal Investigator and the relevant organisations, such as the police or social services.

If a participant discloses harming themselves, or plans to harm themselves, the following will apply:

- The researcher will recommend that they terminate the interview and reimburse the participant with a £10 Love2Shop voucher for their time. The participant will be fully debriefed and provided information on local and national alcohol and mental health services.
- The researcher will also explain that they are obliged to disclose this information to the Principal Investigator.

- If the participant is in immediate harm, the researcher will advise that they seek medical help and ask for the details of their GP, or call an ambulance, if necessary.

If a participant discloses causing injury or harm to someone else, the following will apply:

- The researcher will recommend that they terminate the interview and reimburse the participant with a £10 Love2Shop voucher for their time. The participant will be fully debriefed and provided information on local and national alcohol and mental health services.
- The researcher will also explain that they are obliged to disclose this information to the Principal Investigator.
- If the researcher believes that the participant is an immediate risk to others, they will explain that they are obliged to inform the police.

In the event that the participant ends the interview when the risk protocol has been triggered, the researcher will attempt to re-contact the participant to check their wellbeing and fully debrief them with the aims of the study and local and national alcohol and mental health agencies available.

The risk to the researcher is minimal, as telephone interviews will be used. The researcher volunteered at the Samaritans for two years as a fully trained listening volunteer. The research team is highly qualified, with experience of conducting similar qualitative studies around drinking in military populations, to support the researcher in conducting this research safely and professionally.

All participants will be emailed a written debrief sheet detailing local and national alcohol and mental health agencies, should they require additional support. Participants will also be advised to speak to their GP if they are concerned about their alcohol consumption or mental health.

Appendix 29. Debrief sheet (Chapter 9)

Participant Debrief Sheet

Thank you for participating in this important research about UK police employees' experiences of alcohol use.

What is this study about?

This study aims to understand UK police employees' experiences of risky drinking (a level of drinking which is potentially harmful to a person's health), or abstinence from alcohol. This study is part of the student researchers' (Patsy Irizar) PhD studentship, which aims to understand the proportion of UK police employees who report risky drinking, and to explore the relationship between drinking and mental health or work stress. You first completed a short screening questionnaire, known as the Alcohol Use Disorder Identification Test (AUDIT), which is used to determine risky levels of drinking. You were eligible to participate in the interview, if you either reported abstinence, or met the criteria for risky drinking. You then completed the interview, which is the final study of the project and aims to provide a deeper insight into personal experiences of police employees' drinking. We hope to use this research to inform policy and improve education and treatment for UK police employees who may be drinking to hazardous or harmful levels.

Can I be sure that you will keep the information safe?

All the provided information will be kept safe under data protection procedures from The University of Liverpool. The recording of your interview will be deleted after it has been transcribed and approved by you, and the transcript will be anonymised, by removing all identifiable information. The anonymised transcripts and questionnaire data will be stored securely in the University of Liverpool's server, for up to 10 years, in line with the University's data archiving procedures. Only the researchers named on this application will have access to the data. We will store your consent forms and questionnaire data separately from your interview recording and transcript, to prevent identification.

What is happening with my information?

Your consent forms and questionnaire data will be stored securely in the University of Liverpool's server. Your interview will be recorded, and the audio recording will be transcribed. You will be sent the pseudo-anonymised transcript of your interview for you to approve, to ensure that you agree it is an accurate portrayal of the interview. After you have confirmed that you are happy with the transcript, the data from the questionnaire and the

interview transcription will be analysed and prepared to be published in peer-review papers, conferences, and the final thesis.

Under UK data protection legislation, the University acts as the Data Controller for personal data collected as part of the University's research. Patsy Irizar acts as the Data Processor for this study, and any queries relating to the handling of your personal data can be sent to Patsy Irizar (contact details below).

If you are unhappy, or if there is a problem, please feel free to let us know by contacting the student researcher, Patsy Irizar (p.irizar@liverpool.ac.uk), or the principal investigator, Dr Laura Goodwin (laura.goodwin@liverpool.ac.uk) and we will try to help. If you remain unhappy or have a complaint which you feel you cannot come to us with then you should contact the Research Governance Officer on 0151 794 8290 (ethics@liv.ac.uk). When contacting the Research Governance Officer, please provide details of the name or description of the study (so that it can be identified), the researcher(s) involved, and the details of the complaint you wish to make.

Can I withdraw from the study?

You can request your information to be withdrawn from the study at any point, up until the point of analysis. The analysis is likely to be 2 weeks after the interview takes place, after this, you will not be able to withdraw your data from the screening questionnaire or the interview. You can contact Patsy Irizar (contact details below) to request the removal of your data from both the screening questionnaire and the interview.

Organisations who offer support should you need it:

- NHS alcohol support: https://www.nhs.uk/live-well/alcohol-support/
- Drinkaware: https://www.drinkaware.co.uk/alcohol-support-services/
- Alcohol Change UK: https://alcoholchange.org.uk/help-and-support/get-help-now
- NHS list of mental health helplines: https://www.nhs.uk/conditions/stress-anxiety-depression/mental-health-helplines/
- Mind: https://www.mind.org.uk/
- Police Charities UK: https://www.policecharitiesuk.org/
- Samaritans: https://www.samaritans.org/how-we-can-help/contact-samaritan/