Psychological and Educational Outcome of Very Low Birthweight Children at 12yrs

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SOURCES

With the exception of one area, all data presented in this thesis were collected, analysed and interpreted by myself. The collection of data regarding 'neurological soft signs' was collected by Dr. Powls. The 'soft sign' data were subsequently analysed by myself using an 'index' format. All text presented in the thesis is solely my own work with advice from my supervisor.

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LIST OF ABBREVIATIONS

LBW	Low birth weight
VLBW	Very low birth weight
ELBW	Extremely low birth weight
FBW	Full birth weight
WHO	World Health Organisation
IVH	Intraventricular haemorrhage
PVL	Peri-ventricular leucomalacia
SGA	Small for gestational age
AGA	Appropriate for gestational age
ICU	Intensive care unit
NICU	Neonatal intensive care unit
WISC	Wechsler Intelligence Scale for Children
WORD	Wechsler Objective Reading Dimensions
WPPSI	Wechsler Preschool and Primary Scale of Intelligence
IQ	Intelligence quotient
FSIQ	Full scale Intelligence quotient
BAS	British Ability Scales
MLD	Moderate learning difficulties

ADHD	Attention deficit hyperactivity disorder
ADD	Attention deficit disorder
DSM	Diagnostic and Statistical Manual (of mental disorder)
CAPA	Child and Adolescent Psychiatric Assessment
CMAS -R	Child Manifest Anxiety Scale - Revised
FSSC-R	Fear Survey Schedule for Children - Revised
MFQ	Mood and Feelings Questionnaire
BAC	Behaviour and Activities Checklist
SE	Self esteem
RPQ	Rutter parent questionnaire
ANOVA	Analysis of variance
ANCOVA	Analysis of covariance
SD	Standard deviation
IQR	Interquartile range

ABSTRACT

137 Very Low Birthweight (VLBW) children were compared at 12 years with a sample of matched peers on a number of cognitive and educational assessments, regarding psychiatric symptoms and on other developmental outcomes. Psychiatric areas examined included Attention Deficit/hyperactivity Disorder, depression, anxiety and anti-social behaviour using the Child and Adolescent Psychiatric Assessment parent interview and various parent and child questionnaires.

VLBW children were shown to have lower IQ scores and to perform significantly worse on all objective educational measures. Significantly more VLBW children had received remedial education. Rather than "catching up" cognitively, there was a non-significant trend for VLBW children to be more likely to fall out of the normal IQ range from 6 to 12 years.

The main psychiatric risk was Attention Deficit Hyperactivity (ADH) disorders with 31/136 (23%) VLBW children meeting clinical criteria, compared to 9/148 (6%) of peers. VLBW children were also more likely to have generalised anxiety and more symptoms of depression. Nearly one quarter of VLBW children (38/136; 28%) showed a psychiatric disorder of some type compared to 9 % (14/148) of peers.

VLBW children are at increased risk of cognitive/educational and psychiatric difficulties. Impairment is not evenly distributed across the VLBW group but can be 'clustered' to reveal that a third have both cognitive and psychiatric problems, and a quarter have neither. Outcome is discussed in terms of neurological, environmental and cumulative impairment factors and in the context of developmental theory.

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INTRODUCTION

During the past decade there has been much interest in the outcome of babies who are born at low birthweight, both in clinical practice and in the research literature. Initially studies appeared to concentrate on outcomes which constituted major impairment such as major neurosensory impairments (e.g., Papile et al 1983) and cerebral palsy (e.g., Kitchen et al 1984) or severe developmental delay (e.g., Kumar et al 1980). As more of these babies survived and as medical care advanced, researchers and clinicians became interested to discover whether children without major impairments showed more subtle difficulties when compared to their peers, and to follow up such children to later ages.

Following World Health Organisation guidelines, any baby born under 2500g is termed as being of Low Birthweight (LBW); if the weight is under 1500g, this is considered to be a Very Low Birthweight (VLBW); and if the baby weighs less than 1000g, the child is described as having Extremely Low Birthweight (ELBW) (Expert Committee on Maternal and Child Health, WHO 1961). For a baby to be born prematurely, the birth must take place before 37 completed weeks of gestation (WHO 1977).

Advances in the medical care of neonates born early and at low birth weight have resulted in increased survival rates. Until around 1950, the survival rate of the group

with birthweights between 1501g and 2500g was steadily increasing, and since then it has stayed roughly constant (Illsley and Mitchell 1984). Whilst this statistic has stabilised the prognosis of children surviving low birthweight has improved and this has been largely due to improvements in medical management which will be discussed later. Literature now suggests that babies born in this 'heavier' group, that is between 1500g and 2500g, have only a slightly increased risk of impairment. (Drillien et al, 1980; Dunn, 1986).

For the babies born below 1500g, however, the pattern of change has been different. Until the 1950's very few survived and almost none in the group born below 1000g survived. The survival rates for this lighter group have increased rapidly since (Illsley and Mitchell 1984). In a recent US report, the annual number of admissions of Extremely Low Birthweight (ELBW) children are reported to have doubled between 1977 and 1990, and the survival rates of such children rose from 20% in 1977-80 to 36% from 1983-85 and now stands at around 50% (La Pine et al 1995). Their study identified babies under 700g as those contributing most to the increase in survival rates.

This increase in survival has created a population of children new to the medical world, and which requires a comprehensive examination regarding longterm development. Literature exists which focuses on the outcome of these children in infancy and sometimes beyond (Cooke 1987; Stewart et al 1981; Marlow and Chiswick 1985) and which addressed some of the relevant outcome issues.

As babies born as early as 24 weeks gestation began to survive in greater numbers there was some concern that infants born at such very low weights would inevitably suffer severe and life disrupting disabilities. Researchers did not find this to be the universal picture, although early studies did report alarmingly high proportions of these children with major handicap - from around a quarter (McDonald 1962) up to two thirds of very low weight births (Lubchencho et al, 1963). Medical advances during the twenty years following these studies have meant that the proportion of severe impairment has fallen but much of this is due to the increased number of unimpaired survivors. This is especially true concerning visual handicap which is the outcome represented in the large proportions noted above.

Disability is related to the gestational age of the child at birth. Born between 32-40 weeks, development is usually completely normal. Eyes and lungs are developed fully and often no ventilation or special care is needed. Between 28 and 32 weeks, prognosis is also thought to be good regarding disability, with the risk of handicap standing at around 5%. However between the ages of 24-28 weeks gestation, this risk rises to around 15%.

La Pine and colleagues investigated prevalence of major neurosensory impairment in Extremely Low Birthweight children born in three different eras of neonatal intensive care: 1977-1980, 1983-1985, and 1986-1990. Although disability rate is lower than the large proportions first reported, they found a fairly consistent level across these time periods of around 20% and report that mean cognitive scores are also stable across the groups (La Pine et al, 1995).

It is still unclear what minor difficulties such early children have once they are discharged as normal. At the present time there are many questions being asked about the intensive care of neonates and in particular, the age of viability. Some centres are keen to reduce the age at which they consider it is possible to treat preterm babies. At the same time other medical forums believe that this would create an unacceptable level of disability. Another pertinent issue is the cost of intensive care for preterm babies (Stevenson et al, 1996).

Since the earlier work on major disability, attention has turned to the more subtle consequences of being born very prematurely, partly in an attempt to assess the overall "success" of neonatal treatment in these children. It began to be apparent that children who had been discharged as normal and who were attending mainstream schools and nurseries, were often showing signs that they were not fulfilling expected potential, either educationally or behaviourally (Drillien, 1964). By this it is meant that whilst their achievements in a number of areas examined were within the normal range, they were significantly below the performance of peers.

Some concern that there would be a cumulative effect of disability was noted. That is that VLBW children may fall further behind educationally through being continuously in the lower end of their age-range or may develop psychological difficulties primarily as a result of chronic impairment in other areas such as motor skill. It is these children with which the current study is concerned.

Research into the outcomes of low birth weight children has been, to a large extent, piecemeal and uncoordinated. In a great number of these studies, it has been difficult to draw any conclusions for VLBW children from the results due to a series of problems. Often factors such as socio-economic status, which are well known to correlate with children's progress in general (Drillien 1964), have not been accounted or controlled for within the study. Other studies have not specified which birthweights were linked with which results and have simply reported on a much wider group of all those below 2500g (e.g., Vohr et al, 1989). In addition some studies used outcome measures which were not well standardised or objective enough to provide useful conclusions (Nilsen et al 1984); some used small sample groups (e.g., Eilers et al, 1986); others did not have matched controls (e.g. Scottish Low birthweight Study 1992). Aylward and colleagues (1989) provide a useful review and comment on the results and shortcomings of research thus far.

In an even more recent overview by Lukeman and Melvin (1993), a number of issues are highlighted which pertain in particular to childhood psychology. In this report, similar methodological considerations are noted including those of poorly defined study populations, biased population sampling, the lack of use of control children or shortcomings in the way they are selected. This point has also been highlighted in a study by Gross (1992) which is discussed later and in a study by Wolke and colleagues (1994) who showed that using normative test data alone leads to an underestimation of the difficulties experienced by VLBW children.

Lukeman and Melvin also comment on outcome measures, for example, the fact that survival rate becomes less informative as more babies survive and tells us nothing about outcome past this stage. Although Lukeman and Melvin's concerns about the variations in educational achievement across regions in the country are largely solved by the use of matched comparison groups, they also comment that it is not sufficient to use a single outcome measure to identify the challenges which face VLBW children. This appears to be increasingly reflected in the literature, for example the article by Msall and colleagues (1993) which attempts to examine holistically the functional impairment experienced by premature children. This report also notes that overall functional status has been neglected as an outcome measure, with mortality and short term outcome forming the central results.

One of the most surprising limitations of previous studies is their absence of long- or even middle-term follow up. Very little of the present literature has followed children from this population further than school age, indeed Aylward and colleagues (1989) reported that out of 80 studies examined in a meta-analysis, 2/3 did not follow children up past the age of 5 years. The longterm effects of VLBW on children as they reach adolescence is therefore unclear. For any child, this stage of development brings many changes - both internally (such as pubertal and emotional development) and socially (including a change of school and family life). Teenage issues of independence, sexuality and aspirations for the future are raised. It is at this time when children may begin to suffer educationally and/or psychologically. It has been suggested that the combination of VLBW and this developmental stage, may for whatever reason result in an increased frequency of difficulties in these areas. Only longterm research will be able to reveal

accurately the outcomes of VLBW.

The remaining sections of this introduction gives an overview of the research findings currently available concerning the outcome of VLBW children, a discussion of some of the relevant developmental theories. Medical care in relation to outcome and medical/physical outcome itself is included since these factors shed important contextual information onto psychological and educational outcome. Finally a summary of these is given in relation to the present studies aims.

Medical care of VLBW in relation to subsequent outcome

A significant advantage to the care and prognosis of VLBW children would be the ability to link certain medical events to specific outcomes. These events fall into three broad categories. Firstly, studies have investigated events occurring during pregnancy. These include occurrences such as intrauterine viral infections; physical injury e.g., fall during pregnancy; maternal pre-eclampsia or hypertension. Some research has divided cases into the time at which the insult occurred - 1st, 2nd or 3 rd trimester (e.g. Drillien et al, 1980). This has revealed some interesting results showing that VLBW children with identifiable early pregnancy problems were significantly more impaired and had more severe postnatal complications than other VLBW babies.

However, the difficulties in assessing exact time of the risk factor means that this preliminary work must be treated with some caution. In addition, no prospective study has been published to date to determine the risk of such an insult leading to extremely premature birth. That is participants who took part in the research were selected on the

basis of having had a preterm baby, thus providing only a clinical population. Details of insults were also gained retrospectively or from medical notes.

The second type of variable around which there has been much interest recently, is that of perinatal events. These include problems such as intra-ventricular haemorrhage (IVH), septicimaea, peri-ventricular leucomalacia (PVL), and also indications of the baby's status during its stay in intensive care, for example length of ventilation, Apgar score and neurological status. Complications such as IVH are common in VLBW babies and occur in about 40-60% of this group of children (Vohr & Ment, 1996).

Studies investigating such variables have shown that whilst they are related to major disability (Cooke, 1987; Papile et al, 1983; Eken et al, 1995; Roth et al 1993), there are few correlations to be found between these events and later outcome in children who entered mainstream education and different studies disagree on which events are predictive. Marlow, Roberts and Cooke (1989;1993) for example, found that 19 different perinatal variables were not associated with outcome at 8 years.

This result may reflect the shortcomings of measurement techniques. For example, Apgar scores are often regarded as poor predictors because they reflect the baby's status at a single point in time. Cerebral ultrasound scanning techniques used in studies are constantly being improved by more advanced technology. Magnetic Resonance Imaging now used in many hospitals may hold the key to a better understanding of the effects of perinatal events. Unfortunately, financial considerations mean that it has been used little if at all when examining the effects of VLBW.

On the other hand, the fact that the early health of VLBW children does not appear to relate to their outcome in childhood, may indeed be a genuine characteristic of those who survive without handicap. It may be that if the individual is capable of surviving, say a haemorrhage, without major disability, that they can also overcome any minor undesirable effect it may have been expected to cause.

A few recent studies seem to have been more successful in identifying predictive neurological factors. This may reflect advances of knowledge in this area generally. Wallace and colleagues (1995), for example, reported cognitive scores at both one and 6 years of age for VLBW children who had poor visual-following and auditory orienting. Additionally, Lipkin and Altshuler (1994) showed that a neonatal neurodevelopmental assessment was a strong predictor of motor and cognitive ability, although these outcomes were assessed at a very young age of 13 months. Vohr and Ment (1996) have produced a useful review of the impact of intraventricular haemorrhage in preterm infants mainly in terms of associated medical risks. This article also suggests that the incidence of IVH can be reduced and that further research is needed in this area to determine specific methods.

A newly developed surfactant, not available when these children were born, appears to be showing good results in helping VLBW babies to breathe more easily. This may serve to improve respiratory performance in later childhood although at present its main effect has been to improve survival rates. Ante-natal maternal steroids are another intervention thought to reduce perinatal risk. The 8 year stage of the present investigation reports that children whose mothers had received such drugs were significantly less likely to be

having behavioural problems (Marlow, Roberts and Cooke 1993) and subsequent studies have also shown the positive effects of steroid treatment. (Hagan et al 1996; Spinillo et al, 1995). Again this is a difficult area of investigation, since those births before which ante-natal steroids were administered are inevitably those that are less immediate and thus potentially those with less risk.

One factor thought to provide important predictive power, is the degree of growth retardation evident in each individual. This is usually examined by assessing weight against normative data for weight at that gestational age. Babies that are smaller than would be expected are described as 'small for dates' or 'small for gestational age' (SGA). Some studies have shown poorer performance in these children over a number of different areas. For example, van Beek et al (1994) have produced several reports indicating that SGA babies show poorer mother-child interaction at an early age than AGA premature babies or fullterm babies. However although most research suggests that growth retardation is an additional risk factor, results are mixed and not all studies have found this to be the case (e.g. Dowling and Bendell-Estroff, 1991).

More recently an emphasis has been put on studying hidden growth retardation, that is babies who appear in the normal weight range for gestational age, but who are retarded in relation to their genetic potential. Certainly at present, this is a very difficult assessment to make, although suggestions include monitoring weight gain during pregnancy and identifying a slowing of the normal growth pattern. This technique however only identifies individuals who start growing normally and then start to become retarded (in a so called asymmetrical growth pattern). Those babies who have always

been smaller than they should have been cannot easily be distinguished from normally developing individuals. Nevertheless, birth weight ratio (actual weight divided by mean population weight at that gestational age) has recently been used (Cooke 1994; Morley et al 1990) to show that the issue of growth may be central to the outcome of VLBW babies.

In summary, little has been clarified about the effects of perinatal illness or early care in relation to the outcome of VLBW children. The role of maternal ante-natal steroids and other medical advances may reveal clearer relationships to outcome in future practice and research.

Medical Outcome of VLBW Children

Although this report does not directly concern the medical outcome of VLBW, a brief overview of the literature in this area is provided to provide context to psychological examinations. With some psychological or educational difficulties, physical variables such as height or motor clumsiness may play an important part. There appears to be a general agreement about a number of physical outcomes of VLBW.

Firstly, VLBW children appear to remain of smaller stature into middle childhood (Marlow, Roberts and Cooke 1993; Powls et al, 1996). Several studies have reported smaller head circumference, lower weights, and different limb lengths, but these have usually not been standardised for standing height and height may be the only clinically interesting difference between premature children and their peers.

Powls et al (1996) found the children used in this study to have smaller current heights and also to have slightly advanced bone ages. This means that rather than catching up with their peers, the gap is set to widen throughout adolescence. Head circumference was smaller in this cohort even after standing height was taken into account.

Secondly, it seems that VLBW children are more likely than their peers to receive medical care during childhood. This is represented in the number of hospital admissions (Stjernqvist & Svenningsen 1995), the number of referrals to other professionals (such as physiotherapists), and in the reported occurrence of atopy, asthma and chest infections (e.g., McLeod et al, 1995).

Eyesight is poorer in children with very low birthweight (Dowdeswell et al 1995 ; Jongmans et al 1996). Studies suggest that acuity is affected as well as stereovision reported in some investigations (Powls et al, 1997; Jongmans et al, 1996). The VLBW children in this cohort had significantly worse acuity as measured by standard techniques and by more advanced assessment (contrast sensitivity), poorer stereovision and significantly more wore glasses (Powls et al, 1997). Hearing difficulties also appear more common in VLBW children. This has only recently become a recognised possible outcome of low birth weight, and has affected children to varying degrees causing some delay on occasion in recognising the hearing loss. This may be an important factor when considering speech and language development and behavioural problems in VLBW children. Kelly and colleagues (1993) have suggested that some types of hearing loss may instrumental in the aetiology of attention deficit disorder.

One of the most reliable findings across studies appears to concern motor impairment. At younger ages VLBW children have been found to have significant problems with motor skills in relation to the performance of peers (Marlow et al. 1993; 1989). This result is confirmed by similar reports from Smedler and collegues (1992), The Scottish Low Birthweight Study Group (1992), and Dunn (1986) among others. The last of these, The Vancouver Study found some improvement in motor skill over time with gross motor movements improving more than fine movements.

Powls and colleagues (1995) found VLBW children to show improvement in motor skill from 6 to 8 years with some catch-up on the performance of peers. However results at 12 years suggest no further improvement, leaving the VLBW children with a significant physical disadvantage at 12 years. A recent paper by Jongmans and colleagues (1996) reports 'additive' difficulties for VLBW Children in motor skills and in eyesight, linking the two areas of impairment.

Although "soft" neurological signs have only been examined in relation to VLBW in a limited way and in only a few studies (e.g., Dunn, 1986), a number of "soft signs" have been examined in relation to psychological outcome (Shaffer et al 1985). Although soft signs are often felt to be unreliable indicators of neurological cause, their use in an "index" form may give some insights into psychological difficulties and an "index" of signs has been created by the current author from those tested in order to examine their relationship with educational or psychological difficulties (see chapter 2 for methodology).

Cognitive outcome

Pre-school development is probably the most thoroughly described area of Very Low Birthweight outcome. Many studies have presented reports examining the cognitive outcomes of children under 5 who were described as medically normal and have found impaired performance by VLBW children. Dunn (1986) for example found that the VLBW Vancouver children were at a significant disadvantage to peers on a number of developmental tests such as the Griffiths, Stanford Binet and WISC assessments administered at 2 and/or 4 years of age. The longitudinal design of this study enabled the authors to note an improvement in the index group (which included LBW children) until 6 years by which time IQ's were in the normal range. They were however still 11 points lower than full term peers. Gross (1992) also assessed preterm children at 6, 15 and 24 months of age and reported a similar outcome, emphasising the importance of control groups and presenting the alternative, misleading results which would have been used simply by referring to population norms. Unfortunately this study included children with severe impairments and is therefore less useful than it might otherwise have been.

Very Low Birthweight children have also been reported to perform less favourably than their fullterm, normal weight peers on cognitive and educational measures during early school age. The Scottish Low Birth Weight Study group (1992), Zubrick et al. (1988), Saigal et al. (1991), Szatmari et al (1993), Pharaoh et al. (1994a), Marlow et al. (1989;1993) all found differences between VLBW children and peers up to 8 years of age.

One issue pertinent to early cognitive development is the adjustment of age according to prematurity. This is supposed to be done up to the age of 2 years since at this age the few months difference between actual age from birth and expected date of delivery, begins to have little effects on test scores. However, some studies have deviated from this adjustment age, or have not adjusted at all, thus confusing the results of the research.

As mentioned above, some reports concerning cognitive outcome have included both children with no obvious impairments and those with major disabilities. This has made the results extremely difficult to interpret regarding those children who are not severely neurologically impaired. In pre-school children, some neurological abnormalities may even be transient (McCarton, 1986). Apart from notable exceptions (Hunt et al,1988; Dunn, 1986; Smedler et al 1992, Levy-Shiff et al 1994a), very few studies have continued to examine cognitive or educational outcome in these children beyond middle childhood and the development of VLBW children exposed to more recent ICU techniques, as they enter early adolescence remains uncertain.

Much of the recent work has focused on predicting cognitive impairment in VLBW children. A study by Dammann and colleagues (1996) found that their VLBW cohort was below the standard cognitive level for age (no direct comparison children were used) and that this was related more closely to environmental factors than to neurological morbidity. Levy Schiff and colleagues (1994a) found that cognitive performance in VLBW adolescents was related both to biological and environmental factors, and importantly that relationships were "domain specific", that is different developmental

outcomes were related to different predictive factors. Another study by Liaw and Brooks-Gunn (1994) regarding low birth weight children in the Infant Health and Development Program reports that IQ scores are directly affected by the number of risk factors (including biological, socioeconomic and family variables) and that early intervention improved later IQ scores regardless of risk factors.

Some studies including those cited above, have also reported educational outcome in terms of performance in curriculum areas such as maths or reading, or in terms of remedial education. Hall and colleagues (1995) reported that 15% of ELBW children in their total population study were attending special school at eight years of age. Those in mainstream school also showed poorer IQ scores and more than half were receiving remedial help. Educational outcome is an important addition to the literature on cognitive outcome, since although these factors are likely to be related to cognitive ability, they may reveal additional deficits or indeed "protected" skills. Levy Schiff and colleagues (1994a), for example, report no reading comprehension deficit in their otherwise cognitively impaired sample.

ADHD as an outcome of VLBW

There has been an increasing body of research examining the effects of being low birth weight in children who have no major neurological impairment. One of the areas to receive attention outside of health, growth and motor impairment, is that of inattention and overactivity. Much of this work has unfortunately been short term in nature or has been described under the general heading of behaviour problems.

Research which has examined psychopathology has found VLBW children to be more vulnerable to an increased prevalence of inattention and hyperactivity in VLBW groups at very young ages (Astbury et al 1987; Drillien, 1972; The Scottish Low Birthweight Study Group, 1992) and other studies have shown that increased risk of hyperactivity/inattention was present in middle childhood (Szatmari et al, 1993; Klebanov et al 1994) and even into adolescence (Dunn, 1986). In non-VLBW populations, these attention deficit difficulties have been noted to lead to behavioural problems as children become older (e.g., Bird et al, 1994; Loeber & Keenan, 1994). However, little is known about the possible long term impairment this hyperactivity or attention deficit may cause VLBW children.

Szatmari et al (1993) have recently reported a higher incidence of hyperactivity and attention deficit in babies of less than 1000g than in their peers at age 8 years. Importantly, this study also commented that the ELBW children with hyperactivity were not developing antisocial behaviour as frequently as matched peers who had also been recognised as hyperactive. It is possible that this implies a different aetiology or development of attention deficit in ELBW babies to that of their full birth weight peers.

As commented in the following review section at least one recent study reporting "behavioural problems" (McCormick et al 1996) has found that these are more specifically behaviours related to attention deficit or hyperactivity. Stjernqvist and Svenningsen (1995) also separated ADHD from behavioural difficulties and found that ELBW children showed an increased rate of only the former difficulty. Because of the lack of specific tests and checklists for hyperactivity, especially for younger children, it

is possible that this outcome is being "hidden" by non-specific assessment techniques in some studies.

Anxiety

Little research to date has specifically examined anxiety in relation to low birth weight. Studies have either reported general emotional behaviour using behaviour questionnaires such as the Rutter questionnaire or Child Behaviour Checklist (Achenbach et al, 1987) or have not examined this aspect of outcome at all. Those that have examined this aspect of development in very low birth weight children have usually done so at fairly young ages and these investigations are contradictory in their conclusions with some finding VLBW children to be more anxious than their peers (Zelowitz et al, 1996) whilst others found no increased frequency of anxiety (Sommerfelt et al, 1993). As with depression sequelae, only a few authors have conducted long term follow-up studies regarding anxiety (Levy-Schiff et al 1994b; Dunn, 1986).

The first of these studies by Levy Schiff and colleagues found that VLBW teenagers were more anxious (as well as depressed) and that this was related strongly to birthweight with this variable explaining 20% of the variance in questionnaire scores. Dunn (1986) also found that 20% of the small number of VLBW children followed up at 13 years met clinical criteria for "neurosis" compared to 9% of controls. Thirty percent of this Vancouver follow up reported having used medication to 'calm nerves'.

Once again it is important to place any anxiety experienced by the VLBW children in the context of normal development and in relation to rates of disorder found in a cross

section of the population. Because of the developmental pattern of *normal* anxiety, the diagnoses of anxiety disorders must be made in the context of the child's age and developmental level. Indeed, anxiety disorder is one of the most common problems experienced in adolescence. Current research estimates that in the general population prevalence ranges from 2.9% (Anderson et al, 1987) to 7.3 % (Kashani and Orvaschel 1988) for generalised anxiety or overanxious disorder. This is a higher proportion than was noted in the Isle of Wight study in which 2% were affected at 10, 11 and 14 years (Rutter et al 1970).

Results also vary widely depending on who is asked to report on the anxiety, parent or child. Agreement tends to be low between these two possible sources of data (Costello 1989) with children reporting more anxiety than their parents. Sex differences are also noted in anxiety disorders with girls being more likely to experience anxiety (Bowen et al 1990), although this difference is more marked in late adolescence (Graham 1991). As children enter adolescence, types of anxiety will change. They are less likely to experience specific fearfulness and this is most likely to take the form of social or school phobia. Overanxious disorder is the main anxiety disorder connected with adolescence.

It is uncertain still what level of anxiety causes significant problems, with some children being functionally impaired with apparently less anxiety. One reason for this may be the finding that older children report more symptoms. General anxiety shows co-morbidity with other types of disorders. Two of the main coinciding problems may be depression (47% overlap) and Attention Deficit disorder (35% overlap) (Bowen et al, 1990).

Causes of anxiety can be many and varied but there are the usual theories regarding biological or environmental aetiology. These two potential bases for anxiety have obvious implications for the incidence of anxiety one might expect in a VLBW population. If neurological factors are indeed important in the development of anxiety, then the preterm group might be expected to be at increased risk of this outcome. In addition, social factors appear to play some part with children living in insecure families being more predisposed to anxiety and fears than more settled children. Parental upbringing is also widely reported as a variable in anxiety with overprotective parents being characteristic of anxious children. It is unclear whether VLBW children are born of less settled, more anxious families. Studies do suggest that parents of VLBW children are or at least become highly anxious during the early years of the child's life (Lobel, 1994) but other studies have found no evidence for an increased level of "overprotectiveness" in parents of VLBW children (Portnoy et al 1988). The role of environmental causes of anxiety are unclear but might also contribute to an increased frequency of general anxiety in the VLBW adolescents.

Finally anxiety in adolescence is often left untreated and it is only the more intense symptoms which are addressed clinically. Generalised anxiety may well not be classified as a problem and indeed may not warrant specialist treatment. However extreme anxiety in adolescence undoubtedly makes social, educational and physical development more difficult.

Because of the wide variation in "normal" anxiety and because of the differing forms it can take, the assessment interview used in this study asks about a number of different

areas including phobias and panic attacks. However, generalised anxiety will be the main outcome examined here since this is likely to be the most frequent regardless of group and because its criteria are somewhat more easily defined than other disorders. Phobias for example are harder to determine given the necessary strength of reaction and level of illogicality in the fear. These features are often difficult to judge in an interview especially if a high level of avoidance is reported.

Depression

There is at present very little research which has measured depression in populations of low birth weight. This may be largely due to the low incidence of depression before adolescence and the few studies which are able to follow up cohorts of vulnerable children to this age. In addition, only a very small number of studies have aimed specifically to examine the relationship between depression and Very Low Birth Weight.

In the most recent and possibly most comprehensive study to date which has examined adolescent depression in VLBW children is that by Levy-Schiff and colleagues (1994b). This investigation found an increased prevalence of a number of emotional difficulties including depressed mood in 90 VLBW children when compared with matched controls. This study highlights six methodological factors which have been problematic to research in this area to date and these are as follows: a focus on early childhood with little work at later ages; a lack of standardised measures; the use of parental reports only; the inclusion of children with major or severe disabilities; a lack of control groups; and a failure to examine environmental factors or to include only SES factors.

Their study attempts to avoid these shortcomings and successfully shows that as well as cognitive and educational difficulties, VLBW children are "also at risk for a wide array of emotional and behavioural difficulties" (p330). This thesis addresses the majority of the criticisms forwarded by Levy-Schiff et al (op cit.) although it still includes a limited amount of information about family environment and parenting style beyond demographic data collected.

Because most studies assess VLBW children during middle childhood (5-8 years of age), they may fail to detect a vulnerability to depression and anxiety which does not become apparent until a later age. Szatmari and colleagues (1990) comment that their failure to find any psychiatric disorders except ADHD in a sample of ELBW children, may be due to the age of their cohort (5 years). Not only is depression recognised as occurring more frequently at adolescence than at younger ages (Angold, 1988), but the cumulative effects of other impairments may only be evident after many years. That is, the findings of various studies that VLBW children are shorter, clumsier, less intelligent and poorer socially may indeed lead to low self esteem and/or depression after repeated failure through primary school. It may also be that these impairments are more noticeable in and indeed more important to adolescents than younger children.

Aside from studies directly examining depression and low birth weight, others have investigated the relationship between depression and a number of other birth related factors. Using birth records, Kinney and colleagues (1993) found that overall "obstetric complication" scores were significantly higher in adult subjects with bipolar depression disorder than in their siblings. Furthermore, this difference was most marked for

perinatal complications. In a different study, children with conditions involving "brain dysfunction" were found to be more susceptible to depression than age-matched controls (Breslau 1990). Hay and Kumar (1995) found that low birth weight added to the likelihood that children with depressed mothers, would also show depressive symptoms. Other research, has linked depression and comorbid disorders also thought to have a neurological basis. These include increased depression in children with learning disabilities (Emslie, Kennard and Kowatch, 1995; Kobe & Hammer, 1994), obsessive compulsive disorder (Thomsen, 1994; Flament et al 1991), autism (DeLong & Nohria, 1994), and attention deficit and hyperactivity disorders (Biederman et al, 1991).

It is important to note concerning this thesis that reasonably large numbers of the participating teenagers might be expected to report feelings of depression regardless of their birthweight status. Depressed mood is reported as a phenomenon which affects a significant proportion of adolescents in the general population. The Isle of Wight study (Rutter et al, 1970) reported that 10-11% of 10 year olds often felt miserable, tearful or unhappy, but this number doubled during early adolescence, culminating in an estimated prevalence of 21-24% in 14 year olds. The study highlighted the substantial occurrence of sadness in teenagers despite the fact that only around 3% of these children could be identified as depressed using the DSM criteria. For this reason, Angold (1988) in a useful review of the measurement and definition of childhood depression, suggests that studies should use a range of assessment methods (including psychiatric classification and depression scales) in order to gain a complete picture of depressed mood and syndrome in differing populations.

Behavioural difficulties and social development

The social and antisocial behaviour of children is a complex area of development to study and yet forms one of the most important areas of concern to parents and professionals. Research into the effect of VLBW on this part of the child's progress, is best examined separately in terms of behavioural difficulties and in terms of pro-social development. Although these areas are connected and are often appropriately discussed together in this thesis, very few studies appear to have examined both aspects of socialisation. For the majority of this section they will therefore be considered individually.

Behavioural difficulties/ antisocial behaviour

A number of studies have looked at the relationship between VLBW and later 'behavioural difficulties' and many of these have found a correlation between the two (e.g., Marlow et al, 1989; The Scottish Low Birthweight Study, 1992; Weisglas-Kuperus et al, 1993, Pharoah et al 1994b). However, the evidence is mixed and some studies have found no increased incidence of behavioural problems (Portnoy et al 1988; Walker, 1989). As with most other aspects of VLBW outcome, few of these studies have studied children past middle childhood.

One of the studies in this area does examine children of more than 8 years of age (McCormick et al 1996). Again this study shows an increased incidence of general behaviour problems in VLBW and ELBW children as recorded on the Behaviour Problems Index (an adaptation of the Achenbach Child Behaviour Checklist). However at this age it appears that problem behaviour can be more specifically defined. On closer

examination of this result one can see the main differences lie in hyperactive, rather than aggressive behaviours. Most studies in this area, have assessed behavioural difficulties in general and have not used measures which enable closer analysis of the types of problem behaviours. Consequently, at least some of the reported behavioural problems are due solely to emotional or attentional difficulties as opposed to anti-social behaviour. Other types of difficulty may also be confused with "behavioural problems" in the literature. Weisglas-Kuperus and collegues (1993) for example reported higher problem scores using the Child Behaviour Checklist but this appears to be mainly due to a increase in depressed mood and behaviour rather than disruptive behavioural problems. In the same study a clinician also rated a large percentage of children as having behavioural problems (77%) but the majority of these difficulties were emotional or attentional in nature.

In this thesis, "behavioural difficulties" refers to behaviours which are anti-social or intentionally oppositional in nature and which are not better defined by more specific terminology. Difficulties pertaining to attention deficit, hyperactivity, depression and anxiety have been discussed in detail in earlier sections. Of course, behavioural difficulties and other forms of psychological impairment often coincide. The nature of this area of the study in no way intends to imply clinically separate behaviours across groups, and indeed the relationship between behavioural difficulties and other problems will be addressed later.

Social Behaviour

One of the least researched areas of VLBW outcome is that of social development and yet it could be one of the most important. Preterm babies are by necessity separated from their mothers during the early months of life and are consequently at risk of health-related, cognitive and psychological risk. It is important for us to determine how these other outcomes relate to social development and discuss whether any intercorrelation is causal. In any child, inadequate social skills development has been shown to relate to poor outcome in educational and psychological development (e.g., Feehan et al 1995) and in recent years, there has been an increase in the clinical application of social skills training for a wide range of different populations including children with Moderate Learning Difficulties (MLD; e.g., Margalit 1995) and ADHD (e.g., Sheridan et al 1996). Very low birth weight children however have hardly been investigated in this way and consequently have received very little advice.

Throughout the study, many parents of VLBW children expressed concerns that their child was not good at social interaction. In particular, they felt that VLBW children found difficulties with people their own age and were not noticeably poor at interacting with adults or much younger children.

Studies which have examined social interaction in VLBW children tend to have concentrated on individuals in the first few years of life. VLBW children involved in the Infant Health and Development Program in America, for example, have been comprehensively examined regarding infant-mother interaction patterns and have been reported to show differing communicative patterns even at a very young age (Berlin et

al 1995). Landry et al (1990) observed 3 year old children who were either low birthweight and premature or full term. The low birthweight group were also categorised as showing low or high medical risk. They found impaired self-directed behaviour in children and poorer quality of response to maternal directives to be related to high medical risk. In addition parents of LBW children were more likely to be directive towards their children. Other studies have found that preterm babies are less responsive socially (Malatesra-Magai et al 1994) and that this may be related to insecure attachments in the first 12 months (Butcher et al 1993; Plunkett & Meisels, 1989). Barrera et al (1990) also found that social competence measured at 8 months of age was a significant predictor of social competence during the second year of life.

If differences can be found this early in life, one might expect a "knock-on" effect causing increasing differences as children develop. However, there is little evidence either way due to lack of studies looking at older children. Some studies have reported results at school age, using fairly general measures of social competence, the most common being the Harter Scale for Perceived Competence. Such studies have also found poorer social skills even using these rather crude measures (Klebanov et al 1994; McCormick et al 1996). Furthermore, studies have failed to examine social ability in relation to earlier measures of competence in this area. One exception to this is a report by Beckwith, Rodning and Cohen (1992) in which a relationship was found between maternal responsiveness both in infancy and at early adolescence, and the self-esteem and behaviour of a group of preterm children aged 12 years.

In addition, whilst maternal interaction has attracted research attention, almost no work has been carried out regarding social interaction with peers. One investigation which has examined this area of social development is a study by Hoy and colleagues (1992) who examined the levels of social maladjustment, social skill and peer acceptance in a large cohort of very low birthweight children who were aged 6 to 9 years of age. They found that VLBW children had lower scores for social skill and peer acceptance, and showed higher scores for social withdrawal than other children of their age. The VLBW group also showed higher sadness/unhappiness scores compared to peers. A recent study already mentioned regarding its reports of behavioural difficulties, also reported on perceived competence of VLBW children using the parent version of the Harter scale (McCormick et al 1996). These authors report that perceived social acceptance of the child was less favourable for VLBW and ELBW children.

In a more general study Rosenbaum and colleagues (1995) examined the overall functioning of a cohort of ELBW children using the Vineland Adaptive Behaviour Scales (Sparrow et al 1984). Among other factors, this measure assesses communication skills and socialization. They found 72% of ELBW children to be functioning adequately in communication skills and in socialization and these areas were not as impaired as daily living or motor skills. However they also found 12% of ELBW children in the low score range on socialization where only 2.5% would be expected from the normal population.

Eating and Sleeping

Many parents of VLBW children express a concern that their baby will suffer from feeding or sleeping difficulties, either through prematurity itself or more usually because

of the highly technological environment in which babies spend their first few months of life. The Neonatal intensive care environment has certainly been identified in the literature as a potentially stressful environment for normal development (e.g., Wolke et al, 1995).

In particular, constant ambient lighting has been suggested as a cause for disturbed behavioural cycles including the sleep-wake cycle (Becker et al, 1993) and that these may lead to longterm sleeping difficulties (Mann et al 1986). Furthermore adjustments to care routines in the NICU environment have also been related to shorter hospital stay, shorter time to breast feeding and improved behavioural organization (Becker et al, 1993).

It might be expected therefore that VLBW babies who did not experience this "developmental" approach to NICU care would subsequently be at risk of sleeping or possibly eating difficulties. Many parents describe a "restless" temperament in their VLBW baby which involves them being more difficult to settle and generally noisier than other babies (Wolke et al, 1995).

Research has associated sleep behaviour with other types of perinatal event (e.g., Minde et al, 1993), but research on sleep and the premature infant is inconclusive. Keener et al (1988), Golding (1986) and Shimada et al (1993) all reported frequencies of sleep difficulties or the development of the sleep-wake cycle in preterm infants to be similar to those who were fullterm. Whilst some of these studies examined children who were born at 32 weeks or later, a very recent study showed preterm (32-36weeks and very

preterm (<32 weeks) babies to show improved nighttime and sleeping patterns than matched fullterm peers (Wolke et al, 1995). One study examining children at 3 years does report sleep difficulties mainly due to difficulty settling the child to sleep (Walker, 1989). However, this study used small numbers and 1-tailed statistical analysis, and further studies of infants are needed to confirm this result.

It seems then that there is at present a discrepancy between parental reports of sleep in preterm babies and the research available on this subject. It is also unclear whether sleep and eating disturbances reported by parents continue into later life, and whether they are precursors to more serious eating and sleep disorders. Conversely, difficulties of somatic organization such as these may disappear as VLBW become older. Parents of VLBW children in this study also gave anecdotal reports of sleep disturbances in their children as babies, but even more surprisingly were often still concerned about their children's sleep patterns at 12 years of age.

Even fewer studies seem to have addressed the question of feeding difficulties in VLBW children or of later eating disorders in this population. Perhaps unsurprisingly, preterm children have been reported to show poorer sucking abilities than full term peers who had also required special care and had experienced a similar length of time in hospital (Brake et al 1988). An earlier study also linked this less efficient sucking to some aspects of the neonatal neurological evaluation and with developmental assessment at 7 months of age. Bu'Lock and colleagues (1990) have suggested that poorer early feeding technique is due to neurological immaturity when they controlled for postnatal ages of the babies. There have been no studies to date either relating poor early feeding to

longterm outcome, or examining the reoccurrence of eating problems later in development.

The current thesis examines sleeping and eating behaviour to determine whether these children show differences in behavioural organisation as they enter adolescence. Although it seems that the literature has not identified severe problems in these areas for VLBW children, they remain areas which cause a great deal of concern to parents and which may relate to other areas of longterm development.

Very Low Birth Weight & Developmental Theory

This section presents a few of the theories which may inform and be informed by VLBW research. It is not intended to be an exhaustive review of developmental theory (which is not the aim of this thesis) but to add some theoretical context to the outcome findings discussed above.

There has been thus far, very little directly written about current theories of development and what light they can shed on the progress of very low birth weight children. Equally, the study of low birth weight children may be able to inform and enrichen developmental theory, but as yet this population has not been the subject of much theorising. The emphasis on outcome per se may arise from the tradition of research in this area being medically organised and funded, and it is only recently (as the longterm and more psychological aspects of impairment in these children has become clearer) that this question has arisen.

Several theories of development exist and co-exist. After the effect of any biological influence on outcome, it is important to examine possible mechanisms and patterns of development which leads to certain developmental pathways within the VLBW group and which separate VLBW children's development from that of their full birth weight peers.

Because of the relative sparsity of longterm follow ups of very low birth weight children, it is as yet difficult to ascertain whether impairments shown are simply a delay in maturity. If, as some researchers believe, the deficits in this group "catch up" over time, then the development of VLBW children may be one of delay rather than abnormal development. However, there are some indications that particular areas of difficulty exist for VLBW children such as particular difficulty with mathematics and motor skills and an increased risk of ADHD. If these impairments remain whilst others normalise, then a more disordered and asymmetrical pattern of development is evident and it is these areas which need examining in terms of explanatory theories.

Most modern theories of development describe an active or interactive process in which the child is an agent in the learning process (Miller, 1983). Many also see development as having a qualitative aspect in terms of generalisation of cognitive skills (Piagetian theory), improved imitation of others (social learning theory) and some also describe qualitative differences in terms of stages of development (e.g., Piagetian, Freudian, Eriksonian).

Regarding the cognitive development of children who are born VLBW, this group appear to follow a similar pattern to other children and although their milestones may be slower, there is at present little evidence from the literature that they are more likely to remain at ceratin stages of development. IQ scores are seen to fall within the normal range despite being lower than peers and one might argue that it is quantitative difference which is seen. For example, that VLBW children do reach the stage of abstract reasoning, but never master this skill to the extent of their peers.

However, it can also be seen that the impairments of VLBW children are not explained by a simple theory of delay in cognitive development. As mentioned above, some studies have revealed particular problem areas for these children suggesting specific areas of developmental impairment and whilst these deficits cannot neatly be described by a stage theory of development, they suggest that there may be specific and potentially identifiable mechanisms underlying certain difficulties. This idea is relevant to the current debate about the modularity or domain specific approach, particularly in the area of cognitive development. If VLBW children are impaired in specific areas and relatively unaffected in others this suggests that certain "modules" of ability may be affected and that all cognitive development is not necessarily intrinsically linked.

Theories which might explain the impairments seen in VLBW children

One theory which might go some way to explaining the mechanism behind the impairments shown is that of the information processing school. Recently, various "executive functions" have been posited as an explanation for limitations seen in children with other disorders such as working memory and 'theory of mind' in Down's

syndrome or autism (Baron-Cohen, 1995) and in young children (Bryant, 1974) since as normally developing children become older, they learn to plan and organise their problem solving abilities to a higher degree. These skills are probably also partially inherent. VLBW children have been shown to be poor at the very skills which may rely on 'planning' ability or on processing capacity. For example, hyperactivity (Szatmari et al, 1993), spatial ability, complex language structures (Grunau et al, 1990), reading comprehension and mathematics (Saigal et al, 1991) and motor skill (Marlow et al, 1989, 1993), are all areas noted to be impaired in some VLBW children. A limitation on the processing capacity or functions (maybe at a specific level) may account for the deficits seen in these skills and in social and emotional areas of development.

Another major school of thought is that of social learning theory. This approach may be of particular interest regarding anxiety and depression in very low birth children. Vicarious learning as described by Bandura (1977) may be of central importance to this group. VLBW children may show increased depression and anxiety as a direct consequence of living with parents who are exhibiting similar traits during the early years. It may be that even if no actual overprotective behaviour can be identified (and as stated previously, there are mixed views on this), that a parents 'anxiety' specifically about their 'vulnerable' child and his or her behaviours is transferred to the child affecting their development of normal risk taking and inhibiting the usual lessening of anxiety over time. This effect may indeed be an interactive one in the case of the VLBW child in that he/she may also be less mature to begin with. Children with similarly anxious parents but who have not experienced the trauma of prematurity, and children with VLBW who do not have anxious parents in this way, may both be groups who not show

anxiety. Additionally, it may be those VLBW who show the most immature behaviours who elicit more anxious behaviour in their parents, thus creating a circular pattern of development.

Thirdly, the theory of attachment first suggested by Bowlby (1953) has obvious relevance for VLBW children, who are inevitably separated from their mothers and families for a substantial part of their first year. Attachment theory has, at least on the face of it, much to contribute to explaining the findings regarding long term outcome. The theory suggests that if the distance between mother and infant becomes "unacceptable", the infant will show behaviours designed to elicit proximity. In terms of VLBW infants this might exhibit itself in the form of behavioural problems, sleep difficulties and food and may elicit feelings of insecurity, poor social skills, anxiety and even depression. Bowlby felt that the early pattern of attachment would affect long term development in these areas. Studies which have been conducted regarding premature infants and attachment status show some evidence for an increased proportion of insecurely attached individuals in this population (Wille, 1991; Mangelsdorf, Plunkett and Dedrick, 1996).

More recent discussions of the theory have also recognised the importance of the caregiver's reaction in this process, and studies have shown mothers of insecurely attached children to be less sensitive or over responsive (e.g., Belsky, Rovine and Taylor, 1984). In VLBW children, mothers have indeed been shown to exhibit both these characteristics more than parents of full terms, in part due the premature infants less well defined social behaviour. Of particular interest is the fact that children categorised by Ainsworth's Strange situation as "anxious-resistant" are more likely to have limited

positive mothering at the very early stage - the stage at which VLBW children are hospitalised. Even at 2 months babies have been shown to experience stress at their mothers absence.

From the parent's perspective too, bonding may be difficult in the early months due to fear of losing the child, and the well-publicised nature of attachment theory means that separation causes additional feelings of guilt and anxiety in the mother regarding her relationship with the baby. As well as the obvious links from attachment to later social development (Sroufe, 1983; Lamb et al, 1984), other studies have also shown that children who are not securely attached are less able to attend to their environment and therefore show poorer cognitive development (e.g., Bell, 1970 and Bretherton, 1979).

Summary of current literature and remaining research questions

The review of literature above shows that the most thoroughly researched area outside medical outcome, is that of cognitive development. Studies clearly indicate that a significant impairment can be seen in VLBW children well into school age compared to peers, although average ability for this population appears to fall at the low end of normal rather than outside the normal range. Literature regarding psychological outcome is more sparse, but a number of studies highlight problems with Attention deficit/hyperactivity disorders at an early age. No studies have at present been able to report clear and reliable correlates of these outcomes in terms of perinatal factors after VLBW itself. However, several studies have shown a clear effect of socio-economic status, parenting style and other environmental factors. There is a distinct lack of studies following up very low birth weight children past primary age. Intervention studies are

also few in number but are beginning to become more frequent as outcomes are determined more reliably.

Several important research questions therefore remain which are addressed in this thesis. Firstly, do deficits seen in other studies apply to this cohort as they reach early adolescence? Are other psychological difficulties more prevalent in VLBW children at this age than in their peers? Can predictive or causal factors be identified for individual outcome areas or for overall outcome status? Fourthly, is current research correct in treating the VLBW population as an homogenous group for the purpose of outcome studies? How do different outcome measures relate to each other as a group and in terms of individual co-morbidity? Finally what implications do outcomes have for intervention and prevention?

The present study

As can be seen from the reviews above, the period of adolescent development is largely an unknown quantity regarding children born with very low birthweights and it is equally unclear what factors precede, predict or even cause better or worse outcome at this age compared to full term, normal weight peers.

The present study therefore attempts to address the issues surrounding VLBW children (who were able to enter mainstream schooling) as they enter puberty and adolescence. It examines their performance at twelve compared to matched controls and in relation to previous performances when the same cohorts were seen at 6 and some of them at 8 (Marlow, Roberts Cooke 1989; Marlow Cooke Roberts 1993;) It also examines a

number of outcomes in relation to each other and in relation to perinatal variables. In brief the study examines outcomes in the following areas:

1) IQ or cognitive ability and educational performance - maths, spelling, reading.

2) Behaviour including social skills, anti-social traits, overactivity and eating/sleeping.

3) Affective or emotional difficulties such as anxiety and depression.

This thesis also attempts to present the distribution of impairment in this sample of VLBW children. That is, how many children suffer any impairment and the proportion of children who experience a large number of the impairments examined, thus leading to a significant functional handicap. This is an area which is of great concern to clinicians and yet which is difficult to ascertain from most of the current literature on VLBW children. It is important to note that the children in question throughout this report are those who were considered able to enter mainstream education at 6 years. This group of children are therefore "discharged" by the medical profession and are expected to follow entirely normal paths of development. Finally this thesis aims to incorporate the findings from this study and those from other recent research into a theoretical framework of development.

Unlike other studies of VLBW children, the current investigation has used a longitudinal design with perinatal variables and six year data available for predictive analysis, assessing children into teenage years, has a matched control group, has examined a wide range of developmental factors so that outcomes can be viewed in context and has used standardised and comprehensive assessments wherever possible.

METHOD

General Design

Two cohorts of children, all of whom were treated at Liverpool Maternity Hospital Special Care Baby Unit following VLBW comprised the sample for the present study. The first of these cohorts was made up from births between January 1980 and July 1981, and have been seen previously at both six and eight years of age (Marlow et al, 1989). The second cohort was collected from January 1982- November 1983 births and was seen only at age 6 years previously (Marlow et al , 1993).

Both groups were seen before in their own primary schools and had been assigned classroom matched controls at these earlier visits which proved post hoc to control for many confounding variables.

The present study traced as many infants as possible from the two cohorts and visited them again in school surroundings between the ages of 11 and 13. For each child a trace was made for the earlier control and this child was also seen. In cases where the original control had gone to a different senior school, another classroom control was chosen by the school of the same age, sex, race and sometimes primary school and this child was seen with the index child. The original controls, however were also followed up to improve comparison measures and to gain longitudinal data. The details of these cohorts will be discussed fully in the following chapter.

Three main groups of children were therefore assessed at approximately 12 years of age:

1) Index children (VLBW).

2) Controls at the same school (both those seen before and new controls).

3) Previous controls no longer attending the same school as index child.

The present investigation attempts to examine the differences if any between the index group and the two latter groups. For the purpose of this part of the study, the groups will be compared on a number of variables falling into three main categories:

1) Cognitive and Educational

2) Behavioural

3) Emotional

All children also underwent medical assessments including neurological and motor control skills which do not constitute part of this report but which will be referred to where necessary. These assessments are reported in full elsewhere (Powls 1997, MD). In order to gain an encompassing view of the children's progress, the data was collected from 3 groups of people -

* The children themselves

* Their parents

* Their teachers

Most data collected directly concerned the children even when gained from other sources. This study does not aim to examine in detail the teachers or parents own practices or principles.

In addition to comparison analysis between groups, this report will examine intra-group differences; developmental change from 6-12 within the VLBW group; and the differences between index and control groups regarding this developmental change.

The data was collected using three main methods:

1) Standardised assessments

2) Questionnaires

3) Clinical interviews

Again it was felt that this would provide a multifaceted approach to assessment. However no detailed observational techniques such as video recording or time analysis took place regarding children's behaviour.

One central part to the investigation, was the psychological aspect of development. For all the psychological measures the aim was twofold:

1) To obtain comparison measures on raw scores.

2) To obtain frequencies in each group of children meeting clinical criteria for any disorder.

Hypotheses

Three central hypotheses are explicit in this largely exploratory study:

1) That very low birth weight children will show poorer cognitive ability and a higher incidence of psychiatric difficulties compared to peers in early adolescence.

2) That these differences will be mediated by developmental risk factors.

3) That within the VLBW group, impairment will vary and be mediated by perinatal and developmental factors.

Analysis

Analysis was undertaken according to the above hypotheses. For all univariate analyses frequency data was examined using Chi-square comparisons and continuous data using t-test or Mann Whitney U analyses. Multiple regression and logistic regressions were performed using the forward stepwise option where p for entry into the model was 0.05. Correlations were performed using Spearman rank for non-parametric data and Pearson for parametric data. Changes over time or between respondents (e.g, mother & child) were performed using Wilcoxon tests.

Firstly, direct comparisons were made between VLBW children and their peers for each outcome measure and sub-measures in accordance with hypothesis one. Possible related variables such as gender were examined in relation to both groups and their outcome status. Following this, important potential predictive factors were compared to different outcomes both univariately and in multiple analyses (linear or logistic regression for continuous and dichotomous dependent variables respectively). Multiple regressions were intended as an exploratory method in which plausible

predictors were entered in a stepwise manner to determine the central factors related to the outcome. This was felt to have clinical validity since if factors "overlap" significantly, clinicians need only to use the single largest of the factors to predict outcome. Predictive variables were examined in terms of contemporary demographic and related variables, then in relation to possible mediating factors both between groups and within the VLBW group alone.

Relationships between different measures of the same or similar outcomes were compared in relevant chapters and comorbidity is discussed in a separate chapter. Different subgroups of the VLBW population were identified and examined for potential predictors. The relationship between respondents on the same measures and for the same respondent across measures is examined and discussed in terms of outcome validity.

Participants in the study

Very Low Birth Weight Children

In total 137 Very Low Birth weight children participated in the present study. This sample consisted of two previous assessed cohorts. The first cohort were all less than 1250 grams birthweight and were born between January 1980 and July 1981 (no gestation threshold was given for entry into this cohort). The second cohort were all below 1501g birthweight **and** were born before 31 weeks gestation. This cohort were all born between January 1982 and November 1983. Both cohorts only included children who had entered mainstream school.

Comparison Children

Overall, 163 comparison children were also assessed as part of the 12 year study. The majority of these children joined the study at six-years of age. In all cases the teacher suggested a comparison from the same classroom who was the same sex, used the same first language, and was the same age as the VLBW child. All comparison children's parents were asked to complete a preliminary questionnaire reporting birthweight and gestation, and specifying any problems with pregnancy or birth. Any child with a birthweight or gestation below the normal range was excluded as were children who had been treated in a special care baby unit.

The first cohort recruited 53 comparison children at age six years. At the 12 year study, the six year comparison child was invited to participate in all cases. However, where this child was unwilling to take part or was untraceable, the child recruited at eight years was invited to volunteer. In the case of no previously assessed comparison child being available, a new comparison child was again selected from the VLBW class and asked to take part.

All of this cohort and many of the second cohort children were attending secondary or middle schools at the time of the present study. In order to control for educational experience, where the comparison child was now attending a different school to that of the VLBW child, an **additional** comparison child was selected and assessed. (The only exception was if a VLBW had gone to special school. In this case no new control was sought as to select from this special population would automatically bias the control group). Hence for some VLBW children, two matched comparisons exist

- one matched at primary age, and one matched at 12 years of age. This accounts for the larger number of control children.

Since no differences were found between the original (6 or 8 year) and newly recruited comparison groups on any of the demographic variables (see chapter 3), the control group will be treated as one homogenous group throughout the study.

Matching of the VLBW and comparison groups

A number of questions were asked of parents regarding family and socioeconomic status to examine post-hoc matching of the two groups. Firstly maternal and paternal education were reported. Parents were asked to say what qualifications if any they possessed using an open question format. The current investigator then categorised responses as representing minimum education (no qualifications); basic education (O'levels, GCSE's, Btech's, low NVQ's, City and Guilds Certificates, most other vocational qualifications); higher education (A'levels, ONC's, higher NVQ's,) or advanced education (degrees, HND's).

Parents were also asked to report family income. They were given eight bands of income to choose from ranging from less than £2,500 to over £14,300 a year. The bands were expressed as yearly wage, monthly wage and weekly wage to facilitate responses. Although the banding may be a little out of date with salaries mainly falling in the top half of the scale, it was felt that a family income of over £14,000pa represented a satisfactory level of income and that over this it was more difficult to determine the relationship between income and developmental outcome.

Other factors reported by parents were: the number of liveable rooms in the house; the status of the house in terms of council rented, privately rented, owned or mortgaged; the number of children in the family; and the order of birth of children.

Occupational status was asked in the form of describing current or most recent job for each parent. However, the current climate in which people with good educations are unemployed or more misleadingly, taking work which is below their potential lead to this variable being very unreliable as a socio-demographic marker. In addition, the present trend to describe jobs in a vague way (e.g., manager) or in an over descriptive way (e.g., refuse technician) made classification of jobs given into social class groups invalid. Finally, the most recent Standard Occupational Classification (OPCS, 1995) encourages a move away from viewing employment as a hierarchy and suggests that employment areas (e.g., medicine) are more useful and acceptable.

Outcome Measures

Cognitive and Educational Assessments

A set of three standardised objective tests were used in this part of the study and will be discussed in detail below. They covered the areas of cognitive ability, reading and spelling and mathematics skill.

Cognitive ability

This was assessed by means of a standardised IQ test - The Wechsler Intelligence Scale for Children III (Wechsler, 1992). It is designed for a wide age range of 6-16

and has 'sister' tests at either end of this range (WPPSI for under 6's; WAIS for over 16's) making it useful for longitudinal study. It was standardised in the UK using 824 children across all age groups and social classes. In the US standardisation 2200 children were used. The reliability coefficients (split half) are as follows:

Verbal IQ = .95 Performance IQ = .91 Full Scale IQ =.96.

This indicates that the items on any given scale produce results that are highly correlated with each other. The test retest reliabilities are correspondingly high:

Verbal IQ =.94 Performance IQ = .87 Full Scale IQ =.94

Correlations of the test with other measures of cognitive ability are also good suggesting that the WISC III assessment has good criterion related validity, that is it is genuinely measuring the ability usually thought of by others as cognitive skill or intelligence.

Apart from these statistical reassurances, there were several other reasons for choosing this test over others. Firstly it is the most widely used of intelligence tests and has recently been made available in an updated and restandardised version. Other scales such as the British Ability Scales are less used in practice and are not used at all in the United States, whereas the WISC is used internationally.

Secondly and probably more importantly, the Wechsler test is extremely well designed in that it allows the examiner to stop testing after a given number of consecutive failures. This prevents the child from feeling overwhelmed by difficult items and allows him/her to perform optimally.

Finally, the British Ability Scales (BAS) were found to be much less 'child friendly' at this age level comprising more monotonous tasks. It was felt that since the sample in this study may be more predisposed to inattention or hyperactivity, and because the children were being asked to complete several assessments, that it would be most helpful to choose a test which was enjoyable.

Because of time constraints and because IQ testing was not the main focus of the study, (having taken place at 6 years and being expected to remain fairly constant), it was decided that a shortened version of the WISC III should be administered. Whilst there is no official publication material suggesting a short form, as for the BAS, there is general support for a selection of subtests which produce Verbal IQ scores and Performance IQ scores which correlate highly with scores obtained on the whole test (Henderson & Hall 1982; Sattler, 1974). In addition the WISC III manual itself provides individual subtest correlations with Full Scale IQ, (FSIQ) and these are detailed below.

The five (out of ten possible subtests) with the best correlations with overall IQ are as follows:

Similarities	0.85 Corr. with FSIQ	
Vocabulary	0.84 Corr. with FSIQ	} Verbal
Information	0.84 Corr. with FSIQ	
Block Design	0.77 Corr. with FSIQ	} Performance
Object Assembly	0.72 Corr. with FSIQ	

These five tests are those which correlate most highly with the FSIQ using all subtests. The fact that "verbal" IQ would use more subtests was felt to be an advantage, as the verbal scale is more susceptible to "educational" bias and therefore a wider sample of subtests may produce more valid results. IQ scores presented will therefore be referred to as estimates and are used mainly in comparison with my own control data.

A Verbal IQ is calculated from three subscales and the Performance IQ from the two indicated. A Full Scale IQ is then calculated from the Verbal and Performance subscores. The tests are administered individually and take approximately 30 minutes to complete. For each subtest, the examiner presents the item, gives instructions and records performance.

Subtest Details

The 'Information' subtest consists of a series of factual and every day questions ranging from "What must you do to make water boil?" to "Where does aluminium come from?". 'Similarities' involves asking the child in what way a collection of pairs

are alike, for example " How are milk and water alike, How are they the same?". In 'Vocabulary' the child is asked to supply the meaning of various words starting with "Cow" and ranging to "Abberation".

The 'Block Design' subtest involves the child forming red and white blocks into geometric pictures as shown to him/her on a card whilst being timed for speed and the 'Object Assembly' tests the child's ability to put jigsaw type puzzles together to form various pictures such as a girl or a face.

Reading and spelling ability

Reading and spelling skills were both measured using a newly available test called the Wechsler Objective Reading Dimensions (WORD; Wechsler 1993). In this assessment three dimensions are measured:

* Sight reading (Basic Reading) * Reading comprehension * Spelling

The test is a standardised assessment for children between 6 and 16 yrs of age. As with the other Wechsler tests, items are graded allowing the examiner to discontinue assessment before the child gets unduly overwhelmed by items too difficult for him/her.

Previous to this test's publication, it was proving difficult to find a suitable test for study. Many only test sight reading or minimal sentence based comprehension (e.g.,Schonell; Suffolk Reading Scale). In addition some well used tests did not

extend to the age range studied in this examination e.g., Neale analysis of reading.

Another advantage of the test is its up to date material. Many of the passages in the reading comprehension section are relevant to the children being tested, for example, pollution, drink-driving and animal extinction all feature. Being new, it also has recent standardisation. This was carried out in the UK as well as on US samples, using groups of 800 and 4252 respectively, across social classes and ages.

The reliability coefficients (split half) are also high for this test, indicating consistency among items. The values for each subtest is given below, along with test-retest values which are also good:

Basic Reading	0.95 (test retest = 0.94)
Spelling	0.92 (test retest = 0.94)
Reading Comprehension	0.91 (test retest = 0.85)

WORD is reported as correlating highly with other achievement tests such as the Wide Range Achievement Test (WRAT) and Kaufman Test of Educational Achievement (K-TEA) suggesting that it has good criterion related validity.

The assessment is generally very quick, taking between 10 minutes and 20 minutes to administer. It is done individually and the examiner records responses during testing. The Basic Reading test involves reading a list of words aloud one at a time. The spelling involves the child attempting to accurately write down a list of words given

in the context of a sentence. Finally the reading comprehension consists of a series of passages which the child reads (silently or aloud) and on which he/she is then asked a question. Standard scores are produced for each of these subtests and additionally for a "Composite" score of language skill.

One particular feature of the WORD test is that it is designed with IQ comparisons in mind. That is, the manual provides a table of predicted scores for each subtest based on Full Scale IQ as gained from the WISC III. It was therefore possible in this study to calculate a predicted composite score and compare this to the actual observed composite score.

It was thought that this may prove particularly useful in detecting possible dyslexia, underachievement and in reflecting different school policies. Thus a child with an average IQ but a poor reading ability results in a higher predicted WORD score than he/she actually gained. This might then be interpreted as representing a specific learning difficulty, or as a general educational underachievement for whatever reason.

Mathematical ability

The main measure of the child's mathematical ability was through objective written testing. For this the study used The Basic Maths Test published by NFER (1969; see appendix 1). This assessment had been used in a different version for younger children when the children were 8 years of age. It was felt to be particularly useful in this study because it claims to assess mathematical understanding and tests children on conceptual knowledge rather than rote learnt problems thus eliminating effects of

different teaching methods. In addition it was felt to be an advantage to use the same test administered in previous assessments of this cohort for longitudinal purposes.

The test covers the age range 7-15yrs in total and is published in various age band forms. During this study two forms were used, the FG version which is designed for children ranging from 12-15 and the DE version standardised for 10-12 year old children. The test comprises a booklet of 10 pages containing 55 problems which are not graded in order of difficulty. It officially takes approximately 40 minutes to administer but generally took a little longer during this study and the test is not timed. The child completes the test on an individual basis and is allowed to make notes or do written working on the test booklet.

The test is standardised, although it has used relatively small sample sizes for this process and in the older version is based on 3 different studies. The main standardisation took place in 1969 and involved 1579 children across all different school types. Using the results from the standardisation study, however it is possible to gain a standard score making it possible to compare the performance of children of different ages. Since this study uses matched controls and does not intend to use general population norms as comparison criteria, the possible limitations of the standardisation were not thought to present any problems methodologically.

The reliability of the test based on the same 1579 children is reported in the manual as being 0.95 (using Kuder-Richardson Formula 21). Validity of the test is not mentioned in the booklet, however the problems are evidently mathematical in nature

and it is unlikely that the assessment is measuring a different construct from that of mathematical knowledge and understanding.

It has been reported by Graham (1991) that there is no one well used and standardised maths assessment for children. This is borne out in the Basic Maths Test in that it is necessary for children to continue on through questions which they are finding very difficult. Mathematics problems can often confuse or panic children and adults causing lower scores than the individual's actual ability and this test may have elicited this reaction to some extent. However, since there is no reason to suppose that an underestimated result would occur any more frequently in the VLBW group as compared to the control group, this was also felt not to be a problem concerning results. An example page from the Basic Maths Test can be seen in Appendix 1.

Teacher and child ratings

The children's teachers were asked to rate each individual's educational performance in class. A 5 point scale was used representing: "poor", "below average", "average", "above average" and "excellent", and teachers rated for various curriculum areas. These were mathematics, reading, spelling, writing and an overall performance rating. Teachers were also asked whether the child had ever received remedial education. For those children still completing their last primary year, all of the listed curriculum areas were assessed by their classteacher. The data for children in secondary education were provided by the relevant subject teachers, with the form teacher rating overall performance. Children were asked to rate themselves on the

same 5-point scale as the teachers in the areas of reading, writing, spelling, maths and also on physical education.

Emotional and behavioural development

Child and Adolescent Psychiatric Assessment (CAPA)

This is a recently developed interview style research tool by Angold et al (1995) designed to assess a child's psychological state regarding a number of potential problem areas. The format is flexible and sections can be utilised or missed out depending on the study. In the present investigation the following areas were assessed:

* Hyperactivity/Attention-deficit disorder * Generalised anxiety * Separation anxiety * Depression * Conduct disorder * Oppositional disorder * Eating disorders * Sleeping disorders * Social behaviour * Family factors

Both a parent and a child version of the CAPA are available, but for this study only the parent interview was used. This was partly due to my interest in hyperactivity and attention-deficit both of which are difficult areas of self report for children and are therefore not included in the children's version. Time restraints also meant that it was not viable to complete both a parent and a child interview. All CAPA 's were done as home visits and one or both parents were interviewed without children being present. In most cases the mother was the main respondent, however in a number of interviews fathers were available due to unemployment whilst mothers were working and so were fulfilling the main caregiving role. In two cases carers other than the

child's parents were interviewed but in both cases they were the most appropriate attachment figure.

The CAPA has several advantages over its similar counterpart the Diagnostic Interview Schedule for children - revised (DISC-R). In the latter, the interview follows the schedule and codes responses under set criteria. Whilst the CAPA also provides criteria for coding the presence of certain symptoms, the interview relies more on clinical judgement and often asks for behavioural examples of the child in various symptom provoking scenarios. Taking into account all the information given by the parent, the age and developmental level of the child, as well as the style of the parent themselves, the interviewer makes a judgement as to whether the child meets the given criteria. The interview is semi-structured and includes 'screening questions' and 'skip rules' which allow the interviewer to miss out time consuming questioning in an area which has already been established as irrelevant to that child. It is designed to ask questions based on the DSMIV and ICD 10 diagnoses allowing easy categorisation of data. This study will provide additional detail on its validity using self report questionnaires as the criterion. A detailed description of the development, format and appropriate use of the CAPA interview has recently been published by its authors (Angold et al 1995a).

The CAPA tool has been used in large prevalence studies in the United states and has also been piloted in the UK. In the first published reliability study, the CAPA interview produced diagnosis reliability levels ranging from 0.55 for conduct disorder to 1.0 for substance abuse (Angold and Costello, 1995).

I was given comprehensive training in the technique by the Institute of Child Psychiatry, London and already have a good knowledge of normal age appropriate behaviour to use as a context for discussion of problem areas. In addition, Angold and colleagues (1995a) report that they have found both clinically trained individuals and lay-people to be good CAPA interviewers. Table 1 below indicates the areas examined in the CAPA interview in this investigation. As mentioned above, some questions are asked to all participants and these are described as "screening questions" and marked with an asterisk. The table provides the relevant DSM match where applicable in order to guide the reader as to which items were used in assigning "clinical" labels.

In this study, a child was classified as having a disorder using only those CAPA items which match DSMIV items. Thus Attention Deficit disorder was deemed present if 4 out of 5 DSM-matched symptoms in the attention deficit section were reported, Hyperactivity disorder if 5 of the eight Hyperactivity/Impulsivity symptoms which matched a DSM equivalent were present. Children were deemed to have Attention deficit hyperactivity disorder if they met criteria for both Attention deficit and Hyperactivity. This was felt to appropriately approximate DSM criteria (Simonoff, personal communication). Children were also categorised as to whether they showed any one of these three disorders and these children will subsequently be referred to as the ADHD group. Behaviours were required to occur during at least two separate activities and age of onset as reported by parents was required to be earlier than 7 years of age.

Children were deemed to meet clinical criteria for major depression if they met 5 of the 9 CAPA items which matched DSM criteria. Generalised anxiety disorder was defined by presence of worries, more days than not for at least 6 months and presence of 2 out of the 5 remaining anxiety items which matched DSM criteria. Conduct disorder and oppositional disorder were determined by 3 out of 14, and 4 out of 7 DSM-matched CAPA items respectively.

Behaviours for all disorders were required to be uncontrollable at least some of the time, and to cause some functional impairment (for example: a serious interference with schoolwork; serious interruption of social relationships through discord or withdrawal).

Table 1: CAPA items (DSM equivalents) - * Indicates a 'screening' question

i) Hyperactivity	
*Fidgets uncontrollably	*(Often fidgets with hands or feet or squirms in seat)*
*Cannot remain seated for more than a few minutes	*(Often leaves seat in classroom or in other situations in which remaining seated is expected)*
Rushes around/ is always on the go	*(Often runs about or climbs excessively; Often on the go or acts as if driven by a motor)*
Talks excessively	*(Often talks excessively)*
Has difficulty doing things quietly	*(Often has difficulty playing or engaging in leisure activities quietly)*

Impulsivity

*Often acts before thinking

*Has difficulty waiting for turn in games or group situations — *(Often has difficulty awaiting turn)*

Frequent calling out inappropriately in class

Often blurts out answers to questions — *(Often blurts out answers before questions have been completed)*

Often engages in physically dangerous activities

Often interrupts or intrudes on others — *(Often interrupts/ intrudes on others)*

Inattention

*Has difficulty concentrating on tasks requiring attention	*(Often has difficulty sustaining attention in work or play activities)*
*Has difficulty following instructions	*(Often does not follow through on instructions and fails to finish school work etc.)*
Often doesn't seem to listen to what is being said to him/her	*(Often does not seem to listen when spoken to directly)*
Easily distracted by extraneous stimuli	*(Often easily distracted by extraneous stimuli)*
Fails to pay close attention to detail in school or other work	*(Often fails to give close attention to details in school work or other activities)*
Often shifts from one uncompleted activity to another	

iii) Depression

*Depressed Mood **or** * Irritability (more days than not)	*(depressed mood)*
* Feels unloved	
*Anhedonia **or** *Loss of interest in life (more days than not)	*(markedly diminished interest or pleasure in all activities)*
*Self-depreciation **or** Pathological guilt / Delusions of guilt	*(feelings of worthlessness or excessive or inappropriate guilt)*
* Suicidal behaviour (any of items below) Thinking about death Suicidal thoughts Suicidal plans Non-suicidal self harm Suicidal attempts	*(recurrent thoughts of death/suicidal ideation)*
Anergia	*(fatigue or loss of energy)*
Inefficient thinking / Indecisiveness	*(diminished ability to think or indecisiveness)*

Subjective motor slowing/ subjective motor agitation	*(psychomotor agitation or retardation)*
Distinct quality of depressed mood	
Hopelessness	
Helplessness	
Loss of affect	
Loneliness	
Looks unhappy	
Alleviation of depression	
Diurnal variation in depressed mood	
Tearfulness	
Boredom	
Feels sorry for oneself	
Ideas of reference	
Slowed thoughts / Rushing thoughts	
* Reduced weight	*(significant weight loss or gain)*
*Insomnia **or** *hypersomnia	*(insomnia or hypersomnia)*

iii) Generalised Anxiety

*Worries (more days than not)	*(Excessive anxiety and worry)*
Worries about future events	
Worries about past events	
Worries about own competence	
Excessive need for reassurance	
*Nervous tension (more days than not)	*(Muscle tension)*
*Anxious foreboding (more days than not)	
*Subjective anxious affect	*(Feeling keyed up or on edge)*
*Irritability	*(Irritability)*
*Insomnia	*(Sleep disturbance)*
*Difficulty concentrating	*(Difficulty concentrating)*

iv) Separation anxiety

*Separation anxiety (any one of items below)

Worries about harm to parent	*(Persistent and excessive worry about losing or about possible harm befalling major attachment figures)*
Worries about calamitous separation	*(Persistent and excessive worry that an untoward event will lead to separation from a major attachment figure)*
Reluctance to sleep alone **or** Avoidance of sleeping away from home	*(Persistent reluctance or refusal to sleep without being near a major attachment figure or to sleep away from home)*
Separation dreams	*(Repeated nightmares involving the theme of separation)*
Avoidance of being alone	*(Persistently and excessively fearful or reluctant to be alone)*
Distress when parent absent **or** Distress when absence is anticipated	*(Recurrent excessive distress when separation from home or major attachment figures occurs or is anticipated)*

v) Conduct/oppositional behaviours

Conduct -

*Extortion	*(Often bullies or threatens)*
*Sexual extortion	*(Has forced someone into sexual activity)*
*Fights - frequent and initiated	*(Often initiates physical fights)*
*Use of weapon in fights	*(Has used a weapon that could cause serious harm)*
*Assault and cruelty	*(Has been physically cruel to people)*
*Cruelty to animals	*(Has been physically cruel to animals)*
Stealing involving confrontation	*(Has stolen while confronting a victim)*
*Firesetting	*(Has deliberately engaged in fire setting)*
*Vandalism	*(Has deliberately destroyed others' property)*
*Stealing; Shoplifting	*(Has stolen things of non-trivial value)*

*Often lies **or** *Often cheats **or** *Forgery	*(Often lies to obtain goods or favours or to avoid obligation)*
*Has run away from home overnight at least twice	*(Running away with deliberate intent)*
*Truancy	*(Is often truant from school)*
*Police contact	
Breaking and entering **or** stealing vehicle	*(Has broken into someone else's house, building or car)*

Oppositional-

*Often loses temper	*(Often loses temper)*
*Rule breaking **or** *disobedience	*(Often actively defies or refuses to comply with adults' requests or rules)*
*Often deliberately annoys people	*(Often deliberately annoys people)*
*Lying to blame others	*(Often blames others)*
*Irritability	*(Often touchy or easily annoyed)*
*Angry and resentful	*(Often Angry and resentful)*
*Spiteful/ vindictive **or** Letter writing or telephone calls of a vindictive nature	*(Often Spiteful or vindictive)*
*Swearing	

vi) Eating and sleeping difficulties

*Insomnia - Initial falling asleep/ nightwaking/Early waking

*Hypersomnia - falling asleep in the daytime

*Sleepwalking

*Nightmares

* Night terrors

*Bedwetting

* Excessive appetite

* Unusual loss of appetite

* Excessive weight loss or weight gain

* Food fads

* Constipation

*Anorexic type behaviour

-Body image problems

-Amenhorrea

-Attempts to vomit, take laxatives
or excessively exercise

* Bulimic type behaviour

-Excessive, uncontrollable binges

-Guilt or depression after binge

-Secret eating

-Attempts to vomit, take laxatives
or excessively exercise after binge

vii) Social behaviour-

* Difficulty making friends

* Does not have a 'best friend'

* Does not have a friend who is a confidante

* Shows indiscriminate social behaviour towards adults

* Shows indiscriminate social behaviour towards other children

* Shows a lack of empathy towards others

* Is a regular target of bullying

viii) Parent factors

* No positive activities with parents

* Parent - child communication is poor

* Child does not use parent as confidante

* Inappropriate level of parental supervision

* Inappropriate level of parental involvement

* Overly harsh discipline

*Selectively negative parental view of child

* Parental dissatisfaction with partner

* Lack of parental communication between partners

* Excessive parental discord.

* Parents have sought psychological help

These parent factors were scored 2 for presence and 0 for absence and then summed to create a "parental index score".

Psychological Questionnaires

Child Manifest Anxiety Scale- R (CMAS-R)

This is a tick box measure designed by Reynolds and Richmond (1978) which was completed by parents about their children and by the children themselves (see Appendix 2). It comprises 28 items regarding possible anxious feelings the child may have experienced over the preceding three months. The respondent simply chooses "no" or "yes". Scores are summed and compared between groups. No subscale analysis was performed. Only the Anxiety Scale items used to score the CMAS-R were presented to the children. Lie items were not included in this version following advice from clinicians (Simonoff, personal communication).

Fear Survey schedule for Children - Revised (FSSC-R)

This second questionnaire was designed by Ollendick (1983). It consists of 39 items, and respondents can choose whether the child is "not scared", "a little scared" or "very scared" of a wide range of potentially frightening objects and events. For the last two items, choices were subheaded "No panic reaction or avoidance" and "Panic reaction or avoidance" respectively and these concepts were explained to the children immediately prior to completing the schedule (see Appendix 2). The scale has been described as both reliable and valid (Ollendick 1983).

Mood and feelings Questionnaire

All children completed the Mood and Feelings Questionnaire (MFQ). This is a 28 item tick box measure developed by Costello and Angold (1988). The questionnaire asks children to rate whether in preceding months they have "never", "sometimes" or " nearly always" experienced a thought or feeling. Examples of items are " I felt grumpy and irritable with my parents", "I thought my family would be better off without me", "I felt like killing myself" and "I thought that everything I did was wrong". The full version can be found in Appendix 2. This questionnaire was adapted for parents to complete regarding their children. This version was identical to the self-report MFQ except that in this version items read "He/she often feels lonely" etc. For both the versions "0" was given for "never", "1" for sometimes, and "2" for "nearly always. Scores were then summed to give an overall "depression score", where high scores represent depressed mood.

Self-Esteem scale

A self-esteem scale was also completed by the children. This consisted of an eight item scale which was originally based on Rosenberg's self esteem questionnaire (1965), but which had been subsequently adapted by Warr and Jackson (1982). In this scale, respondents are required to decide how accurate each of the eight statements are for them. Examples are " When I do something I do it well" and "I feel I'm not really getting anywhere with my life". This is done using a five point scale ranging from "not at all true" to "very true". Some items are positive and others negative but "0" is given for the most favourable response and 4 for the least favourable. These item scores are then summated to give a self-esteem score which

is higher if self-esteem is low. Again, a version of this measure was administered to parents about their children in the form "He/she..." (see Appendix 2).

For all questionnaires, child versions were read out aloud to participants to avoid any reading difficulties. Explanations were given for any word misunderstandings, but no further interpretation of questions was given, in order to avoid bias. The alternating positive/negative nature of items on the self-esteem scale was pointed out to children before completion to avoid errors. All but 1 (0.7%) VLBW child and 1 (0.6%) comparison child completed questionnaires. These two children's families refused completion of the questionnaire by their children because they felt they were too young to be confronted with questions about depressed mood and in particular, suicidal feelings.

Parent questionnaires were administered by post and "chased up" at the home interview appointment. In total all but 10 (7.2%) for VLBW children and 13 (8%) for comparison children were returned fully completed.

Connors scale

Teachers also completed the short scale version of the Connor's hyperactivity scale consisting of ten behavioural items regarding behaviours in the classroom (Connors, 1969).

Rutter Behavioural Questionnaires

Designed by Rutter (1967), these behaviour questionnaires have become a recognised and well used measure for assessing general behaviour patterns in children aged between 7 and 13 years. There are two slightly different versions, one for completion by the child's parent (A2), which has 32 items, the other for completion by the child's teacher (B2) which consists of 26 items in total, 18 of which are identical to the questions in the behaviour section of the parents scale (see Appendix 2).

Respondents are asked to tick whether the behaviour "does not apply", "applies somewhat" or "certainly applies" to the child in question. Responses are scored 0, 1 and 2 and are totalled. Both versions have been established as reliable (test-retest, parent=0.74 ; teacher=0.89) and they are also clinically valid with agreement between clinical definition and questionnaire cut-off score being around 80% (Rutter, 1967). Both the parent and teacher schedules were used previously with this cohort of children and was therefore issued again for longitudinal data as well as general screening purposes. It also provides an indication of severe behavioural difficulties using threshold scores of 13 for the parent questionnaire and 9 for the teacher version. Additionally the scales indicate whether the problems are largely emotional or anti-social in nature. This is done only for those children scoring over the threshold and is calculated by adding scores on a number of key emotional and key anti-social items and noting the higher of the two.

Both scales are designed for the age range 7-13. Whilst the scale was developed some time ago, the Institute of Child Psychiatry are constantly updating it, and the present

investigation used updates completed in the year of testing the first children in this study (1993). The children in the present study were at the upper end of the range of ages for which the scale was designed. Nevertheless, the items have proved relevant and discriminative for both cohorts. The item referring to asthma attacks has been reported as failing to be a significant discriminator of behaviour for girls. This may be because asthma is a highly frequent problem in childhood. Because asthma is now known to manifest often as persistent night cough, a question asking parents about this health problem was added by the present author to ensure that undiagnosed or unrecognised asthma was recorded.

The Child Behaviour Checklist (Achenbach, 1987) would have provided an alternative measure but the importance of longitudinal data in this study meant that it was not the test of choice. In addition, the items focus on many more normative trends of behaviour, some of which are dependent on age at testing.

Behaviour and Activities Checklist

Another tick box measure designed by Olweus (1989) to assess the level of anti-social behaviour using 35 behavioural items ranging from 'being late for school' to 'breaking and entering houses'. Respondents are asked for each item to say whether the child has behaved in this way "never", "recently, in the last 3 months" or "before the last 3 months"(see Appendix 2). Items are then scored 0, 1 and 2 respectively and summed. This questionnaire was completed by parents and by the children themselves. Confidentiality from parents, teachers and police was promised to the children and questionnaire forms did not bear the child's name.

Other areas of assessment

Soft Signs

From the entire battery of neurological tests which are reported fully elsewhere (Powls 1997, MD), a small selection used by Shaffer and colleagues (1985) in their paper regarding psychological outcome were combined to create a "soft sign index score". This was achieved by scoring the presence of a soft sign as "1" or for a few as "1" for mild and "2" for marked and then summing these values. Children with more soft signs therefore scored higher using this index. The signs used in this index were as follows: inability to perform diadochokinesis (rapid hand turning movements); astereognosis (failure to identify objects by touch alone); dysgraphesthesia (failure to identify shapes traced onto the palm of the hand); inaccuracy on finger-nose touching; tremor ; and mirror movements during diadochokinesis.

Parental consent and general testing considerations

Ethical permission for this project was granted by the local Paediatric Research Ethics Committee based at Alder Hey Hospital under the chairmanship of Dr. Campbell Davidson. Before participating in the study, all families were traced and were sent letters inviting them to participate. Informed written consent was gained from all parents whose children took part in the study as well as all schools who helped with the research.

Families and schools were reassured that information gathered in the study would only be for the purpose of this research and training, and that no individual, child,

family or school would be identifiable in final reports. Parents were also informed that details about their incomes houses and other demographic information would not be given to other agencies. Parents were informed of children's results if they requested information about the testing and teachers were informed if they requested **and** if parents agreed. Children were informed prior to completion of psychological questionnaires that the content of these would be confidential from their parents, teachers and from the police. This was because the scales included some questions about illegal acts, rule breaking, smoking and also about emotions and behaviours which children of the age concerned may wish to be private. By doing this it was felt that a high level of honesty and accuracy was gained from the children themselves.

The majority of children were assessed individually in school but out of class. Seven VLBW children and eight controls were assessed out of school after parents or schools expressed a wish for the testing to be completed outside the school environment. Testing took around 3 hours with a normal school break. The mathematics test and psychological questionnaires were read out to all children in order to eliminate any biases in reading ability as much as possible.

Where the child was felt to be experiencing severe psychological difficulties, it was suggested to the parent that help might be warranted. In these cases, parents were nearly always aware of the problem and requested information about how to access appropriate health care professionals. I did not however personally refer children to other agencies or attempt to supply a clinical opinion of children's difficulties.

RESULTS

The details of cohort follow up at this age and demographic characteristics of the sample are given first. Following this, the results of other outcomes will each be presented individually. For psychiatric outcome, a separate chapter is included presenting co-morbidity data.

Cohort details

VLBW children

In the first cohort, there were 76 survivors born between the dates given above, 4 of these children died after discharge from the NICU and a further 14 had significant neurodevelopmental handicap such that they were unable to attend mainstream school. Of the 58 remaining, 2 children were found to have significant motor disabilities and were excluded from the study leaving an "eligible population" of 56 children. See table 2 for eligible cohort. A further 3 families refused to be enrolled in the study and thus 53 children (95%) were seen at six years (Marlow et al 1989). Of these 53 children, 52 (98%; 93% of eligible population) were also assessed at 8 years of age (Marlow et al 1993) the one child having emigrated. Forty-eight children (92% of eight year sample; 91% of six year sample) were seen and assessed at the current stage of follow-up. In total therefore, 86% of the first cohort eligible population participated in the current study. Two of those who participated at eight but not at twelve had emigrated, and two refused further follow-up.

In the second cohort, there were 127 survivors of which 12 had significant neurodevelopmental disability leaving an "eligible population" of 115 (see table 2). A further 8 families refused to be enrolled and 14 were untraced. These children did not differ for birthweight, gestation or on any adverse perinatal events from the available cohort. In total therefore 93 children (81% of eligible population) were traced and assessed at six years of age. 90 of those seen at 6 were assessed in early adolescence and therefore represent 97% of those seen at six years old and 78% of the eligible population. All of the three families who took part at 6 years but not at 12 years, refused further assessment.

138 children were seen at 12 out of an eligible cohort of 171 (80%) and represent 96% of those who had been assessed at six years of age. Seventy VLBW children were boys and 68 were girls. Mean age at examination was 142 months (range:132-163). Details of age and gender by cohort are shown in Table 3. Three VLBW children showed signs of mild cerebral palsy. However all were fully integrated in to mainstream school and their results are included for most assessments (except where mentioned).

As one would expect considering the different inclusion criteria for each cohort, the second group have a heavier mean birthweight (1139g) than the first group (1036g) and this was significantly different at $p<0.01$. However the groups showed a similar mean gestation (28.5 and 28.4 weeks respectively.) The overall mean birthweight was 1104g and mean gestation was 28.4 weeks. In addition there were proportionately more female survivors in the second cohort (52/90) than in the first (17/47).

Table 2: Details of the eligible study cohort

	Cohort 1	Cohort 2	Whole cohort
VLBW babies admitted to SCBU	161	310	471
Babies surviving until discharge	76	127	203
Children surviving to 6 years	72	127	199
Children attending mainstream school	56	115	171
Families available & willing at 6yrs	53	93	146
Families available & willing at 12yrs	48	90	138

The two separate cohorts are essentially very similar as regards other perinatal characteristics. There are a few small differences. The second cohort were significantly more likely to have had mothers who received ante-natal steroids (12/46 vs. 46/90; $p<0.01$). This represents a change in medical care policy over the years in which the sample was born. This latter sample were less likely to have experienced respiratory distress syndrome ($p<0.05$), had improved 1 minute Apgar scores ($p=0.05$) and fewer were diagnosed as having surfactant deficient lung disease ($p<0.05$). The two cohorts are considered as one throughout the study.

Comparison children

In total 40 (74%) of the originally recruited first cohort controls took part at 12 years of age. The second cohort had only previously been assessed at six at which time 93 control children were recruited. The original control child was invited to participate at the twelve year study and 68 (73%) of the second cohort controls were assessed again at 12 years.

Overall 25 (18%) of VLBW children had two matched comparisons, one from aged 6 (now at a different school) and one from the current stage and school. One child had no comparison at 12. In this case, the original child refused to participate and the VLBW child was attending special school at the time of the study so a new comparison would not have been appropriate. In total 105 (64%) were six-year controls, 4 (2.5%) were eight year controls and 54 (33%) were new controls.

Matching of the VLBW and comparison groups

On post hoc analysis the VLBW group and the comparison children were well matched. Not surprisingly, there were no differences found on age at examination or numbers of girls and boys since these variables were matched a priori (table 3).

Table 3: Details of study sample age & gender

	1st cohort	2nd cohort	Entire cohort
	age (months) at examination		
VLBW	153 (147-163)	137 (132-149)	142 (132-163)
Comparisons	154 (145-164)	137 (130-149)	143(130-164)
	p=0.8	p=0.95	p=0.89
	gender		
VLBW	19 boys / 29 girls	51 boys / 39 girls	70 boys / 68 girls
Comparisons	24 boys / 36 girls	58 boys / 45 girls	82 boys / 81 girls
	p=0.96	p=0.96	p=0.94

There were also no differences found regarding socio-economic status. This was assessed via parental report on a number of key areas as described in chapter 2. Firstly, there were no significant differences in the levels of education between the VLBW and comparison groups for mothers or fathers. Table 4 below shows the distribution of education in both groups, with the majority of participating parents having no formal qualifications.

Table 4: Parental education levels

Maternal Education

	No qualifications	Basic qualifications	Higher education	Advanced education
VLBW mothers	90/129 (70%)	12/129 (9%)	21/129 (16%)	6/129 (5%)
Comp. mothers	90/151 (59%)	15/151 (10%)	30/151 (20%)	16/151 (11%)

Paternal Education

	No qualifications	Basic qualifications	Higher education	Advanced education
VLBW fathers	76/129 (59%)	23/129 (18%)	23/129 (18%)	7/129 (5%)
Comp. fathers	78/150 (52%)	28/150 (19%)	24/150 (16%)	20/150 (13%)

Again there were no differences between control children and VLBW children on family income. The banding sheet given to parents can be seen in Appendix 2. Fig. 1 below shows that the majority of families in both VLBW and comparison study samples were earning more than £14,300 and the samples were therefore not families who were severely disadvantaged financially.

The housing related variables also showed no difference across the two groups with both groups largely living in owned or mortgaged accommodation (66% VLBW and 69% comparison) and the median number of living rooms being 5 for both VLBW families and comparison families (a three bedroomed, two reception room house would fit this criteria). However VLBW children were found to be significantly more likely to be first born children ($p<0.001$) and were also more likely to be only children ($p<0.01$). There were no differences on the ages of the children's mothers in both groups or the numbers of children living with two, one or neither natural parent with most children in both groups living with both natural parents. Table 5 summarises these family data in three parts. There was also no differences between groups on the parenting index score (described in chapter 2).

Fig1: Distribution of income level in VLBW and comparison groups.

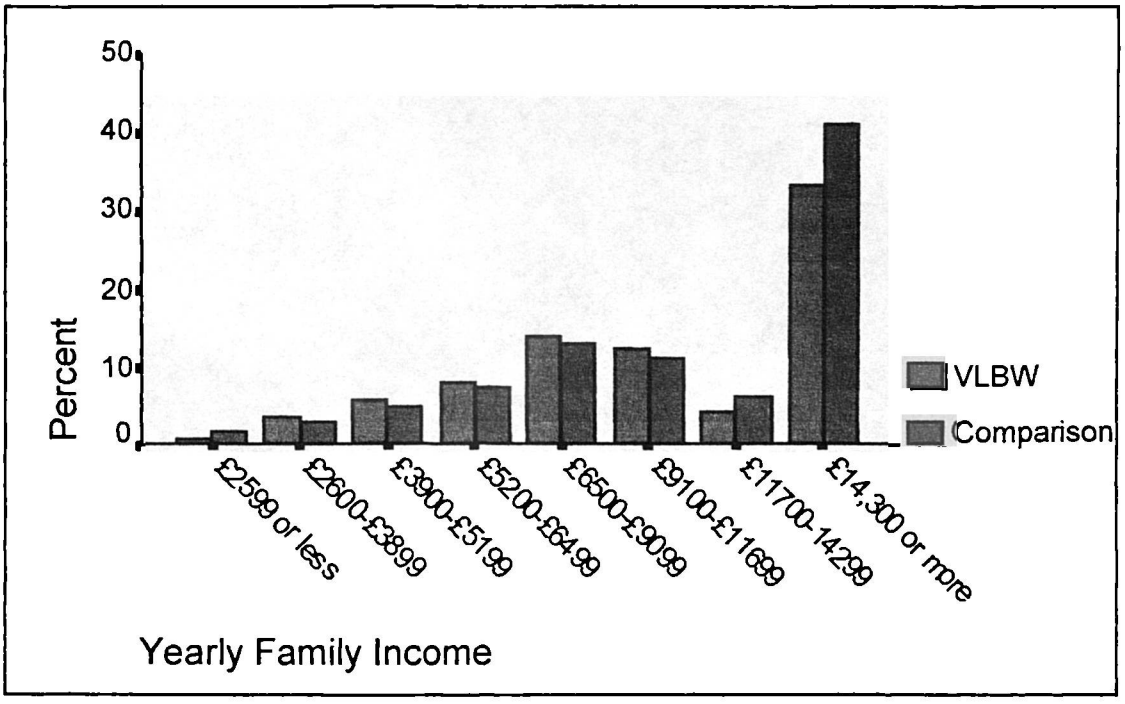


Table 5: Family variables for both groups

i) **Parenting arrangements**

	Both natural parents	One natural parent *	Neither natural parent
VLBW families	91/129 (71%)	34/129 (26%)	4/129 (3%)
Comparison families	116/151 (77%)	35/151 (23%)	0/129 (0%)

*(with or without step parent)

ii) **Birth position in family**

	1st	2nd	3rd	4th or later
VLBW families	81/129 (63%)	26/129 (20%)	17/129 (13%)	5/129 (4%)
Comparison families	64/151 (42%)	64/151 (42%)	19/151 (13%)	4/151 (3%)

iii) **Number of siblings**

	None	1	2	3	4 or more
VLBW families	28/129 (22%)	48/129 (37%)	31/129 (24%)	20/129 (16%)	2/129 (1%)
Comparison families	12/151 (8%)	68/151 (45%)	64/151 (32%)	15/151 (10%)	8/151 (5%)

Table 6 below shows a summary of demographic variables across both groups. As can be seen from this, whilst no individual variables show differences, the least favourable situations are always slightly increased in frequency in the VLBW group. This may lead to a more subtle, cumulative disadvantage for these children.

Table 6: Summary demographic and family data for both groups

	Poor paternal education	Poor maternal education	Not living with both birth parents	Council Rented Housing	Family Income <£14,500	No siblings	First born
VLBW	76/129 (59%)	90/129 (70%)	38/129 (29%)	44/129 (34%)	67/113 (60%)	28/129 (22%)	81/129 (63%)
Comp.	78/150 (52%)	90/151 (59%)	35/151 (23%)	47/151 (31%)	77/144 (53%)	12/151 (8%)	64/151 (42%)

Numbers vary as some participants did not wish to answer some questions

Educational experience

The two groups were matched as closely as possible for educational experience as described above. At the time of assessment 99 (72%) VLBW children were at secondary, middle or high schools. The remaining 38 (28%) VLBW children were at primary school in their final junior year. The proportions are of course identical for comparison children. Therefore 118 (72%) control children were at secondary and 45 (28%) were still in primary schools. Four VLBW children (3%) and none of the comparison children were attending special schools at the time of the study. However, one comparison child who refused participation was also receiving special education.

Soft sign index

As described earlier, as soft sign index was devised for each child. As a group, VLBW children had significantly higher scores (median=3, IQR=3 to 4.5) on this measure than

comparison children (median=3, IQR=2 to 3.5; $p<0.001$). Although this finding shows considerable overlap between the groups and is not strictly part of psychological or educational outcome, it has been included because of its possible role as a mediating factor or marker for other outcomes and is used as such in later analyses.

Head circumference

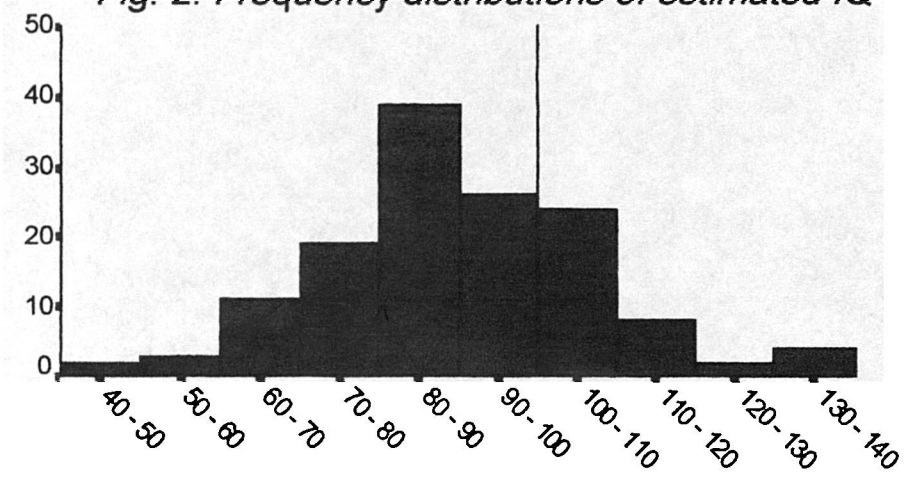
As for soft signs, this measure is strictly a medical finding. However, the relationship between head circumference and cognitive and psychiatric outcome is of interest and this factor is analysed in relation to these outcomes in later chapters. VLBW children as a group were found to have smaller head circumferences (median=53.6cm, IQR=53.2 to 53.7) than their peers (median=54.2cm, IQR=54.1 to 54.6).

Cognitive and Educational Outcome

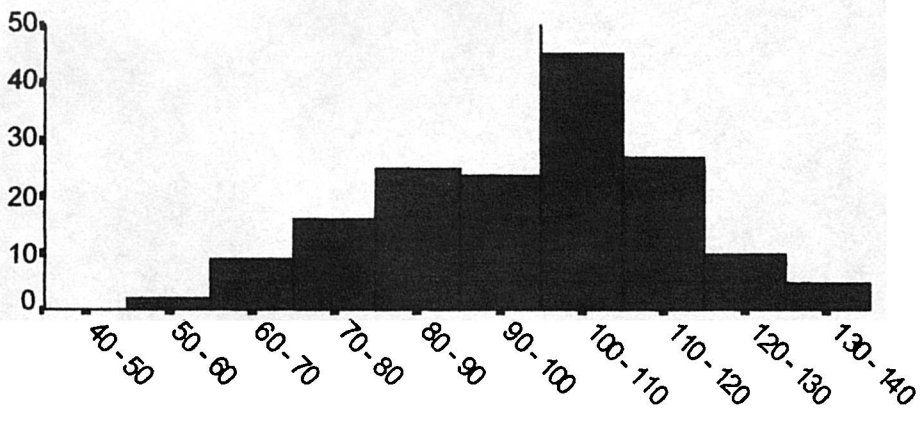
Cognitive Ability

VLBW children were found to have a lower IQ score (mean 89.7; sd=17.2) compared to that of their peers whose mean IQ was 97.8 (sd=17.4 ; $p<0.0001$) . Fig. 2 shows the distributions of IQ scores for both groups in relation to the normative population mean score of 100 points.

Fig. 2: Frequency distributions of estimated IQ



Estimated Full Scale IQ VLBW children



Estimated Full Scale IQ comparison children

The mean difference between the two groups was approximately 8 points (95% CI : 4 to 11.9), which is an important difference in cognitive ability. When the IQ scores were broken down into their respective performance and verbal quotients, (see table 7) the difference in full scale scores was mainly due to poorer performance IQ scores in the VLBW group with a mean difference of 10 (95% CI : +14.5 to +5.6) IQ points. Although estimated verbal IQ was also lower, the difference was not as great (4.5 IQ points; 95% CI : +8.4 to +0.8) and not all of the differences in verbal subtest scores were statistically significant. VLBW children had significantly lower scores than their peers in all subtests except Information (see table 7).

Table 7: Cognitive outcome

	VLBW mean score (n=137)	**Control mean score** (n=163)	**Mean Difference (95% CI)**
Block design	8.2	9.8	-1.6 (-2.3 to -0.9)**
Object assembly	7.8	9.2	-1.3 (-2.1 to -0.6)**
Information	9.5	9.8	-0.3 (-1.1 to 0.4)
Similarities	8.8	9.9	-1.1 (-1.8 to -0.8)*
Vocabulary	8.5	9.4	-0.9 (-1.7 to -0.1)*
Est. Performance IQ	87.3	97.3	-10.0 (-14.5 to -5.6)**
Estimated Verbal IQ	94.0	98.6	-4.6 (-8.4 to -0.8)+
Est. Full Scale IQ	89.8	97.8	-8.0 (-11.9 to -4.0)**

+<0.05 *<0.01 **<0.001

Seventeen out of 121 (12%) VLBW children and 12/163 (7%) control children had scores below 70 ($\chi^2(1) = 2.1$, $p=0.15$). This is the usual threshold for describing a child as having moderate learning difficulties.

Cognitive development over time: VLBW children compared to peers.

Full scale IQ scores were then analysed in relation to those recorded at six years of age, to assess whether any significant changes had occurred or indeed whether VLBW and comparison children had changed to different degrees. Both cohorts showed a significant drop in mean IQ scores from 108 (17.8) to 90 (17.2) for the VLBW group and from 113 (22.7) to 97 (17.4) for their peers. This is a difference of 18 and 16 points respectively. When these data were entered into a repeated measures design ANOVA analysis with IQ at both 6 and 12 as the within factor and VLBW or comparison as a between groups factor, no significant interaction was evident between group and assessment time. That is, on average both groups fell in IQ points to approximately the same degree.

On closer analysis, the number of children in both groups who were in the normal range at 6, but who fell below 85 (1sd from the norm mean) were examined. In the VLBW group a total of 50/135 (37%) children for whom both scores were available had scored less well in this way. In the comparison group, 26/100 (26%) children for whom 6 and 12 year IQ's were recorded had fallen out of the normal range. This difference in the proportions of children moving out of the normal IQ range fell just short of significance ($\chi^2(1) = 3.2$; $p=0.07$).

No children in the VLBW group moved from outside the normal range at 6 to within 1sd at 12. Equally no VLBW children moved from the normal range into the above average range, over 115 IQ points (1sd above the norm mean). In the comparison group, one child had moved to within 1sd of the mean from outside this range and 2 children scored above 115 points at 12 years following normal range scores at 6 years of age. It appears therefore that rather than an increase in scores for the VLBW group, representing some form of "catch up" effect in terms of cognitive ability, the opposite is occurring and there is a trend for the gap to widen as the children become older.

Using control group IQ scores a standard deviation score was calculated for VLBW children at each age. Figs. 3 and 4 show the number of VLBW children falling into each sd category at each age. As can be seen, at age 12, a much larger percentage of VLBW children fall below the control mean than at age 6, with a particular increase in the group between 1 and 2 sd below the comparison mean.

Fig.3 : VLBW children falling in each IQ standard deviation category at 6 years

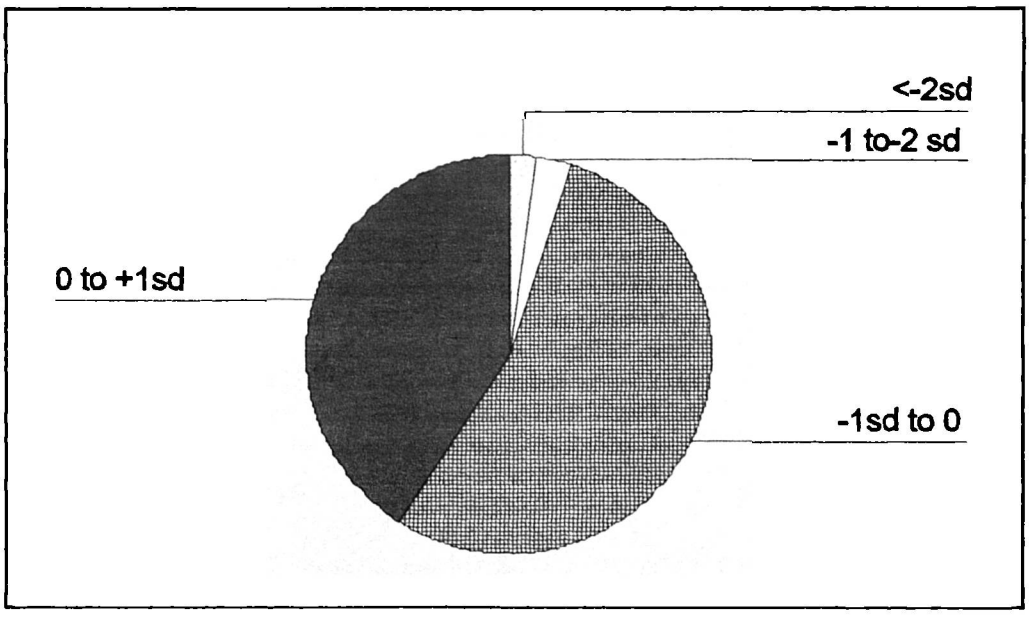
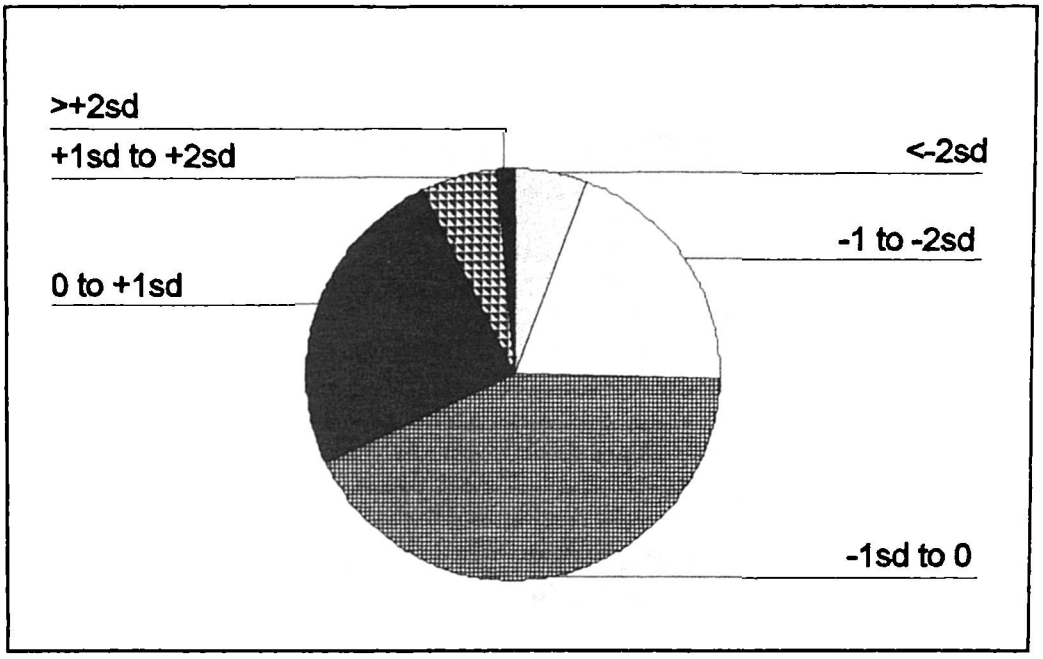


Fig.4: VLBW children falling in each IQ standard deviation category at 12 years



Educational attainment

Objective measures

VLBW children performed less well than their peers in all areas of educational skill tested (see table 8), mean differences in standardised scores ranging from 4.2 to 7.1 points lower. Some of these differences may be a consequence of lower IQ in the VLBW group. After allowing for IQ differences (ANCOVA) reading comprehension score ($F(1) = 4.7$; $p<0.05$) and Basic Maths score ($F(1)=18.4$; $p<0.001$) remained poorer in the VLBW group. A discrepancy analysis was possible for the WORD assessment as described earlier in this chapter allowing examination of the numbers of children who were poorer at reading and spelling than expected from IQ. The VLBW and comparison groups did not differ on the average discrepancy between expected and obtained reading scores.

Table 8: Educational outcome (before adjusting for IQ)

	VLBW (n=138)	**Control** (n=163)	**Mean Difference (95% CI)**
Sight reading	97.3	101.7	-4.4 (-7.2 to -1.5)*
Reading comp.	87.7	93.1	-5.3 (-8.0 to- -2.8)**
Spelling	93.9	98.1	-4.2 (-7.6 to -0.8)+
Overall WORD score	91.4	96.9	-5.5 (-8.7 to -2.4)*
Maths score	96.3	103.4	-7.1 (-9.5 to -4.7)**

+<0.05 *<0.01 **<0.001

Teacher and child ratings

The teacher assessments rated VLBW children as performing less well than their peers in the classroom (see table 9). VLBW children rated themselves significantly poorer at P.E. ($\chi^2(4)=14.3$; $p<0.01$) and maths ($\chi^2(4)= 11.6$; $p<0.05$). However, they did not rate themselves as significantly worse than peers on spelling, reading, or writing (see table 9). Since mathematical ability and motor skills are the most pronounced difficulties experienced by these VLBW children (Marlow et al 1989; Powls et al 1995) it is not surprising that VLBW children were more accurately aware of their performance in these areas.

Table 9: Teacher and child ratings of school performance : frequencies (%)

	Teacher Rating		Self rating		
	VLBW (n=132)	**Control** (n=155)	**VLBW** (n=137)	**Control** (n=159)	**Sig.** (teach/child)
MATHS					
Poor	11 (8.5)	2 (1.3)	11 (8.0)	3 (1.9)	
Below Average	37 (28.5)	19 (12.3)	19 (13.9)	19 (11.9)	p<0.0001
Average	52 (40.0)	55 (35.5)	43 (31.4)	41 (25.8)	p<0.05
Above average	23 (17.7)	63 (40.6)	48 (35.0)	61 (38.4)	
Excellent	7 (5.4)	16 (10.3)	16 (11.7)	35 (22.0)	
READING					
Poor	6 (4.5)	6 (3.9)	6 (4.4)	1 (0.6)	
Below Average	31 (23.5)	14 (9.2)	9 (6.6)	6 (3.8)	p<0.0001
Average	56 (42.4)	51 (33.3)	24 (17.5)	33 (20.8)	p=0.75
Above average	30 (22.7)	58 (37.9)	54 (39.4)	81 (50.9)	
Excellent	9 (6.8)	24 (15.7)	44 (32.1)	38 (23.9)	
SPELLING					
Poor	16 (12.1)	8 (5.2)	9 (6.6)	6 (3.8)	
Below Average	32 (24.2)	24 (15.7)	18 (13.1)	16 (10.1)	p<0.001
Average	54 (40.9)	62 (40.5)	46 (33.6)	48 (30.2)	p=0.18
Above average	25 (18.9)	43 (28.1)	44 (32.1)	69 (43.4)	
Excellent	5 (3.8)	16 (10.5)	20 (14.6)	20 (12.6)	
WRITING					
Poor	9 (6.8)	5 (3.3)	9 (6.6)	3 (1.9)	
Below Average	31 (23.5)	18 (11.8)	18 (13.1)	10 (6.3)	p<0.01
Average	58 (42.0)	76 (49.7)	43 (31.4)	56 (35.2)	p=0.09
Above average	28 (20.3)	35 (22.9)	45 (32.8)	65 (40.9)	
Excellent	6 (4.3)	19 (12.4)	22 (16.1)	25 (15.7)	
P.E					
Poor			8 (5.8)	6 (3.8)	
Below Average	Not rated by teachers		14 (10.2)	8 (5.0)	
Average			37 (27.0)	22 (13.8)	p<0.01
Above average			34 (24.8)	53 (33.3)	
Excellent			44 (32.1)	70 (44.0)	

"Poor" ratings were more frequently given to VLBW children by their teachers. Six (4.3%) and 14 (10.1%) VLBW children were rated as poor in 1 subject, and in 2 or more subjects respectively compared to 3(1.8%) and 7 (4.3%) comparison children . These differences were statistically significant for "poor" in 2 or more subjects ($\chi^2(1)=3.9$, $p<0.05$) and almost reached statistical significance for "poor" in at least one subject ($\chi^2(2) =5.8$; $p=0.054$). However there is a large overlap between the groups and a relatively small percentage of VLBW children were rated as "poor" in school subjects.

Results from the objective testing of comparison children were also used to define a cut off score in each school subject assessed (sight reading, reading comprehension, maths and spelling) using the 10th centile of control scores as a threshold. In contrast to teacher ratings, using this objective definition, sixty (43.5%) VLBW children performed poorly in at least one subject and 30 (21.7%) were failing in two or more.

The number of school subjects in which each child was "poor" based on objective testing correlated highly with the number of subjects the teachers rated as "poor" for each child ($p<0.001$). It correlated less well with the number of subjects at which each child felt he/she was "poor" but was still statistically significant ($p<0.001$).

In keeping with these observations, very low birth weight children more frequently received remedial education. Forty-six out of 133 (35%) VLBW children compared to 21 out of 155 (14%) comparison children were reported by teachers to have had extra help of some description ($\chi^2(1)=17.7$; $p<0.0001$). However, the numbers of children described by teachers as unmotivated was not significantly different across the groups

with 28/133 (21%) of VLBW children and 25/155 (16%) of comparison children being described in this way (p=0.28).

Cognitive and educational measures in relation to each other

There was a strong relationship between IQ score and educational test scores using Pearson rank correlations both for the VLBW group (spelling: 0.51; sight reading: 0.52; reading comprehension: 0.65 and maths: 0.56) and for the comparison children (spelling:0.52; sight reading: 0.55; reading comprehension: 0.55 and maths: 0.74). Correlations between objective tests of educational performance were also high as shown in Table 10 below.

Table 10: Relationship between educational measures

VLBW children

	Maths	Spelling	Sight reading
Spelling	0.48		
Sight reading	0.40	0.81	
Reading comprehension	0.51	0.58	0.64

Comparison children

	Maths	Spelling	Sight reading
Spelling	0.58		
Sight reading	0.65	0.78	
Reading comprehension	0.65	0.54	0.62

Teacher ratings correlated well with test scores (using Spearman rank analyses) in the VLBW group for maths (r=0.58), spelling (r=0.66) and reading (sight reading: 0.63; reading comprehension: 0.56). Comparison group analyses showed similar results (maths:0.59; spelling: 0.55; sight reading: 0.56 and reading comprehension: 0.60). Child ratings were generally less related to actual performance on objective tests. For the VLBW group the correlation coefficients were: Maths=0.28; spelling=0.64; sight reading=0.29 and reading comprehension=0.27. For comparison children they were: Maths=0.38; spelling=0.49; sight reading=0.36 and reading comprehension=0.29.

Cognitive ability and educational performance in relation to other factors

Gender

IQ scores for boys and girls were different in both in both groups combined with girls (mean= 92, s.d.=16.3; 95%CI=89.4 to 94.7) scoring more poorly than boys (mean=96, s.d.=18.8, 95%CI=93 to 99.1; $p<0.05$). However, when the groups were analysed separately, this gender difference was only found in the VLBW group (girls: mean=87.1 s.d.= 14.9, 95%CI=83.5 to 90.6; boys: mean=92.3, s.d.=18.9, 95% CI=87.7 to 96.9; $p<0.05$). No gender differences were evident on educational tests for both groups combined or separated.

Learning disabilities and psychiatric problems

It was thought that psychiatric problems present (presented fully in later chapters) may be related to lower IQ scores and this relationship was examined. This analysis was performed on both groups combined because of the small number of children with learning or psychiatric difficulties. Chi Square analyses showed that children with

moderate learning difficulties (MLD ; IQ<70) were also significantly more likely to have a psychiatric disorder (Fisher's Exact: $p<0.01$) with 10/26 children showing at least one other disorder. Eight of these were VLBW children and two were comparisons. One comparison child showed ADHD and conduct disorder, the other presented with ADHD, conduct disorder and oppositional disorder. In the VLBW group 4 of the 8 MLD children met clinical criteria for ADHD alone, the remaining 4 presented with the following combinations: ADHD and generalized anxiety; ADHD, conduct disorder and generalised anxiety; ADHD, conduct disorder and oppositional disorder; and generalised anxiety alone. 9/26 children with MLD therefore also had ADHD (Fisher's exact test; $p<0.01$).

Parent index and IQ

IQ scores in both VLBW and comparison groups were examined in relation to family relationships using the parenting index designed from CAPA items and described fully in chapter 2. IQ scores did not correlate significantly with parental index for VLBW children ($r=-0.01$) or for comparison children ($r=-0.02$). Similarly, children with IQ's of 70 and below did not have significantly different parent index scores from the rest of the group in either VLBW or comparison samples.

Neurological soft signs, head circumference and IQ

Despite higher soft sign index scores and lower IQ scores seen in VLBW children, weak relationships were found between full scale IQ score and soft sign index score (described fully in chapter 2). Correlations between these two variables were very small for VLBW children ($r=-0.10$) and their peers ($r=-0.14$). Comparison children with IQ's

of less than 70 points were found to have significantly higher, that is less "mature", soft sign scores (median=3, IQR=2 to 4.5) than others in their group (median=2, IQR-=1 to 4; $p<0.05$), but this was not true for VLBW children.

Head circumference was found to be smaller in VLBW children (see chapter 3), and this was examined in relation to IQ score. The two outcomes were found to be significantly related to, with smaller circumferences being related to lower IQ scores in both groups, although correlations were still weak (VLBW: $r=0.19$, $p<0.05$; Comparison: $r=0.31$; $p<0.001$). Again children in the comparison groups who fell more than 2sd below the norm mean for IQ (70 points or less) showed significantly lower head circumference measurements (median=53.2, IQR= 52.2 to 53.8) than comparison children who scored more than 70 IQ points (median=54.5cm, IQR=53.2 to 56; $p<0.01$), but this was not true for VLBW children. As these results indicate the relationship of IQ with neurological variables was stronger in the comparison sample suggesting the possibility that the VLBW group represent a neurologically vulnerable group as a whole and therefore masking the relationship in separate analyses.

Prediction of cognitive & educational performance at 12

Multiple regression analyses were performed to test the second and third hypotheses, namely whether mediating factors, many examined above, can be identified to explain the differences between groups or within the VLBW groups. Separate analyses were done to avoid more recent variables masking predictors from earlier stages of assessment. Dependent variables chosen were estimated IQ, reading comprehension score and maths score (since these educational variables were lower in VLBW children

independent of IQ score using univariate statistics).

The perinatal analysis was performed on the VLBW group alone, as detailed data is not available for control children. 6 perinatal data points were used : Birthweight (grams); gestation (weeks); Apgar score at 5 minutes; number of days receiving mechanical ventilation; presence and grade of intraventricular haemorrhage (IVH); presence and grade of periventricular leucomalacia (PVL). Six year factors used were Full Scale IQ and Test of Motor Impairment (TOMI-R) scores at 6 years.

Using contemporary demographic data, multiple regression analyses were performed to reveal relationships with the three dependent variables: Full scale IQ, reading comprehension score and maths score. In addition to the FBW/VLBW variable, the following demographic variables were entered in a stepwise method: maternal and paternal education (no qualifications; basic qualifications ;higher qualifications; advanced qualifications); Income (8 bands ranging from less than £50 - over £14,000 a year); House status (council; rented privately; owned/mortgaged); House size (number of living space rooms in house); Number of siblings, position in family and parental status (living with both natural parents; one natural parent; neither natural parent).

When Full scale IQ was the dependent variable, four variables were entered into the model. These were maternal education ($p<0.0001$), income ($p<0.0001$), VLBW or control ($p<0.001$) and position in family ($p<0.001$). This model explained 25% of the variance in IQ ($p<0.0001$; see table 11 below).

Table 11: Regression of demographic details on full scale IQ (12yr)

	Correlation with FSIQ	B (final model)	Beta	sr^2 (unique)
Entered				
Income	0.34	2.51	0.28 **	0.07
VLBW / Control	0.23	7.86	0.22**	0.05
Maternal education	0.32	2.89	0.24**	0.07
Position in family	-0.23	-4.14	-0.20**	0.04
Overall R^2 =0.27	Overall adj. R^2 =0.25	R=0.56**		
Not entered				
House status	3.11	1.30	0.66	
Parental status	-0.98	-0.82	0.76	
Paternal education	0.03	0.42	0.69	
House size	0.27	1.29	0.10	
Number of siblings	-0.19	-0.86	-0.05	

**<0.001

With maths score as the dependent variable, five variables entered the equation. Factors predicting low maths scores were VLBW ($p<0.0001$), lower income ($p<0.001$), lower maternal education ($p<0.001$), later position in family ($p<0.01$) and smaller house size ($p<0.01$). This model explained 29% of the variance in score ($p<0.0001$; see table 12).

Table 12: Regression of demographic factors on maths score (12yr)

	Correlation with FSIQ	B (final model)	Beta	sr^2 (unique)
Entered				
Income	0.33	1.24	0.22 **	0.04
VLBW / Control	0.31	6.43	0.28**	0.08
Maternal education	0.32	1.64	0.22**	0.04
House size	0.31	1.21	0.15+	0.02
Position in family	-0.16	-1.97	-0.15*	0.02
Overall R^2 =0.11	Overall adj. R^2 =0.11	R=0.33**		
Not entered				
House status	0.20	-1.45	-0.12	
Parental status	-0.09	-1.16	-0.05	
Paternal education	0.06	0.42	0.11	
Number of siblings	-0.16	-1.08	-0.10	

+<0.05 *<0.01 **<0.001

When reading comprehension was the dependent variable lower maternal education ($p<0.001$), VLBW ($p<0.001$), lower income ($p<0.01$), and higher number of siblings ($p<0.01$) were all significant predictors of low reading scores. The model explains 19% of the variance ($p<0.0001$; see table 13).

Table 13: Regression of demographic factors on reading comprehension score (12yr)

	Correlation with FSIQ	B (final model)	Beta	sr^2 (unique)
Entered				
Income	0.24	1.07	0.18 *	0.03
Maternal education	0.30	1.88	0.24**	0.05
Number of siblings	-0.21	-2.06	-0.19*	0.04
VLBW / Control	0.22	4.86	0.21**	0.04
Overall R^2 =0.20	Overall adj. R^2 =0.19	R=0.45**		
Not entered				
Paternal education	0.05	0.31	0.08	
House status	0.25	0.28	0.02	
House size	0.21	0.72	0.09	
Position in family	-0.15	-0.70	-0.05	
Parental status	-0.09	-1.69	-0.07	

*<0.01 **<0.001

As VLBW status was still evident as a major predictor of outcome, other possible mediating factors were examined. With full scale IQ score was the dependent variable, FBW/VLBW, Full scale IQ at 6 years, TOMI at 6 years, soft sign index and head circumference were entered as possible predictive mechanisms underlying the difference in IQ at 12. Full scale IQ at 6 was the strongest predictor, followed by head circumference and 6 year motor score with the unique effect of VLBW being no longer significant (see table 14 for details).

Table 14: Regression of mediating factors between groups on full scale IQ (12yr)

	Correlation with FSIQ	B	Beta (final model)	sr^2 (unique)
Entered				
FSIQ at 6 years	0.43	0.39	0.37*	0.13
Head circumference	0.29	2.32	0.25*	0.09
TOMI total score at 6yrs	-0.21	-0.78	-0.14+	0.02
Overall R^2 =0.26	Overall adj. R^2 =0.25		R=0.51*	
Not entered				
VLBW/FBW	0.22	2.06	0.06	
Soft sign index	-0.12	-0.09	-0.02	

+<0.05 *<0.0001

VLBW children were then examined alone to investigate possible within-group factors mediating IQ outcome. First, just perinatal factors were used, and the duration of perinatal mechanical ventilation was the only significant predictor being inversely related to outcome ($p<0.05$). The model explained only 3% of variance in full scale IQ ($p<0.01$).

When FSIQ and TOMI-r scores at 6 years, were added to this analysis along with head circumference and soft sign index, full scale IQ at 6 was significantly related ($p<0.0001$) followed by head circumference ($p<0.05$), the model explaining 32% of the variance. Table 15 shows results of this second analysis in detail.

Table 15: Regression of within VLBW factors on full scale IQ (12yr)

	Correlation with FSIQ	B	Beta (final model)	sr^2 (unique)
Entered				
FSIQ at 6 years	0.55	0.75	0.52+	0.13
Head circumference	0.23	1.68	0.18*	0.28
Overall R^2 =0.33	Overall adj. R^2 =0.32	R=0.57*		
Not entered				
Birthweight	-0.08	0.004	0.06	
Gestation	-0.09	-0.45	-0.05	
Apgar at 5 mins	0.01	0.37	0.20	
IVH	0.02	0.45	0.04	
PVL	-0.06	-1.22	-0.07	
Time ventilated	0.24	0.39	0.17	
TOMI total at 6 yrs	-0.12	-0.64	-0.13	
Soft sign index	-0.06	-0.42	-0.09	

+<0.05 *<0.01

Head circumference and 6 year IQ score were examined for VLBW children in an attempt to identify a pathway for these factors which were in turn related to FSIQ at 12 years. Apgar score at 5 minutes was found to be the sole related factor in both cases explaining 3% of the variance for each (both $p<0.05$).

Perinatal variables did not predict either reading comprehension or maths scores. When TOMI-r scores at 6 were added, there were still no significantly predictive variables for either outcome. TOMI-r scores at 6 years entered alone were correlated with maths

score in the VLBW children ($p<0.01$) and in the whole cohort ($p<0.0001$) and reading comprehension scores in the VLBW group ($p<0.05$) and entire cohort ($p<0.001$). However, TOMI-r scores at six years were not predictive of educational outcome in comparison children when examined separately from VLBW children.

Attention deficit and hyperactivity disorders

An increased prevalence of attention deficit / hyperactivity type problems were found amongst the VLBW group. Allowing for multiple comparisons, three of the six key screening behaviours relating to these disorders were more prevalent in the VLBW group: "Cannot remain seated for long", "Acts before thinking", and "Has difficulty concentrating" (Table 16).

The CAPA data was then analysed in relation to DSMIV criteria for ADH disorders. 31/136 (23%) VLBW children were found to meet the criteria for one of the three categories in comparison to only 9/148 (6%) of their peers ($\chi^2(1)=16.4$; $p<0.0001$) VLBW children were significantly more likely to be hyperactive (9/136 vs. 2/148; $\chi^2(1)=5.3$; $p<0.05$), have attention deficit disorder (11/136 vs. 4/148; $\chi^2(1)=4.1$; $p<0.05$) or be hyperactive with attention deficit (11/136 vs. 3/148;$\chi^2(1)=5.6$; $p<0.05$).

In parallel with this, the VLBW had higher (that is worse) scores on the Connor's Teacher Questionnaire compared to comparison children ($p<0.001$) although there was considerable overlap of group scores (Medians and interquartile ranges = VLBW: 2, 1-5 and Comparison: 1, 0-3). Connors scores were significantly higher for those classified as ADHD using the CAPA ($p<0.0001$; non-ADHD: median=1, IQR=0-3; ADHD: median=4, IQR=3-10).

Hyperactivity scores over time

For the first cohort of VLBW children and their controls, Connor's hyperactivity scores are available from the six year stage of data collection. Scores increased over time for both groups (Wilcoxon tests: $p<0.001$; $p<0.01$ respectively). Surprisingly, scores from 6yrs and 12yrs did not correlate strongly and were only significantly related in the VLBW group ($r=0.40$; $p<0.01$). The comparison children coefficient was only 0.21. In addition, for the VLBW children, the 6 year Connor's scores were not significantly different for those with and without a CAPA based classification of ADHD ($p=0.47$). The number of children in this comparison subgroup with ADHD was too small to allow similar analysis.

Table 16: Frequency (%) of children showing ADHD type behaviours

Key Behaviour	**VLBW group**	**Comparison group**	**χ^2 value (df=1)**
Fidgets uncontrollably	46/ 136 (34%)	35/148 (24%)	3.6
Cannot remain seated for long	32/134 (24%)	13/148 (9%)	11.95**#
Acts before thinking	63/136 (46%)	38/148 (26%)	13.19**#
Has difficulty waiting turn	28/135 (21%)	16/148 (11%)	5.3+
Has difficulty concentrating	42/136 (31%)	13/148 (9%)	22.16**#
Has difficulty following instructions	22/148 (16%)	13/148 (9%)	3.58

+<0.05 **<0.001 # Remained significant after adjustment for multiple comparisons

Attention deficit hyperactivity disorders in relation to other factors

Gender differences

An increased proportion of boys are often found to show ADHD disorders and this was reflected in the comparison population in which boys outnumbered girls 7:2 (although this was not statistically significant , Fishers exact test p=0.17). In contrast, for the VLBW children the boy:girl ratio was 1.1: 1.

ADHD and cognitive ability

ADHD was examined in relation to IQ as cognitive ability may be associated with such difficulties. The Full scale IQ scores in the ADHD group were significantly lower than the non-ADHD group in both VLBW and comparison populations ($t=2.05$ $p<0.05$; $t=2.9$ $p<0.01$ respectively). Mean difference in the VLBW group was 7.2 points (95%CI= 0.3 14.1) and in the comparison groups was 16.7 IQ points (95%CI=5.3 to 28.0) representing a significant functional impairment in both groups but particularly for comparison children with ADHD. Table 17 shows the means and standard deviations for each group.

Table 17: Mean (SD) estimated full scale IQ scores across ADHD and group

	VLBW Children		Comparison Children	
	Non-ADHD	ADHD	Non-ADHD	ADHD
Estimated Full Scale IQ score	91.3 (16.1)	84.1(20.1)+	99.1 (16.6)	82.4 (18.7)*

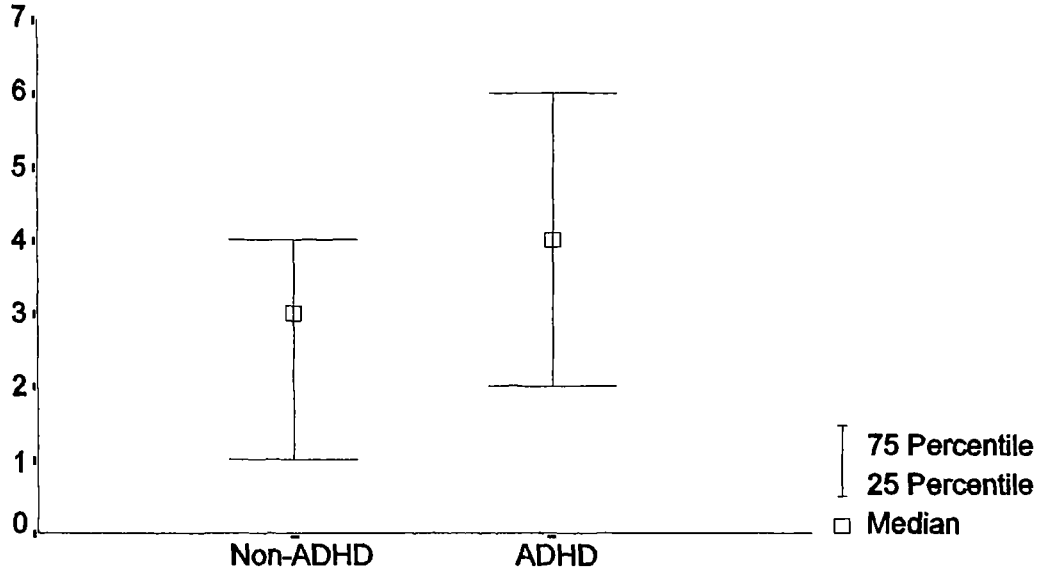
+ <0.05 *<0.01

Parent index and soft signs

In addition to using single variables as predictors of ADHD, the two "indexes" were also devised. The first of these was the parent index, comprising a summation of a number of scored parenting questions from the CAPA (which is described fully in chapter 2), and this score was compared for those with and without ADHD. Those individuals with one of the three disorders were significantly more likely to have higher, that is less favourable scores (median=2, IQR=1 to 4) than those without ADHD (median-2, IQR=0 to 2; $p<0.01$) although as can be seen from these results there was much overlap between the two groups. When VLBW and comparison groups were separated, only VLBW children scored differently on the parent index when compared across ADHD (median =3, IQR = 1 to 5) and non-ADHD subgroups (median = 2 IQR=0 to 3; $p<0.05$).

The second index consisted of a number of "soft" neurological signs (fully described in chapter 2). Since ADHD is often thought to be neurological in aetiology and since

Fig. 5: Soft sign index score by presence of ADHD



VLBW children were already found to have higher soft-sign scores, this relationship was investigated directly. Children with ADHD in both groups combined showed significantly more "soft" signs (median=4, IQR=3 to 6) than those without any ADHD (median = 3, IQR = 1 to 4; $p<0.05$).

Fig .5 shows the medians and interquartile ranges for both groups. When VLBW and comparison children were separated, neither group showed differences in soft sign index score between those with and those without ADHD, and this may be due to the small numbers in each group.

Prediction of attention deficit hyperactivity disorders at 12

Using ADHD (presence/absence) as a dependent variable, full scale IQ, maths score, sight reading score, reading comprehension score and motor impairment were entered into a forward stepwise logistic regression analysis with $p=0.05$ for entry. As with cognitive ability, educational attainment may be related to ADHD, possibly in terms of educational progress being affected by ADHD. A strong relationship may explain the poorer educational performance seen in VLBW children.

However, maths score (odds ratio 0.95, Confidence Interval= 0.94 to 0.97; $p<0.01$;) and the VLBW vs. FBW grouping (odds ratio 1.79, CI=1.45 to 2.20; $p<0.01$) were the only significant associates and removed the effect of IQ. See table 18 for full details.

Table 18: Logistic regression of presence of ADHD as a function of educational variables

	B	odds ratio	95% CI
Entered			
Maths Score	-0.50	0.95	0.94 to 0.97*
VLBW	0.58	1.79	1.45 to 2.20*
Not entered			
Reading comprehension score	-0.02	0.98	
Full scale IQ	-0.01	0.99	
TOMI score at 12 years	0.08	1.09	
Sight reading	0.01	0.99	

*<0.01

Again using log.regression analysis, demographic and social factors were examined. These were family income (eight bands from <£2,599 to over £14,000 a year), house size (number of living space rooms in house), house status (council; rented privately; owned/mortgaged), maternal and paternal education (no qualifications; basic qualifications; higher qualifications and advanced qualifications), number of siblings, position in family, parental status (living with both natural parents, one natural parent or neither natural parent). Being VLBW was the major predictor of ADHD (odds ratio=2.07, CI=1.68 to 2.55; $p<0.01$) but house status was also a predictor with children living in private accommodation less likely to meet DSM criteria (odds ratio 0.51, CI=0.42 to 0.62 ; $p<0.001$). See table 19 for details.

Table 19: Log. regression of presence of ADHD as a function of demographic variables

	B	odds ratio	95% CI
Entered			
VLBW	0.58	2.07	1.68 to 2.55*
House status (private owned)	-0.50	0.51	0.42 to 0.62**
Not entered			
Parental status (both natural)	-0.75	0.47	
Paternal education	-0.04	0.97	
Maternal education	-0.04	0.96	
Income	-0.15	0.86	
House size	0.15	1.16	
Position in family	0.01	1.01	
Number of siblings	0.08	1.08	

VLBW remained as a strong predictor. Therefore, possible predictive or causal factors from early development were examined in relation to ADHD. Six year old variables of Full scale IQ (WPPSI) and Motor Impairment score (TOMI) were entered into log.regression as well as soft sign index and head circumference. Lower IQ scores (B=-0.03, odds ratio= 0.97, CI=0.95 to 0.99; $p<0.01$) and being VLBW (B=1.05, odds ratio= 2.9, CI=2.2 to 3.6; $p<0.001$) were both related to the presence of ADHD.

For the VLBW group only, the perinatal variables of birthweight (grams), gestation (weeks), intraventricular haemorrhage (IVH) , periventricular leucomalacia (PVL), time ventilated (days), and Apgar score at 5 minutes, were entered into log. regression. No

factors were significant predictors. However both birthweight and gestational age were significantly lower for those with ADHD (mean =1366 sd=850 and mean =30 sd=4 respectively) compared with those without ADHD (mean =2145 sd=1240 and mean =33 sd=6, respectively) when using univariate statistics ($p<0.001$ and $p<0.01$ respectively).

When 6 year TOMI and FSIQ scores were added to perinatal variables along with soft sign index and head circumference for VLBW children only, time ventilated (B=0.07, OR=1.1, 95% CI= 1.04 to 1.16; $p<0.05$) and full scale IQ at 6 (B=-0.07, OR=0.9, CI=0.89 to 0.97; $p<0.01$) were significantly related.

Finally, an overall multiple log. regression analysis was performed which including all of the significant variables from separate regressions which were available for both groups (ie. not time ventilated) and parent index scores. VLBW status was still the largest influence on presence of ADHD (odds ratio=2.38, 95%CI=1.91 to 2.87, $p<0.0001$) followed by parent index score (OR=1.3, 95%CI= 1.09 to 1.53, $p<0.05$). No other variables were entered into the model. Table 20 shows the details. Time ventilated was included and analysis run for VLBW children only, both parent index (B=0.39, OR=1.5, CI=1.24 to 1.76) and time ventilated (B=0.07, OR=1.1, CI=1.02 to 1.2) were related.

Table 20: Logistic regression of presence of ADHD as a function of relevant factors

	B	odds ratio	95% CI
Entered			
VLBW	1.21	3.35	2.6 to 4.1*
Parent index	0.37	1.44	1.2 to 1.7*
Not entered			
House status (private owned)	0.23	0.98	
Maths score	-0.02	0.79	
FSIQ at 6 yrs	-0.004	1.00	

*<0.001

Anxiety

Generalised Anxiety

Using CAPA interview data, no individual screening items were significantly different between groups without accounting for frequency and duration of symptoms. When these factors were taken into account, an increased proportion of VLBW children were found to meet clinical criteria for generalised anxiety disorder. In total, 11 out of 136 (8%) VLBW children had generalised anxiety compared to 2/148 (1%) of peers ($\chi^2(1) = 7.36$, $p<0.01$).

Parent and child versions of the CMAS-R were scored significantly higher for VLBW children compared to their peers ($p<0.0001$ and $p<0.01$, respectively). The VLBW group scored a median of 6 (IQR=3-11) on the parent questionnaire and 9 (IQR=4-14) on the child version, whilst their peers scored a median of 1 (IQR=4-7) on the parent scale and 6 (IQR=3-9) on the self report measure.

Reynolds and Richards (1983) found a mean score of 11.85 points (s.d. 5.27) in children of a similar age and suggest that scores over 1 sd from the mean be taken to indicate a possible anxiety disorder. For this age group this represents a score of 17 or over. When groups were analysed in this way, there were also an increased proportion of VLBW children (21/138, 15% using child version and 14/129, 11% using parent scale) compared to peers (8/162,5% child; 2/151, 1% parent) who scored over the threshold ($\chi^2(1)=9.02$, $p<0.01$ child version; $\chi^2(1)=11.72$, $p<0.001$ parent version). Furthermore 6 (4%) VLBW

children scored over 2 sd from Reynolds and Richards norm mean (22 points) compared to none of their peers (fishers exact: p value<0.01). There were also an increased number of VLBW children who scored over 1sd from the norm mean on **both** parent and child versions. Seven of 138(5%) VLBW children were high on both scales but none of the comparison children were more than 1sd from the mean on both ($\chi^2(1)=8.35$, $p<0.01$).

Separation anxiety

A very small number of children (8 VLBW and 4 comparison children) were reported by parents to show any level of separation anxiety as defined by the CAPA screening item. Two of these children subsequently proved to have no clinical symptoms leaving 7/136 (5%) and 3/148 (2%) meeting at least one separation anxiety symptom. This difference was not significant ($\chi^2(1)=2.4$, $p=0.12$). Only two VLBW children and one comparison child met clinical criteria for separation anxiety disorder.

Fears

Only the parent version of the FSSC-R showed a significant difference between VLBW children ($p<0.05$) who scored a median of 9 (IQR=5-16) compared with 8 (3-14) for their comparison peers. Despite the statistical significance of the score difference, the interquartile ranges indicate a large overlap between the groups on this measure. A large number of children in both VLBW reported some specific fears, but it was very difficult to ascertain the level of incapacity or avoidance. The prevalence of specific phobias cannot therefore be reported in this study. Only one VLBW child (and no comparison children) was receiving treatment for specific fears.

Relationship between measures of anxiety

Relationships between different measures of anxiety varied considerably. Classification of general anxiety using parental CAPA data discriminated effectively on parent anxiety scales ($p<0.0001$) between children with anxiety (median=16, IQR=10-17) and those not showing anxiety (median=5, IQR=2-9) and on parent fear schedules (median=20, IQR=10-25; and median =8 IQR=3-15, respectively; $p<0.001$). However, little relationship was found between children rated scales and parental CAPA information. Whether children met DSM criteria for generalised anxiety (as defined using the interview) did not significantly discriminate between scores on children's anxiety ($p=0.42$) or fear questionnaires ($p=0.54$).

Similarly, correlations between parent fear and parent anxiety , and correlations between child fear and anxiety questionnaires were high. However, only moderate correlations were found between parental and child questionnaires, despite the fact that these reached statistical significance. All values are shown in table 21 below.

Table 21 : Spearman rank correlations for anxiety and fear questionnaires

	Child anxiety scale	Child fear schedule	Parent anxiety scale
Child fear Schedule	r=0.68 **		
Parent anxiety scale	r=0.41 **	r=0.30 **	
Parent fear schedule	r=0.23 **	r=0.34 **	r=0.57 **

** <0.001

Anxiety in relation to other factors

Gender Differences

Presence of generalised anxiety was more common in girls (10/140; 7%) than boys (3/144; 2%) and this reached statistical significance for both groups combined ($\chi^2(1)$= 4.2; $p<0.05$). When VLBW and comparison groups were separated a similar trend could be seen but comparisons did not reach statistical significance because of small numbers.

When parent questionnaire scores were compared for gender, girls were again higher scorers . On the anxiety scale girls had a median score of 6 (IQR=3-9) compared to a median score of 4 (IQR=1-8) for boys ($p<0.01$). Median parent fear scores were 12 (IQR= 6-18) for girls and 6 (IQR=3-11)for boys ($p<0.0001$). On child questionnaires, only the fear scores were higher for girls (median=14, IQR=9-21) compared to boys (median =10, IQR=5-18; $p<0.001$).

Neurological "soft signs"

The six neurological "soft signs" identified in the soft-sign index have been found to relate to anxiety and other psychiatric difficulties and were found to be more prevalent in the VLBW group as a whole. The soft sign score was examined in relation to anxiety as a possible marker for a neurological aetiology.

Using Spearman rank correlations, soft sign index scores did not relate to either parent or child anxiety scores ($r=0.09$; $p=0.2$ and $r=0.02$; $p=0.7$ respectively). However, the soft sign index score was significantly higher (indicating more soft signs) for children with DSM defined generalised anxiety disorder compared to children who did not meet the

psychiatric classification. Group medians were 3 (IQR=1 to 4) for those without generalised anxiety disorder and 4 (IQR= 3.5 to 7) for those meeting DSM criteria.

Parent and demographic details

No socio-demographic details predicted parent rated anxiety score at 12 years when entered into multiple regression. The parent index was slightly higher for VLBW children with CAPA based generalised anxiety compared to VLBW without generalised anxiety, and although this fell just short of statistical significance ($p=0.059$), the numbers were very small (number of children with generalised anxiety =8).

Prediction of anxiety at 12 years

Educational and cognitive factors were entered into regression using parent anxiety score to examine possible causes for anxiety or effects of anxiety in VLBW children. VLBW vs. FBW predicted anxiety ($p<0.0001$) followed by full scale IQ ($p<0.01$; see table 22). None of the perinatal or 6 year variables predicted anxiety score.

A multiple regression was performed for parent CMAS-R score entering all variables which appeared to relate to anxiety. These were VLBW or comparison, soft sign index, full scale IQ score at 12 and parent index. All but the soft sign index were significantly related to anxiety score. Parent index having the largest unique relationship explaining 16% of the variance ($p<0.0001$), followed by full scale IQ score adding 6% to the model ($p<0.01$) and birthweight status ($p<0.05$). The final model explained 24% of the total variance ($p<0.0001$; see table 23).

Table 22: Regression of educational/cognitive factors on parent rated anxiety score

	Correlation with FSIQ	B (final model)	Beta	sr^2 (unique)
Entered				
VLBW / Control	0.27	-2.35	-0.23**	0.05
Full scale IQ	0.22	-0.04	-0.17*	0.03
Overall R^2 =0.10	Overall adj. R^2 =0.10	R=0.32**		
Not entered				
Maths	-0.22	-0.02	-0.04	
Reading	-0.14	0.03	0.08	
Reading comprehension	-0.22	-0.05	-0.11	
Spelling	-0.14	-0.01	-0.03	

+<0.05 *<0.01 **<0.001

Table 23: Regression of relevant factors on parent rated anxiety score

	Correlation with FSIQ	B (final model)	Beta	sr^2 (unique)
Entered				
Parent Index	0.41	1.05	0.40**	0.17
Full scale IQ	-0.25	0.05	-0.20*	0.04
VLBW / Control	-0.24	-1.72	-0.17+	0.03
Overall R^2 =0.25	Overall adj. R^2 =0.24	R=0.50**		
Not entered				
Soft sign index	0.07	-0.15	-0.01	

+<0.05 *<0.01 **<0.001

Depression and Self Esteem

Self Esteem

VLBW children scored significantly higher on both parent and child report scales indicating lower self esteem (Mann-Whitney, Child Q: $p<0.01$; Parent Q: $p<0.001$). For VLBW children these were 11 (6-16) on the Child Questionnaire and 7 (4-11.5) on the parent questionnaire compared with comparison scores of 8 (4-13) on the child questionnaire and 4 (2-8) on the parent scale.

Depression

When the results from CAPA interviews were examined, 2 out of 7 of the CAPA depression screening questions were significantly more likely in VLBW children, these being "feels unloved" ($p<0.01$) and "suicidal behaviour" (threats or attempts) ($p<0.05$) with VLBW children 4 times more likely than comparison children to have expressed recurrent thoughts of death or suicidal feelings to their parents (see table 24).

The number of DSM defined depression symptoms experienced by each individual were also totalled, and the VLBW children again showed a trend towards increased depression. VLBW children were more likely to experience an increased number of symptoms than their peers with 46/136 (34%) having experienced at least one depressed symptom compared to 32/148 (22%) of comparison children ($\chi^2(1)=5.3$, $p<0.05$).

Table 24: CAPA screening items for depression

CAPA item	VLBW n (%)	Comparison n (%)	χ^2 value (df=1)
Depressed mood	21 (15%)	12 (8%)	3.71
Irritability	37 (27%)	39 (26%)	0.03
Anhedonia	2 (1.5%)	2 (1%)	0.01
Loss of interest	2 (1.5%)	1 (0.5%)	0.44
Feels unloved	42 (31%)	24 (16%)	8.80*
Self depreciation	16 (12%)	8 (5%)	3.70
Suicidal feelings	11 (8%)	3 (2%)	5.56+

+ <0.05 *<0.01

The numbers of both VLBW and comparison children meeting DSMIV criteria for major depressive episode were very small and statistical analysis was not possible. The results of the Mood and Feelings Questionnaire are very similar. Again the medians and interquartile ranges are significantly higher for VLBW children as rated by themselves ($p<0.01$) and by parents ($p<0.05$) indicating more depressed moods and feelings. Median values and interquartile ranges for VLBW children were 11 (4-21) on the Child Questionnaire and 8 (3-14) on the parent questionnaire compared with comparison scores of 6 (2-13) on the child questionnaire and 5 (2-10) on the parent scale.

Following the finding that VLBW children showed more depressed behaviour than their peers, the Mood and Feelings scores were examined in more detail using Chi-square analysis for individual items. It was important to discover whether differences were due to an increased frequency of mild depressed thoughts such as "I was miserable or

unhappy" or due the more severe items such as "I thought about killing myself". When the items were examined in this way, it appeared that it was the more severe thoughts and feelings which were responded to significantly more frequently by VLBW children. Table 25 shows significantly different items.

Table 25: Items on the child MFQ which were significantly different across groups.

MFQ item	**χ^2 value**
Didn't enjoy anything at all	9.68*
Was less hungry than usual	6.14+
Felt I was no good anymore	15.16**
It was hard for me to make up my mind	6.73+
Felt grumpy and irritable with parents	6.02+
Thought that life was not worth living	12.88 *
Thought about death or dying	7.18+
Thought my family would be better off without me	9.32*
Worried about aches and pains	9.35*
Felt lonely	8.10+
Thought nobody loved me	7.53+
Did not have any fun at school	7.25+
Thought that I did everything wrong	10.97*

+ <0.05 *<0.01 **<0.001

Self esteem and depression measures in relation to each other

Not surprisingly, Self-Esteem scores and Mood and Feeling scores correlated highly in VLBW (Spearman rank, Child Q: r= 0.62, p<0.001; Parent Q: r=0.72, p<0.001) and moderately in comparison groups (Child Q r=0.48, p<0.001; Parent Q: r=0.55; p<0.001).

However, questionnaire correlations were weaker across respondents as shown in table 26. It can also be seen that the number of CAPA depression symptoms correlates moderately with parent report questionnaires in the VLBW group, but only weakly with parent scores in the comparison group and hardly at all with child scores in either birthweight group.

On both self esteem and depression questionnaires, parents tended to be more conservative than children in the number of positive responses (Wilcoxon test, both groups combined: Self esteem:$p<0.0001$ Depression:$p<0.01$).

Table 26 : Spearman rank correlations for self esteem and depression questionnaires

VLBW Children

	Child self-esteem scale	Child MFQ	Parent MFQ	Parent SE scale
Child MFQ	r=0.62 **			
Parent MFQ	r=0.38 **	r=0.36 **		
Parent SE scale	r=0.31 **	r=0.34 **	r=0.57 **	
CAPA symptoms	r=0.19 +	r=0.16	r=0.47 **	r=0.41 **

+ <0.05 *<0.01 **<0.001

Comparison Children

	Child self-esteem scale	Child MFQ	Parent MFQ	Parent SE scale
Child MFQ	r=0.48**			
Parent MFQ	r=0.30 **	r=0.42**		
Parent SE scale	r=0.43 **	r=0.26*	r=0.55**	
CAPA symptoms	r=0.14	r=0.28*	r=0.37**	r=0.19+

+ <0.05 *<0.01 **<0.001

Depression and self esteem in relation to other factors

Gender Differences

Gender had no significant effect on depressed moods and feelings or self esteem. The ratio of boys:girls who experienced at least one clinical symptom of depression was exactly 1:1 in the VLBW group and 1.5:1 in the comparison group. Similarly, there were no differences in depression questionnaire score across gender in either birthweight group.

Intelligence and educational performance

Because cognitive ability was found to be lower in VLBW children, and this may lead to or be related to depressed mood, IQ and educational variables were examined in relation to this outcome. On simple bivariate correlations, estimated full scale IQ score did not correlate strongly with either child (spearman r-square=0.03, $p<0.01$) or parent (spearman r-square=0.008; $p=0.143$) questionnaire scores.

When IQ and the educational variables of spelling, reading, reading comprehension and maths were entered into a multiple regression along with birthweight status, VLBW ($p<0.02$) followed by reading comprehension ($p<0.05$) were related to parent depression scores.

Peer relationships

For both groups, children who were the frequent target of bullying had less favourable depression scores (child:$p<0.001$; parent:$p<0.0001$) and self esteem scores (child: $p<0.01$; parent:$p<0.001$). Similarly, individuals who had marked difficulty making

friends also scored worse on depression measures (child:$p<0.05$; parent:$p<0.0001$) and self esteem scales (child:$p<0.05$; parent:$p<0.0001$).

Neurological "soft" signs

The soft sign index found to be higher in VLBW children was again felt to be a possible marking factor in the mechanisms behind depressed mood. Once again, however, the index score was unrelated to either parent ($r= -0.009$; $p=0.891$) or child ($r=0.06$; $p= 0.337$) depression questionnaires. There was also no difference in soft sign index scores between those with one or more CAPA depression symptoms and those with none.

Depression and physical development

In order to investigate the possibility that less favourable physical development (as reported in Powls et al, 1997) was related to later depression, scores were examined in relation to growth and motor skills.

Depression questionnaire scores were not found to correlate with the child's standing height in either the VLBW children (child: $r=-0.13$; $p=0.13$, parent: $r=0.04$; $p=0.59$) or in the comparison group (child: $r=-0.04$; $p=0.85$; parent: $r=0.0097$; $p=0.94$). Standing heights were also not significantly different for children experiencing one or more clinical depression symptom compared to those with no symptoms in either birthweight group.

Bivariate Spearman correlations revealed that depression scores were also unrelated to 12 year Movement ABC motor impairment scores in VLBW children (child: $r=0.08$;

p=0.36, parent: r=0.03; p=0.72) and comparison children (child: r=0.10; p=0.19, parent: r=0.13, p=0.12). However, when motor impairment score at 6 years (gained using an earlier version of the same test, the TOMI), full scale IQ at six, and birthweight status were entered into multiple regression, 6 yr motor impairment was the only predictor of parental depression score at 12 (r-square =0.03; p<0.01).

Prediction of depression at 12 years

Perinatal events

Extensive perinatal information was available for the VLBW children. In multiple regression a number of these perinatal factors were examined in relation to depression, including presence of intraventricular brain haemorrhage, periventricular leucomalacia, Apgar scores, birth weight, gestation, and number of days artificially ventilated. However, none of these perinatal factors explained a significant amount of variance in MFQ scores.

Demographic and Parent factors

Socio-demographic information was entered into stepwise multiple regression using parent depression scores as the dependent variable and p=0.05 as entry criteria. These factors were house status (council, privately rented or owned); parental status (with both, one or none natural parent); paternal and maternal education; income; number of siblings and house size (number of living space rooms). See chapter 2 for a detailed description of demographic variables.

When both VLBW and comparison groups were combined parental status was the most predictive factor of depression score ($p<0.01$), followed by VLBW status ($p<0.05$) and house status ($p<0.05$) with this model explaining 8% of the variance in parent-rated MFQ score ($p<0.0001$).

When the groups were split, only parental status was related to VLBW children's parental depression score (4%, $p<0.05$), whereas in the comparison group, low paternal education level ($p<0.01$) and low income ($p<0.05$) were related to depression scores.

The parent-index, an index of several features of parental style (see chapter 2 for full details) in which various parenting difficulties were scored and then summed, correlated moderately with DSM depression symptoms as gained from the CAPA interview ($r=0.41$; $p<0.001$) and was significantly different for those experiencing depression in the VLBW ($p<0.001$) and comparison groups (Mann Whitney U test $p<0.05$).

When the socio-demographic regression analysis described above was repeated for both groups combined including the parental index variable, this became the main predictor of parent rated MFQ scores, explaining 9% of the variance alone ($p<0.0001$), with VLBW status as the only other variable entered into the model ($p<0.01$). However, the parent index correlated weakly with other depression questionnaire data in the VLBW group (child:$r=0.01$; $p=0.895$) and comparison groups (child: $r=0.20$, $p=0.25$; parent:$r=0.23$; $p=0.12$). See table 27 for details.

Children experiencing one or more depression symptom in both groups combined were no more likely to have a parent who had received professional help for a psychological problem (p=0.09). This was also true when VLBW and comparison groups were analysed separately. VLBW children as a whole group, showed a slightly increased number of parents who had received psychological help (29/114 vs 20/127), but this also fell just short of statistical significance ($\chi^2(1)=3.5$; p=0.06).

Table 27: Regression of demographic factors on parent rated depression score

	Correlation with FSIQ	B	Beta (final model)	sr^2 (unique)
Entered				
Parent Index	0.31	1.20	0.29**	0.09
VLBW / Control	-0.21	-2.90	-0.18*	0.03
Overall R^2 =0.12	Overall adj. R^2 =0.12	R=0.36**		
Not entered				
House size	-0.07	0.37	0.07	
Income	-0.12	-0.37	-0.08	
House status	-0.17	-0.78	-0.09	
Maternal education	-0.09	-0.24	-0.03	
Paternal education	0.01	0.25	0.04	
Number of siblings	0.05	0.43	0.05	
Position in family	-0.11	-1.18	-0.12	
Parental status	0.13	1.28	0.06	

+<0.05 *<0.01 **<0.001

Behavioural and social difficulties

Behavioural difficulties

VLBW children were no more likely to show any key behaviours from the CAPA conduct items. Neither did they show increased frequency of key oppositional behaviours. Only 6/136 VLBW children and 6/148 comparison children met the clinical classification of conduct disorder. These proportions were not significantly different between groups (χ^2=0.1; p=0.73). A similar analysis was performed for oppositional disorder and whilst there were slightly more VLBW children with this pattern of behaviours (4/136) compared to comparisons (1/148), numbers were again very small and no statistically significant differences were found (two-tailed Fishers exact: p=0.18).

Rutter Behaviour Questionnaires

The Rutter Parent Questionnaire Scores were higher in the VLBW group (median=7, interquartile range=4-14) than their peers (median =5; interquartile range =2-9) indicating more behavioural difficulties (Mann Whitney comparison, p<0.01). This result was also found for teacher ratings with VLBW children scoring higher (median=3; IQR=1-6) than the comparison group (median=1; IQR=0-4 ; p<0.01).

There were no significant differences in the proportions of children in each group who scored over the norm threshold. On the parent questionnaire, 34/129 (26%) VLBW children were shown to have a behavioural disturbance in this way compared to 26/151 (17 %) comparison children (χ^2=3.45; p=0.063). Teachers scored 17/133 (13%)VLBW children and 19/156 (12%) comparison children in this way (χ^2=0.024; p=0.88).

The numbers of children having a "pervasive" behavioural problem, that is scoring high on both parent and teacher questionnaires, were similar in VLBW and peer groups. Nine of 125 (7%) VLBW children compared with 7/144 (5%) comparison children scored over cut-off scores on both versions ($\chi^2(1)=0.7$; $p=0.42$).

Behaviours and Activities Checklist

There were no differences between the VLBW and comparison groups on the Behaviour and Activities Checklist (BAC) scores on either child or parent versions ($p=0.5$; $p=0.12$ respectively). Examination of the individual items using Chi-square analysis revealed only one significant difference: VLBW children were more likely to say they had run away from home for a night, 14/138 (10%) VLBW children compared to 3/158 (2%) of their peers ($p<0.01$).

Relationship between measures of behavioural difficulties

With both VLBW and comparison groups combined: Rutter teacher and parent versions correlated moderately with each other ($r=0.40$). Rutter teacher showed a similar relationship with the Parent BAC ($r=0.41$) and the parent Rutter scale and parent BAC showed an even stronger relationship ($r=0.51$). Parent BAC and child BAC also correlated moderately at $r=0.45$. Parent and teacher Rutter scales showed weaker relationships with child BAC scores ($r=0.30$ and $r=0.27$ respectively). All correlations were significant at $p<0.001$.

Numbers of those with conduct disorder were only large enough for comparisons when VLBW and comparison groups combined. This analysis revealed that those with conduct

disorder also had significantly higher parent BAC scores (median=7, IQR=3 to 14.5) than those without (median=1; IQR=1.5 to 2;$p<0.01$) and higher child BAC scores (median=7.5, IQR=5 to 20) than those with no conduct disorder (median=2, IQR=3 to 4; $p<0.01$).

Behavioural problems in relation to other factors

Gender Differences

The ratio of boys:girls meeting clinical criteria for conduct disorder in the VLBW group was 2:1 and in the comparison group was 5:1. The ratio of boys:girls with a parental Rutter score of 13 or more were more even at 1.1: 1 and 1.4 to 1 in VLBW and comparison groups respectively. Boys in both groups scored higher on the BAC parent version (VLBW: $p<0.01$ & comp: $p<0.01$) and the child version (VLBW: $p<0.05$ & comp: $p<0.01$) but scores were generally low and there was considerable overlap. For example VLBW girls scored medians of 2 (IQR: 0 to 4) and 1.5 (IQR: 0 to 2) on child and parent scales whilst VLBW boys scored 3 (IQR:1 to 7) and 3.5 (IQR:0 to 4.5).

When numbers over the Rutter thresholds were compared separately for boys and girls, VLBW girls were shown to be more at risk than female peers of having a behavioural disturbance as defined by parental Rutter score. Seventeen out of 62 (27%) VLBW girls scored 13 or over, compared to 10/74 (13%) of female peers ($\chi^2(1)=4.1;p<0.05$). There were no differences in the proportion of boys scoring 13 or more nor in the proportion of either gender scoring high on the teacher version.

IQ and behavioural problems

Lower IQ has sometimes been linked with poorer behaviour in schools and was therefore investigated in relation to anti-social problems. Full scale IQ scores were lower for those children meeting clinical criteria for conduct disorder (median = 80; IQR 64 to 90) compared to those without this difficulty when both groups were combined (median=94; IQR 82 to 107; $p<0.05$). When separated, numbers were small, but only comparison children showed a difference in IQ score between those with and without behavioural difficulties (median, IQR: 81, 60 to 92 vs. 101, 86 to 110). IQ scores did not strongly relate to questionnaire scores. Weak negative correlations were revealed between FSIQ and BAC (child:$r=-0.19$; parent: $r=-0.14$) and Rutter scores (teacher:$r=-0.22$; parent:$r=-0.17$).

Educational variables of reading, spelling, reading comprehension and mathematics were also correlated with BAC score as behavioural difficulties may affect school performance or vice versa, however none of the educational measures were related to either parent or child BAC at more than $r=0.2$.

Parent factors

A number of behavioural variables were found to relate to the "parental index" scores (see chapter 2, p72-73). In both groups, being spiteful (VLBW: $p<0.05$; Comparison: $p<0.05$), or annoying (VLBW: $p<0.05$; comparison: $p<0.01$) were related to higher (less favourable) parent index scores. Frequent disobedience ($p<0.01$), fighting ($p<0.05$), swearing ($p<0.05$) and lying ($p<0.01$) were only linked with parent index score in the VLBW group. The medians and interquartile ranges associated with these results can be

seen in table 28. Parental index scores were also significantly higher for those with conduct disorder, both groups combined ($p<0.05$).

Parent completed Behaviour and Activities Checklists and parent Rutter scales were also found to correlate moderately with parent index score in VLBW children (BAC:$r=0.27$, $p<0.01$; RPQ: $r=0.31$, $p<0.01$) and comparison children (BAC:$r=0.31$, $p<0.01$; RPQ: $r=0.39$, $p<0.001$). Teacher Rutter Questionnaires and child BAC scores did not correlate with parental index in either group.

Table 28: Parent index scores related to anti-social behaviour

	VLBW		**Comparison**	
	Showing behaviour	Not showing behaviour	Showing behaviour	Not showing behaviour
Spiteful	6 (2-7.5)	2 (1-3)	4 (2-6)	2 (0-2)
Annoying	4 (1.5-4.5)	2 (0-3)	2 (1.5-4)	2 (0-2)
Disobedience	4 (4-6)	2 (1-3)		
Fighting	3 (2-7)	2 (1-3)		
Swearing	5 (3-7)	2 (1-3)		
Lying	4 (2-5)	2 (0-3)		

In a similar way, children scoring over the threshold for behavioural difficulties on the parent Rutter scales had significantly higher parent index scores in the VLBW ($p<0.05$) and comparison ($p<0.0001$) groups. This difference was not evident using cut offs from the equivalent teacher scales.

Neurological factors

Behavioural problems may be caused by neurological mechanisms in the case of VLBW children or in both groups. However, the collection of soft signs combined to create an "index" score (see chapter 2) was not found to relate to behavioural problems. The soft sign index correlated only weakly with the Rutter teacher questionnaire (r=0.23), Rutter parent questionnaire (r=0.16) and hardly at all with the parent or child BAC scores (r=0.08 and r=0.1 respectively, both ns). Children with conduct disorder did not have higher soft sign scores (p=0.77). These analyses were all done with both groups combined.

Behavioural difficulties over time and predictive variables

For the first cohort only (see chapter 2), Rutter teacher questionnaires were available at 6 years of age. These scores were correlated with current 12 year ratings on this measure. Surprisingly, the relationships over time were weak as shown in table 29 below.

Table 29: Correlations between behaviour questionnaires across two time periods

	Rutter PQ at 6	**Rutter TQ at 6**
Rutter PQ at 12	**0.40***	**0.22**
Rutter TQ at 12	**0.24+**	**0.14**
BAC Child	**0.11**	**0.07**
BAC Parent	**0.36***	**0.18**

+p<0.05 * p<0.01

The strongest correlation was found between Rutter Parent Questionnaires across the two time periods. The Rutter teacher Questionnaire administered at 6 years does not seem to relate well to any of the 12 year questionnaires. Scores had increased in general over the 6 years as expected and no 6 year scores fell over the threshold for extreme behaviour thus comparisons of this kind could not be made.

Univariate analysis was performed to examine differences in perinatal variables between children with and without conduct disorder. The perinatal variables used are detailed fully in chapter 2. None showed differences across groups. Only one of the six children showed any kind of IVH or PVL.

Demographic variables (chapter 2 for details) were also examined using Mann Whitney or Chi Square analysis. Whilst parental education did not differ across conduct disorder and non-CD groups, the conduct group were significantly more likely to come from lower income families ($p<0.0001$), to have more siblings ($p<0.05$), to have smaller houses ($p<0.01$), which were more likely to be council accommodation ($\chi^2(3)=15.3$; $p<0.01$), and were more likely to be living with only one natural parent ($\chi^2(2)=7.8$; $p<0.05$).

Significant demographic features (house status; house size; number of siblings, parent status and income) were entered into a multiple regression along with parenting index score, full scale IQ at 6 years and estimated full scale IQ at 12 years. VLBW vs. FBW was also entered as an independent variable. Parent BAC scores were used as a dependent variable. The method used was stepwise with $p=0.05$ as entry criteria.

Parenting index score was the main contributor which explained 9% of the variance in parent BAC score ($p<0.001$). House status added a further 7% ($p<0.001$) children with conduct disorder being more likely to live in council accommodation. Table 30 shows the details.

Table 30: Regression of relevant factors on parent rated BAC score

	Correlation with FSIQ	B (final model)	Beta	sr^2 (unique)
Entered				
Parent Index	0.32	0.56	0.29**	0.08
House status	-0.30	-1.17	-0.27**	0.07
Overall R^2 =0.17	Overall adj. R^2 =0.16	R=0.41**		
Not entered				
VLBW / Control	-0.17	-0.76	-0.10	
Income	-0.15	-0.01	-0.01	
House size	-0.14	0.03	0.01	
Number of siblings	0.13	0.20	0.05	
Parental status	0.04	-0.48	-0.05	
Full scale IQ at 12 yrs	-0.17	0.01	0.01	
Full scale IQ at 6 yrs	-0.17	-0.02	-0.10	

**<0.001

Social difficulties

Bullying

The percentage of children in both groups who are regularly bullied were identified using a single question from the CAPA interview. In order to be scored by the interviewer on this item, a child had to be a definite target for bullying, rather than have experienced the odd taunt. VLBW children were far more likely to be a regular target with a quarter being scored in this way (33/136; 24%) compared to 15/148 (10%) of peers ($\chi^2(1)=10.1$; $p<0.01$).

Indiscriminate Relationships

In addition to being a target for bullying, VLBW children show poorer social skills than their peers in a number of other ways. Parents reported on the CAPA that VLBW children frequently showed indiscriminate friendships. Typically, this was described by children who sought social approval from any other child, or began interactions with adults with whom they were not familiar. This was an aspect which worried parents of VLBW a great deal as their children reach teenage and are less in their parents control socially.

VLBW children were felt by their parents to show a worrying lack of discrimination socially compared to their peers, both with adults (14%VLBW vs. 2% peers) and with children (22% VLBW vs. 9% peers). In both categories VLBW children were significantly less discriminate ($\chi^2(1)=14.2$, $p<0.001$ adults ; $\chi^2(1)=9.7$, $p<0.01$ children).

Friends & Confidantes

VLBW children were significantly more likely to have difficulty making friends (20/136,15% VLBW vs. 6/148, 4% controls, $\chi^2(1)=9.7$; $p<0.01$). In addition, the premature group were significantly less likely to have a peer confidante ($\chi^2(1)=7.1$; $p<0.01$). Although the proportions are fairly similar, the majority (60%) of VLBW children did not have a confidante whereas only 40% of comparisons were without one. There were no differences on the proportions having a family confidante (90%VLBW vs. 92% Controls, $\chi^2(1)=0.4$; $p=0.52$) or those having a best friend (64%VLBW vs. 71%Controls, $\chi^2(1)=1.6$; $p=0.21$).

Eating and Sleeping difficulties

Sleep disturbances

Very low birth weight children were no more likely to show sleeping difficulties than their peers including getting off to sleep, nightwaking and early morning waking. They were not at an increased risk of nightmares or nightterrors, did not sleepwalk more and were no more likely to wet the bed at night or have hypersomnia (excessive daytime sleeping). In total, 32/136 VLBW children and 28/148 comparison children had one or more type of regular sleep disturbance and this difference was not significant ($\chi^2(1)=0.9$; $p=0.34$). Table 31 gives details of sleep-related difficulties across groups.

Table 31: Frequency of sleep related difficulties

Problem	VLBW (n=136)	Comparison (n=148)	χ^2 value
Insomnia	13	15	0.2 (ns)
Hypersomnia	6	3	1.3 (ns)
Sleepwalking	14	9	1.7 (ns)
Nightmares	6	2	2.4 (ns)
Nightterrors	3	2	0.3 (ns)
Bed wetting	8	8	0.03 (ns)

Sleep in relation to other factors

Gender differences

In both VLBW and comparison groups, girls appeared to be slightly more at risk of sleep disturbance, but no differences reached statistical analysis. 19/67 (28%) VLBW girls compared to 13/69 (19%) VLBW boys, and 17/73 (23%) comparison girls compared to 11/75 (15%) of comparison boys experienced one or more sleep difficulty.

Psychological difficulties and sleep problems

However, sleep was related to some extent to psychological difficulties at age 12 years. The scores of the parental and child anxiety questionnaires were predictors for sleep problems when entered into logistic regression and removed the effect of VLBW status (parent- $p<0.001$; odds ratio=1.1, 95%CI: 1.0 to 1.2; child-$p<0.05$; OR=1.1, 95%CI= 1.0 to 1.2). However, of the 13 children with generalised anxiety (see chapter 6) only 5 had regular sleep problems.

Predicting sleep difficulties at 12 years

Using logistic multiple regression (forward stepwise), sleep was examined in relation to variables collected at earlier stages of development. Insomnia (of any of the three types mentioned above) was not related to a number of perinatal factors in the VLBW children, including time artificially ventilated, gestation time, birthweight, Apgar scores at 1 and 5 minutes and presence of IVH and PVL as shown by perinatal CT Scan. Motor skills at 6 years and IQ at 6 years which may be markers for associated neurological problems were also unrelated to sleep difficulties, as were current motor scores and IQ estimates.

Eating difficulties

In addition, VLBW children were not at an increased risk of eating problems such as food fads or unusual appetite fluctuations or eating disorders such as bulimia or anorexia. Table 32 below gives details of the numbers of children experiencing various food related problems. VLBW children were more likely to have constipation than their peers.

Table 32: Frequency of eating-related difficulties

Problem	VLBW (n=136)	Comparison (n=148)	χ^2 value
Unusual loss of appetite	5	2	1.6 (ns)
Weight loss	6	5	0.2 (ns)
Unusually excessive appetite	11	14	0.2 (ns)
Excessive weight gain	17	15	0.4 (ns)
Anorexia type problems	4	3	0.3 (ns)
Bulimic type behaviour	2	3	0.2 (ns)
Food fads	19	21	0.9 (ns)
Constipation	13	2	9. 5*

*<0.01

Co-morbidity of psychiatric outcomes and distribution of impairment

ADHD and other co-morbid outcomes

ADHD (presence of any one of the three disorders) was examined in relation to conduct disorder or anti-social behaviours, again using CAPA data. In the control group 2 out of 9 children with ADHD symptoms also met DSMIV criteria for conduct disorder whilst in the very low birth weight group this was true for only 2 out of 31. Although using Fishers exact tests neither group showed a statistically significant co-morbidity link, the numbers are very small in the comparison population and a relationship between the two problems has often been reported elsewhere (e.g., Bird et al, 1994; Loeber & Keenan 1994; Biederman et al 1991).

Using questionnaire data, a slightly different picture emerged. On both the Behaviour and Activities Checklists, and on the Rutter Child Behaviour Questionnaires there were significant differences between ADHD and non-ADHD children in both the VLBW and comparison groups. VLBW children with any of the three attention deficit/hyperactivity disorders scored significantly worse than non-ADHD VLBW children on the Behaviour and Activities Checklist (Mann Whitney child rated: $p<0.001$ and parent rated: $p<0.01$) and Rutter Questionnaires (teacher: $p<0.05$), parents :$p<0.0001$). Control children with ADHD, also scored less favourably than non-ADHD peers on these measures (Behaviour and Activities Checklist: parent-report $p<0.001$, self-report $p<0.01$; Rutter Questionnaires: teachers: $p<0.001$, parents: $p<0.001$). Table 33 shows medians and interquartile ranges for all measures and groups.

In contrast, whilst parent questionnaires reported higher rates of anxiety ($p<0.01$) and depression ($p<0.01$) in VLBW ADHD children compared to non-ADHD VLBW children, comparison children with and without ADHD were not rated differently by parents using these measures. Self report versions did not show any differences between ADHD and non-ADHD children in either the VLBW or comparison group when groups were separate.

However, ADHD as defined using the CAPA *was* related to child depression questionnaire scores when groups were combined, with the median depression scores significantly higher for those individuals with one form of ADHD (14, IQR=5-22) compared to non-ADHD individuals (7, IQR 2-17 ;$p<0.01$). This suggests that numbers of ADHD children were too small when separate to produce significant results. As the study found a significantly higher proportion of VLBW children to show ADHD compared to peers, this finding may also go some way to explaining increased depression in VLBW children.

Also using CAPA data, generalised anxiety was found to be more frequent in the VLBW children with ADHD. 6/31 (19%) of this group were found to meet DSMIV criteria for generalised anxiety disorder (χ^2 (1)= 6.9 $p<0.01$) whereas none of the comparison ADHD children also manifested anxiety ($\chi^2(1)= 0.13$ $p=0.72$). This relationship can also be expressed in terms of those with anxiety. In total 6/13 children meeting criteria for generalised anxiety also met DSMIV guidelines for one of the three ADHD disorders. Table 33 shows the co-morbidity data in more detail.

Table 33: ADHD and median scores (IQR) on psychological questionnaires.

		VLBW		Comparison	
		Non-ADHD	ADHD	Non-ADHD	ADHD
		n=105	n=31	n=139	n=9
Behaviour and activities checklist					
	parent	1 (0-2)	3.5 (0-7.5)*#	0 (0-2)	6 (3-7)**#
	child	2 (0-4)	3 (2-7.5)**#	2 (0-4.5)	5 (3-10)*#
Mood and Feelings Questionnaire					
	parent	7 (2-12)	12 (7-23)*#	5 (2-10)	4 (3-9)
	child	11(3-21)	15 (5-22)	6.5(2.5-12)	10 (1-20)
Children's Manifest Anxiety Scale					
	parent	5 (3-10)	11 (5.5-15)*#	4 (1-7)	5 (4-8)
	child	9 (4-14)	9 (7-15.5)	6.5 (3-9)	9 (2-12)
Rutter Child Behaviour Questionnaire					
	parent	6 (4-10)	15 (8.5-21)**#	5 (2-8)	12 (9-23)**#
	teacher	2.5 (1-5)	4.5 (2-12)+	1 (0-3)	4 (4-12)**#

+<0.05 *<0.01 **<0.001 # Remained significant after adjustment for multiple comparisons

Anxiety and psychiatric problems (other than ADHD)

Parental anxiety questionnaire scores related strongly to parent self esteem scores (r=0.57; p<0.001) and also to parent depression scores (r=0.72, p<0.001). Child anxiety scores also correlated strongly with child self-esteem scores (r=0.53; p<0.001) and child depression scores (r=0.79, p<0.001). Generalised anxiety was found to be related to higher scores on all questionnaires when parent rated versions were examined, but not when child questionnaires were used. Table 34 below shows all parent questionnaire details when comparing those with and without generalised anxiety for both VLBW and comparison groups combined.

Table 34: Median (IQR) scores on other psychological questionnaires by anxiety group.

	Without generalised anxiety	With generalised anxiety
Depression scale	6 (2 to 11.5)	14 (9 to 23)*
Self esteem scale	5 (2 to 9)	10 (7 to 14)*
Behaviour scale	1 (0 to 2)	4 (0 to 7)+

+<0.05 *<0.01

Other psychiatric co-morbidity data

Depression and Behavioural problems

Numbers of children meeting DSM criteria for conduct disorder were too small in both groups to investigate to analyse the relationship between depression and behaviour in this way. However, neither set of depression scores correlated strongly with either child (spearman r-square=0.16; p<0.001) or parent (spearman r-square=0.05; p<0.001) behavioural questionnaire score.

A strong relationship was found, however, between Rutter PQ scores and Parent MFQ scores. Many children in both groups scored low on both scales. However, of particular interest is the fact that the relationship between RPQ and MFQ was stronger for the VLBW with RPQ explaining over half the variance in depression score (r-square=0.52,$p<0.001$) compared to r-square=0.31 for their peers ($p<0.001$).

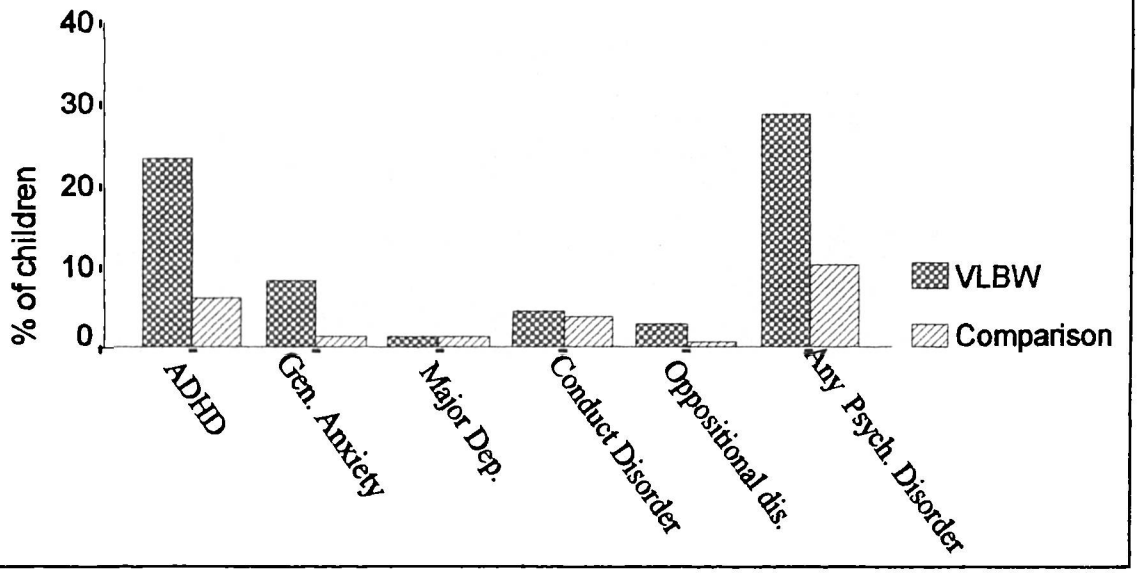
Conduct disorder

Combining VLBW and comparison children (in order to increase numbers for analysis), those with conduct disorder were compared to those without on the other psychological questionnaires. Of all the parent and child scales, only child reported self esteem was significantly different between groups ($p<0.05$). Although this may have a certain degree of clinical validity, one significant result amid many comparisons must be treated with caution.

Overall psychiatric risk

More than a quarter of VLBW children (38/136; 28%) were likely to meet clinical criteria for any of the disorders discussed here compared to 15/148 (10%) of peers ($\chi^2(1)=14.8$, $p<0.001$). Fig.6 shows this along with the frequency of children meeting criteria in each individual area. In total 10 of the 38 (26%) VLBW children and 5/15 (33%) of comparison children with one disorder also met criteria for a second. This difference was not significantly different.

Fig. 6: Proportion of children presenting with psychiatric disorder



Multi-trait multi-method analysis and validity of traits

As well as considering which outcomes fall together it is important to consider the validity of each finding by comparing the strength of relationship between measures of the same trait (regardless of respondent) and between measures completed by the same respondent (regardless of trait) as set out by Campbell and Fiske (1959) . Table 35 below shows the relationship between all psychiatric questionnaire measures.

As this table indicates, the correlations between same-trait measures across respondents are moderate with a mean of r=0.40. However, measures answered by the same rater appear show a slightly stronger relationship with mean correlations for self-reports at r=0.49 and for parent reports at r=0.47. Although these means are only slightly higher within respondent, they mask some very strong connections in particular between depression and anxiety for child raters (0.79) and adult raters alike (0.72). Using criteria set out by Campbell and Fiske (1959), only the BAC shows higher cross-respondent scores than within-respondent results.

Table 35: Multi-trait multi-method matrix

	Ch-CMAS	P-CMAS	Ch-FSSC	P-FSSC	Ch-MFQ	P-MFQ	Ch-Se	P-SE	Ch-BAC
P-CMAS	(0.41)								
Ch-FSSC	0.69	0.30							
P-FSSC	0.23	0 58	(0.34)						
Ch-MFQ	0.79	0 37	0 64	0.22					
P-MFQ	0.40	0.72	0.27	0.54	(0.40)				
Ch-Se	0.53	0.33	0.45	0.28	0.56	0.36			
P-se	0.37	0.53	0.25	0.40	0.33	0.63	(0.39)		
Ch-BAC	0.36	0.23	0.26	0.02	0.40	0.21	0.25	0.24	
P-BAC	0.16	0.39	0.03	0.19	0.23	0.42	0.17	0.31	(0.45)

These figures suggest that whilst there may be some finding of discreet outcomes in very low birth weight children, there is also a rater-factor. That is, rather than identifying several co-morbid difficulties, parents may be identifying a "generalised problem outcome" with their VLBW children which leads to higher scores than peers on all measures. In Campbell and Fiske's terms, the method of measurement (ie. parent or child rater) is contributing more than the trait itself. This is particularly true of depression and anxiety. It is interesting to note that behavioural problems were not confused with other traits, this being the only questionnaire outcome which showed higher rates within trait than within respondent, as stated earlier. This may be because items on this questionnaire are largely explicit actions rather than subjective emotions or cognitions.

Despite the fact that parents may be identifying an unspecified emotional problem, there is some evidence for there being genuine co-morbidity in this sample. Firstly questionnaires do show some discriminant validity and it is questionable whether the measures used show "too high correlations with other tests from which they were intended to differ" (Campbell and Fiske, 1959, page 81) . CAPA data for example also shows that whilst ADHD behaviours were often reported, clinical anxiety items were less often reported and severe depression symptoms were considerably rarer. This suggests some discrimination of symptoms by parents. In addition, although co-morbidity rates were not higher for the VLBW group, there is some evidence for a different pattern of co-morbidity which suggests that if parents of VLBW children and of full term peers were indeed unable to differentiate problem areas an were grouping traits together, they were doing so in a different way according to birth status.

Distribution of impairment

There has been much emphasis in the literature recently on investigating whether **most** VLBW children are at some sort of mild disadvantage compared to peers, or whether a **few** of these children have most of the difficulties listed above.

The present study has also attempted to examine this. All the problem areas identified here represent increased **risk** and not a certainty, with some VLBW performing well in all areas despite apparently hopeless neonatal conditions. However, it also appears that the majority of VLBW children showed at least one of the difficulties described in this study, with a smaller proportion experiencing a number of poor outcomes. These groups are increased when physical sequelae such as being excessively short or clumsy are taken into account.

In brief therefore, it appears that a small group of VLBW children are untouched by the trauma of extreme prematurity. The remaining group experience some, usually slight impairment, and another small group are unfortunate enough to experience a number of difficulties even as they reach adolescence.

Using a cluster analysis technique (see Anderberg, 1973), it was possible to determine four distinct groups of children experiencing a different profile of impairment. Full scale IQ, parent depression questionnaire score, parent anxiety questionnaire score, parent behaviour and activities checklist score and parent Rutter questionnaire scores were used as dependent variables for the VLBW group only. The four groups emerging showed each of four combinations which are summarised below:

Cluster 1: (n=13) **"Pervasively impaired"**

Low IQ scores and high (less favourable) scores on psychological questionnaires.

Cluster 2: (n= 38) **"Normally developing"**

Normal IQ score and low (normal) questionnaire scores.

Cluster 3: (n=54) **"Cognitively impaired"**

Low/normal IQ scores and low (normal) psychological questionnaire scores.

Cluster 4: (n=23) **"Psychologically impaired"**

Normal IQ scores and high psychological questionnaires.

As can be seen from this type of analysis, there are distinct groups of children with different degrees of combined impairment. Cluster 2 is the least impaired group with Cluster 1 forming a pervasively impaired group. Each group was significantly different from each

other on all measures at $p<0.0001$. Importantly for the validity of these clusters very similar groups emerged using child questionnaire data. These can be seen in table 36. In addition, a number of children fall into each cluster group. This is again similar in the child questionnaire analysis with numbers being slightly more evenly spread across subgroups (see table 37 for details).

Table 36: Cluster analysis using IQ and parent rated psychological questionnaires

(Mean cluster centres and standard deviations)

	Cluster 1 (n=13)	Cluster 2 (n=38)	Cluster 3 (n=54)	Cluster 4 (n=23)	Cluster MS	Error MS	F value
FSIQ	70 (12.5)	109 (11 3)	80 (9.0)	95 (8.0)	18622.29	113.91	163.48**
CMAS-R	16 (4.5)	4 (3.5)	5 (3.3)	14 (4.2)	957.78	14.87	64.41**
MFQ	28 (10 8)	6 (4.7)	5 (4.3)	20 (9.3)	4005.19	37.61	106.49**
BAC	9 (7.5)	1 (1.7)	1 (2.0)	4 (4.5)	232.51	12.39	18.76**
Rutter	21 (7.5)	5 (4.0)	5 (3.6)	18 (6.4)	3922.44	24.25	161.76**

**<0.001

Table 37: Cluster analysis using IQ and child rated psychological questionnaires

(Mean cluster centres and standard deviations)

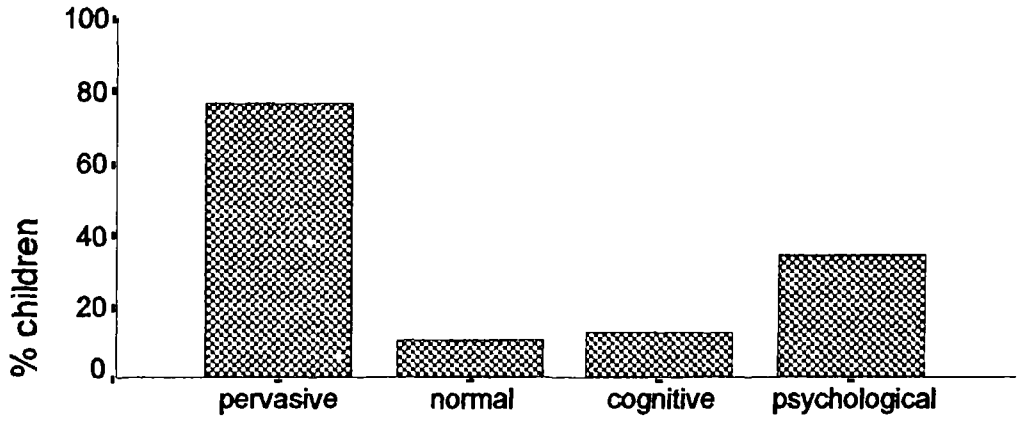
	Cluster 1 (n=26)	Cluster 2 (n=32)	Cluster 3 (n=34)	Cluster 4 (n=36)	Cluster MS	Error MS	F value
FSIQ	71 (10.2)	111 (10.4)	80 (8.9)	94 (7.8)	20667.16	88.96	232.31**
CMAS-R	15 (5.2)	5 (3.7)	6 (3.4)	13 (4.9)	1380.73	50.89	27.13**
MFQ	29 (11.3)	6 (6.0)	5 (3.9)	19 (7.3)	1428.41	16.86	84.72**
BAC	7 (8.0)	2 (2.8)	5 (6.2)	5 (6.4)	279.99	29.59	9.46**
Rutter	18 (14.3)	6 (4.8)	6 (5.0)	11 (7.7)	6261.73	43.63	143.51**

+<0.05 **<0.001

It appears therefore that impairment is fairly widely distributed, with around one quarter of the children developing normally in both psychological and cognitive areas. Although the remaining three quarters experience some unfavourable outcome from being VLBW, only a quarter of the total group have impairments in both areas of outcome.

The clusters of children identified were then used as subgroups in further analysis comparing each cluster on a number of perinatal and six year assessment data. Firstly Chi-square analysis revealed a number of differences regarding categorical outcomes. Ten of the 13 (77%) children with "pervasive" impairment also had one of the three ADH disorders compared to 8/23 (35%) of the "psychological" group, 7/54 (13%) of the "cognitive" group and 4/38 (11%) of the "normal" children (χ^2 (3) = 29.86; $p<0.00001$). Fig.7 shows these differences more clearly.

Fig. 7: The Percentage of Children in each Cluster with Attention Deficit Hyperactivity Disorders



Half of the children in this most severely affected cluster also met DSM criteria for generalised anxiety compared to only one child from the "normal"group ($\chi^2(3)=13.77$; $p<0.003$)and 8/13 (62%) had at least one clinical depression symptom compared to 7/38 (18%) of "normal" VLBW children. Only the group described in the cluster analysis as having "psychological" impairment were more likely to show one depression symptom with 18/23 (78%) experiencing this outcome. The differences in the groups were again highly significant ($\chi^2(3)=31.35$; $p<0.0001$).

From a clinical perspective, the group with impairments which are "pervasive" and the "normal" group are the most interesting in terms of predicting the prognosis of a general VLBW population. By examining differences between each of these groups and the remaining VLBW children may enable us to better understand their respective outcomes.

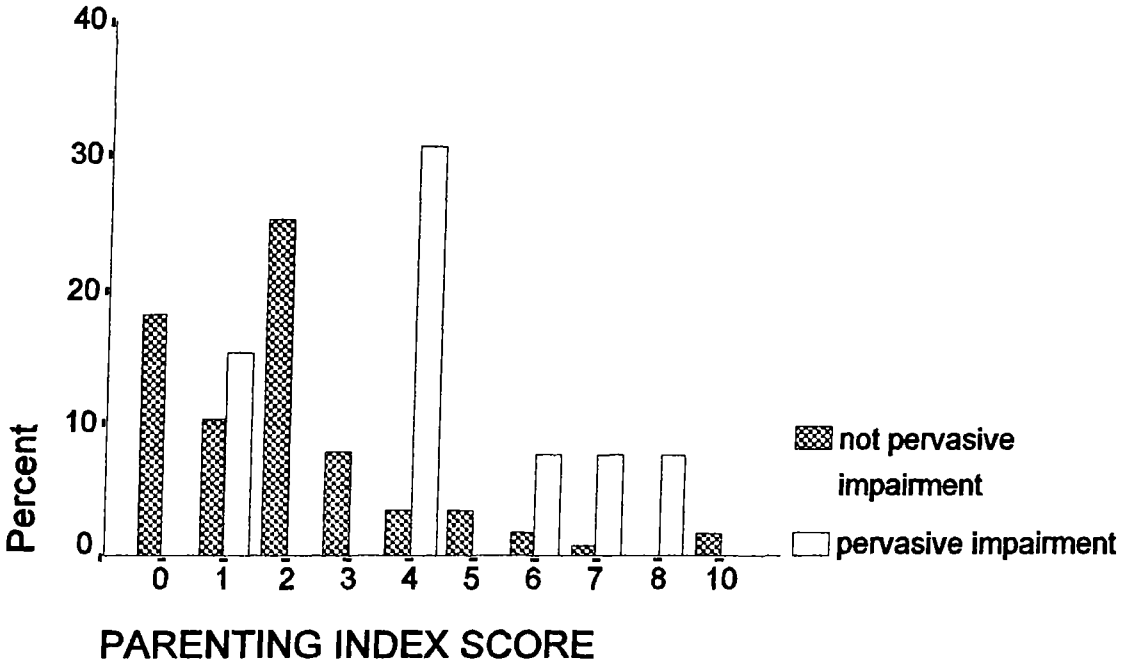
Differences between VLBW children with pervasive impairment and others

Using univariate statistics to begin with, children in the "pervasive" cluster were found to be different from the remainder of the group on a number of factors. Unsurprisingly, the pervasive group were significantly less favourably than the rest of the VLBW group, on most other areas of 12 year performance including motor impairment (median=8, IQR=5 to 10 vs. median=4, IQR=4 to 5; $p<0.05$); reading comprehension (median=76, IQR=67 to 82 vs. median=87. IQR=85 to 90; $p<0.001$); maths (median=86, IQR=80 to 91 vs. median=97, IQR=93 to 99;$p<0.0001$). Of the demographic and family factors, these children were found to have smaller houses (median=4 rooms, IQR=4 to 6 vs. median=5 rooms, IQR=5 to 6; $p<0.05$) which were more likely to be council accommodation ($\chi^2(2)=8.8$; $p<0.05$) and this

group also scored higher (worse) than the others on the "parenting index" (median=2, IQR= 2 to 3 vs median=4, IQR=3 to 6; $p<0.01$), see Fig 8. This group did not, however, show lower family incomes or poorer parental education levels.

Examining factors measured at early ages which could be predictive revealed no clear perinatal differences between the pervasive group and the others. However, full scale IQ ($p<0.001$) was lower for the pervasive group (mean=70, sd=12.5) than for the other VLBW children (mean=93, sd=16.2). There were no differences on motor impairment at six, head circumference or "soft sign" index which may have revealed markers for underlying neurological mechanisms.

Fig. 8: Parenting index distributions in VLBW children with pervasive and non-pervasive problems



Differences between VLBW children with normal outcome and other VLBW children

This group were found to be significantly better at maths (median=105, IQR=102 to 109 vs median=93, IQR=90 to 95; $p<0.0001$); sight reading (median=107, IQR=104 to 110 vs median=96, IQR=91 to 98; $p<0.0001$); reading comprehension (median=94, IQR=93 to 100 vs median=85, IQR=81 to 86; $p<0.0001$); spelling (median=104, IQR=100 to 112 vs median=92, IQR=87 to 95;$p<0.0001$) and motor skills (median=3, IQR=2 to 4 vs median=5, IQR=4 to 6;$p<0.001$) at 12 years. Family factors also revealed differences between this subgroups and their impaired counterparts. "Normal" outcome VLBW children had houses which were more likely to be owned/mortgaged (χ^2 (2)=11.4; $p<0.01$), higher levels of maternal education (χ^2 (4)=22.0, $p<0.001$), and higher family income levels with 20/32 vs. 25/80 falling in the top income band (χ^2 (7)=15.6,$p<0.05$).

Data collected at early ages again showed no relationship between perinatal variables and normal outcome. However, full scale IQ at six was significantly higher for this group(median=119, IQR=114 to 120) compared to the other children (median=107, IQR=100 to 108; $p<0.0001$) as was standing height (median=147cm, IQR=144 to 154 vs median=142cm, IQR=141 to 144; $p<0.05$), and occipital frontal circumference measurements were also larger (median=54cm, IQR=54 to 55 vs. median=53cm, IQR=53 to 54; $p<0.01$).

Multiple analyses

Following these simple comparisons, two logistic regressions were performed using any factors identified as discriminating the groups from the remainder of the VLBW sample. The first, using pervasive outcome as a dichotomised dependent variable ("pervasive" group vs. "rest of VLBW") revealed three main associations: Less favourable parent index scores

($p<0.01$; OR=1.66, 95%CI= 1.27 to 2.04), Council house accommodation ($p<0.01$; OR=6.2, 95%CI=4.56 to 7.91) and Motor impairment ($p<0.001$; OR=1.72, 95%CI=1.35 to 2.09). Table 38 shows regression details.

The second using "normal" group versus "rest of VLBW" as the dichotomised dependent variable also revealed higher full scale IQ at six to be a predictive factor although the effect was small ($p<0.0001$, OR=1.1, 95%CI=1.0 to 1.2) as well as head circumference ($p<0.01$; OR=1.6, 95%CI=1.25 to 1.95). See table 39 for details.

Table 38: Logistic regression of pervasive group as a function of relevant variables

	B	odds ratio	95% CI
Entered			
Parent index	0.51	1.66	1.27 to 2.04*
House status (council)	1.83	6.23	4.56 to 7.91*
Motor impairment score	0.54	1.72	1.35 to 2.09**
Not entered			
FSIQ at 6 years	<0.01	1.00	
House size	- 0.43	0.65	

Table 39: Logistic regression of normal group as a function of relevant variables

	B	odds ratio	95% CI
Entered			
FSIQ at 6 years	0.11	1.12	1.00 to 1.20**
Head circumference	0.47	1.60	1.25 to 1.95*
Not entered			
House status (council)	-0.53	0.59	
House size	0.03	1.03	
Income	0.24	1.27	
Maternal education	0.18	1.20	
Standing height	0.01	1.01	
Motor impairment score	-0.17	0.85	

DISCUSSION

The results from this study show that even those VLBW children who enter mainstream schooling are at a disadvantage in the majority of developmental areas. Compared with their peers they show lower cognitive ability and educational performance, more attention deficit/hyperactivity problems, more depressive and anxiety symptoms (although emotional problems may not be clearly distinguishable from one another) and poorer social competence. Although there are some differences in behavioural problems, anti-social behaviour does not appear to be typical of VLBW children. Eating and sleeping patterns also appear unaffected by birthweight group.

Thus the first hypothesis of this study, that VLBW children will show deficits in cognitive ability and increased risk of psychiatric difficulties was borne out with these exceptions. Although a general delay was noted to some extent, there does appear to be particular difficulty for these children in non-verbal and abstract tasks such as performance IQ, reading comprehension and mathematics. As discussed fully below, the mechanisms and causes underlying these outcomes are likely to be complex and clear pathways have not been revealed by this study. Thus, it appears that neither the second nor the third hypothesis which state that mediating factors will be identified have been entirely supported. However, some outcomes do seem to have related mediating factors, for example the link between soft signs and ADHD may indicate a neurological mechanism in both groups.

Whilst most VLBW children experiencing difficulties score lower than peers but still within the normal range, there is also a significantly increased proportion of children with 'abnormal' development in the areas of cognition/education, ADHD, and generalised anxiety. Analysis of the distribution of impairment has shown that approximately a third of VLBW children experience problems in all areas, whilst a quarter are problem free.

For the purpose of the first part of this discussion, a more detailed overview of results is given and will be grouped into those concerning cognitive and educational performance, those regarding psychiatric difficulties, and eating and sleeping. Following this, different major aetiologies for psychological outcome are discussed, and some possible developmental mechanisms are examined.

Cognitive and educational outcome

Very Low Birth Weight children in this study remain at a disadvantage to their peers at 12 years of age in terms of both cognitive and educational function. They showed poorer performance on the IQ subtests and this was mainly due to their non-verbal problem solving skills, resulting in a mean overall IQ difference of 8 points. The VLBW children also performed less well than the comparison group in all educational assessments. Some of these differences were due to a lower cognitive level, although reading comprehension and maths remained significantly different after controlling for IQ.

The educational disadvantage was reflected in the higher proportions of VLBW children falling below the learning disability threshold, and in the numbers receiving remedial

education. A higher proportion of VLBW children were also described as "poor" at two or more school subjects. Thus, although VLBW showed a wide range of capabilities, many were falling consistently at the lower end of their peer group, and a small subgroup were experiencing more serious difficulties.

Educational and cognitive deficits in VLBW children have now been well documented by several authors in children of younger ages (Eilers et al, 1986; Zubrick et al 1988 Szatmari et al 1993; Vohr et al 1989; Saigal et al 1991). However very few studies continued follow up to the age of the present cohort. It has previously been uncertain whether the VLBW children showed a delay in cognitive and educational maturation which would correct itself over time, or whether results of early testing indicated a long term difficulty in certain areas.

The data here would suggest that the latter is true, as results at 12 show similar cognitive impairment to that found at six years of age, and similar educational difficulties to those reported regarding a subset of these children at eight years (Marlow et al 1989;1993). In addition, subgroup comparisons from 8 to 12 showed no evidence of catch up within the VLBW group. Developmental theories which might explain this outcome are discussed later.

If VLBW children are indeed at an educational disadvantage, it would seem important to attempt to predict which children are experiencing these type of problems in their teenage years. Unfortunately, as with other studies which have tried to predict outcome at earlier ages (Marlow et al 1993; Papile et al 1983, Smedler et al 1992; Roth et al

1993), clear relationships have been difficult to find. Although IQ testing at 6 years gives the best predictive value for both maths and reading comprehension at 12 years, it would still prove a very inefficient way of selecting children for extra intervention. This study did find that motor skill at 6 years was a predictor of both cognitive level and academic achievement. In addition the number of days for which a VLBW baby was ventilated (as a proxy for duration of neonatal illness), may predict their long term cognitive outcome.

Perinatal illness and the pattern of non-verbal difficulties may indicate a neurological cause of impairment. VLBW children seemed to find most difficulty with non-verbal tasks and this may reflect an underlying neurological area which is particularly susceptible. Even reading comprehension which is essentially verbal, represents one aspect of verbal ability which may require a higher degree of spatial and cognitive planning. O'Keefe and Nadel (1978) suggest that semantic mapping such as is used in understanding text, may use a similar neurological system to that of spatial or physical templates. Mathematical ability and the non-verbal problem solving skill assessed in the performance IQ are also both more spatial and abstract than sight reading or spelling. This may be important when viewed in relation to the poor motor skills noted in this same cohort of children as they enter adolescence (Powls et al, 1995). Mykleburst (1975) described these types of difficulties in low birth weight children as a "non-verbal learning disability" and this description was felt by Smedler et al (1992) to accurately portray the growth retarded VLBW children in her study who showed a lack of strategy formation. Later in this discussion, "executive function" impairments of the type described here are examined again as a possible mechanism for poorer performance.

In contrast to the current results, Levy-Schiff et al (1994a) found deficits in all areas except reading comprehension, and also report that psychosocial variables were the central predictors of outcome in this area. It is evident that whilst it seems clear that cognitive deficits exist in the VLBW population, this area of investigation needs a more detailed examination through more specific research studies focusing on motor and cognitive planning, its relationship to semantic and spatial ability and the detailed neurological development of VLBW children.

Studies other than that of Levy Schiff and colleagues (op.cit) have also emphasised the influence of other factors on cognition. Sommerfelt and colleagues (1996) have recently completed a study in which VLBW children's cognitive performance was found to be mainly associated with parental education and other socio-economic variables, and was only weakly predicted by birthweight. Furthermore, in their population, VLBW children were no more sensitive to these demographic variables.

This is similar to the finding in the present study that whilst being VLBW was a significant predictor of cognitive and educational outcome in multivariate analyses, it was less important than poor maternal education and low income in all but the analysis with mathematics score as the dependent variable. Equally Dammann et al (1996) showed that cognitive ability and language skill were much more closely associated with socio-economic factors than to neurological ones, although their study examined within-VLBW group differences only.

In the present study, the status of being Very Low or normal birthweight was a substantial predictor for all outcomes examined after controlling for socioeconomic variables. However as predicted by the studies cited above and others (Pharaoh et al 1994b, Leonard et al 1990), socioeconomic factors (maternal education, income and number of siblings) did relate to performance measures in some respects. These factors may reflect differences in family motivation, aspirations and attitudes to education, which have previously been shown to be important in determining performance at 10 years (Illsley & Mitchell, 1984).

Early interventions may have lasting effects on VLBW children (Achenbach et al, 1993) and such influences may be most effective in children from poorer socioeconomic groups (Spiker et al 1993; Parker et al 1992). The amelioration of these longer term disabilities must remain the goal of future research. It is particularly important to consider the educational and cognitive progress in this group, since they are expected to be those who are able to cope with the demands of mainstream schooling. However, this will only be possible if we are able to identify and acknowledge their continuing difficulties in this area.

Further studies are also needed examining direct links between psychosocial factors, self esteem, individual motivation and school performance in VLBW children. In addition, advances in neonatal cerebral scanning amongst other techniques may enable us to increase our understanding of predictive perinatal events.

Psychological and psychiatric outcome

ADHD

VLBW children in this study were found to be more prone to attention-deficit hyperactivity disorders even in early adolescence. While the prevalence in this group was found to be 22%, the incidence in a group of socially-matched peers was only 6 %. Previous estimates of incidence in the UK also vary from about 0.06% for children attending clinic (Taylor, 1986) to about 6% in community studies (Szatmari et al 1989).

Whilst many of the children assessed in this study had been previously identified as meeting clinical criteria according to parents, none were receiving treatment at the time of the study. A health questionnaire received from each parent showed drug treatment if it was being administered and no parents reported having received help. Several requested my assistance to obtain support for their ADHD children.

Other studies (most notably by Szatmari et al, 1993) have also reported a higher incidence of attention deficit and hyperactivity (but not other psychiatric outcomes) in children born too small and too early. In the cited study, an absence of conduct disorder is also noted. Although this thesis has identified an increased score on anti-social behaviour questionnaires for VLBW ADHD children compared to full term peers with ADHD, the proportion of children meeting conduct disorder criteria defined by the DSMIV was smaller than expected. Increased scores on parent Rutter questionnaires may indicate an increase in general activity and anxiety rather than anti-social behaviour. This supports the suggestion by Szatmari that VLBW children may present with a "purer"

form of ADHD than found in the general population for whom social factors are much more important especially regarding the development of co-morbid conduct disorder. In contrast to this, two recent investigations have reported no increased proportion of hyperactive or attentional problems in middle childhood (Sommerfelt et al, 1996; O'Callaghan et al, 1996).

ADHD has been reported to correspond to poorer psychological and social development at later ages. Stewart and colleagues (1973) for example, examined the feelings of hyperactive children as adolescents. A large proportion of children in this investigation felt "disgusted with self" (62%) and "pessimistic about future" (46%). Twenty percent had thought about suicide. Although this study did not include a control population, it highlights the negative self-image which remains with hyperactive children into adolescence.

Emotional difficulties - anxiety and depression

VLBW children in this study appeared to show symptoms of emotional difficulties. These were measured in terms of anxiety and depression and will be discussed as such, but it must be noted that trait validity on these outcomes was weak. That is, parents in particular may be confusing or merging these two difficulties when responding in this study.

Regarding anxiety measures, a large proportion of the sample (8% vs. 1%) actually met DSM criteria for generalised anxiety disorder even though the age of the group was young for this type of psychological difficulty. In addition, more VLBW children show

extreme scores on the CMAS-R compared to normal birthweight comparison children. The finding of increased anxiety was particularly true for girls. This finding is very similar to another report by Levy Schiff and colleagues (1994b) on adolescent psychological development in premature children. In their study, the VLBW premature group also showed higher rates of anxiety using the State-Trait anxiety inventory for children.

Although generalised anxiety disorder as defined by DSMIV was only seen in a very small number of VLBW children in this study, high anxiety levels as reported through the questionnaires were a source of impairment for many of the children assessed. For example, parents frequently reported significant incapacity surrounding their child's anxiety regarding school work. In some cases, teachers had reported to families that their child was too anxious to answer any questions in class or would not write anything unless they were sure the answer was perfect. Considering the range and depth of secondary school teaching, this was causing some to fall behind compared to non-anxious peers. In this study VLBW children were also more likely than peers to have concurrent ADHD, which may have compounded the effects of each disorder in terms of functional impairment.

As well as higher scores on anxiety measures, VLBW children in this study were found to have lower self-esteem and to show more depressive symptoms than age-matched controls using both individual symptoms from the CAPA and questionnaires completed by the children and their parents. However, no differences were found in the proportions of children of each birthweight group who met a psychiatric classification for major

depression, and numbers of children in both groups were small. This is in accordance with the findings of the Isle of Wight study quoted earlier, in which a very low frequency of fourteen year olds met formal diagnostic criteria despite a high frequency of reported symptoms.

This raises the question as to whether adult depression classification is a valid way in which to categorise adolescent or childhood difficulties. It also highlights the importance of different assessment methods in the measurement of "depression" which has been noted elsewhere (Angold, 1988). In this study, good intercorrelations between self esteem and depression scores were noted for VLBW children (0.62), but were not so strong for comparison children (0.48). These results are very similar to those reported by Levy Shiff et al (1994b) who found 0.72 and 0.26 respectively using self report measures. In the current study slightly higher correlations were found in each group using parent report questionnaires (0.72 & 0.55 respectively).

Some studies examining depression have failed to collect data from the child concerned, instead asking only parents and sometimes teachers. In the present investigation, parents generally rated children as experiencing fewer symptoms using questionnaires than when children rated themselves. Unfortunately, child CAPA interviews were not possible due to time constraints, and it is possible that a higher frequency of children meeting DSMIV criteria for depression might have been identified were self-report techniques used.

In addition, child CAPA data may have provided increased validity for the distinct outcomes of anxiety and depression. As mentioned earlier, multi-trait analysis suggests

that this study may show a general response from parents rather than specific identification of traits.

Social and Anti-social Behaviour

VLBW children in this study scored higher than peers on indexes of general behaviour, such as the Rutter Questionnaire as they enter adolescence. This is in keeping with other studies such as Klebanov and colleagues (1994) who found increased classroom behavioural problems in a large cohort of VLBW children at elementary school and with previous investigations of part of the present cohort (Marlow et al, 1989,1993). It appears that general difficulties remain evident into secondary schooling.

In addition to school based behaviours, parents appear to report a higher incidence of general problem behaviours in this VLBW sample. The current study did not find a statistically significant increase in the proportion of VLBW children with extreme Rutter scores, and the actual proportions crossing the thresholds for behavioural disturbance are not dissimilar in either group to those reported in control groups in other studies. For example, Pharaoh and colleagues (1994b) found 36% of VLBW children and 22% of comparison peers to score over 13 on the parent scale compared with my findings of 26% and 17% respectively. The current study also indicated that very few children in either group (7% VLBW and 5% comparison) scored over the thresholds in both school and home questionnaires.

A somewhat surprising result was the finding that VLBW girls, in this cohort were more likely than female peers to score over 13 the parental Rutter scale when groups were

analysed by gender whereas boys showed no differences across groups. In general any interaction of gender and birthweight status has shown VLBW boys to be more vulnerable to difficulties of this nature (e.g., Pharaoh et al, 1994b). This raises the question as to the nature of parental interpretation of behaviour. It is possible that other behaviours such as those relating to anxiety and depression which may be more common in girls are viewed by parents as oppositional behaviour when manifested in their teenage daughters.

Unlike the Rutter scores, VLBW children did not show increased scores on the BAC, suggesting that the "problems" identified in the former questionnaires reflect an immaturity of behaviour rather than true 'behavioural' problems. The possibility of VLBW children being vulnerable to longterm behavioural difficulties has been of some concern in the literature and researchers of VLBW children at earlier ages have hoped that behavioural differences they found would gradually "catch-up" over time. The development of 'behavioural problems' is still unclear as indicated in this thesis by the poor correlations in Rutter score between 8 and 12 years.

The numbers of clinically defined cases of conduct disorder and oppositional disorder were low in both groups. This may because the children involved in the present study were quite young for many of these behaviours. It may also be the case with conduct disorder behaviours that by asking parents only, this study has failed to detect behaviours occurring without parental knowledge. Finally, the low rates in both groups of oppositional disorder may reflect some conservatism on the part of the interviewer when coding behaviours which are fairly common to *some* degree in an adolescent population.

The combination of neurological, parental and cognitive risk factors associated with VLBW (Weisglas-Kuperus et al, 1993) seemed to make this group of children highly likely to have anti-social difficulties. The present study has found limited evidence to support this, however, and any differences in 'behavioural difficulties' seem likely to be immature, overactive or emotional in nature. For example, whilst the VLBW children in my cohort were three times as likely to have attention deficit or hyperactivity problems, this did not predispose them to conduct disorder or oppositional behaviour and there was limited co-morbidity shown in the VLBW group between ADHD and behavioural problems as discussed above.

In contrast, VLBW children do appear to be suffering from social withdrawal and vulnerability as they enter their teenage years. A number of different social adjustment problems have been highlighted in VLBW children by this study. These include a poorer social framework especially regarding peer relationships. This is in keeping with the few studies of social competence which have been carried out with VLBW populations which were mentioned in the introduction (Hoy et al, 1992, Landry et al, 1990). A study by Klebanov and colleagues (1994), which assessed social competence using the Harter Perceived Social Competence Scale (Harter, 1982) also found poorer "social competence" scores as birth weight decreased, but no comparison group was used and scores were not significantly below general population norms provided by the assessment manual. This particular pattern of 'behavioural' difficulty is discussed later in terms of developmental theory.

Other outcomes

Eating and Sleeping

As with studies examining VLBW children at a very young age, the current investigation has found no differences in any area of eating sleeping or somatic functioning in VLBW children compared with their peers. Hence, early difficulties reported by parents, are at least no more likely to cause persistent problems as the children grow up. Interestingly, sleep difficulties were associated with anxiety score as reported by parents. In the absence of any other associations, especially the absence of any neonatal predictors, this would seem to suggest that anxiety played a causal role in at least some of the insomnia problems recorded.

One exception appears to be the presence of constipation. However given the recognised digestive problems associated with being born prematurely it seems likely that this is more of a medical difficulty than an issue of over-controlled bowel function. Despite the fact that a VLBW cohort might be expected to have minor neurological differences to their peers, and the fact that other studies report an increase in nocturnal enuresis in children with mild neurological dysfunction of a similar age (e.g., Lunsing et al, 1991), the cohort used here were not at an increased risk of this problem.

Differences between child and parent report and multi-method, multi-trait analysis

It was interesting to note the lack of concordance between parent and child measures in the areas of depression and anxiety and to some extent, anti-social behaviour. Children in this study appeared to respond positively to a large number of items on the CMAS-R

and MFQ scoring themselves higher than did their parents in both VLBW and control groups. This has also been found in studies of the general population (Kashani & Orvashel, 1988) and in clinic based research (Costello, 1989). Strauss and colleagues (1988) found a similar effect in a clinic population of teenagers with anxiety disorder, who reported all seven of the clinical symptoms as present, thus suggesting that the criteria should be stricter. It may be that children of this age are poor at assessing their own anxious behaviour and that parents are more sensitive to their worries. Conversely, children may become less willing to share all their anxieties and moods with their parents at this age and this may result in parents underestimating children's worries and feelings.

Which ever of these mechanisms is in play, the parent scores in this study showed more differences across birthweight group than children's responses, which sometimes showed no differences between the groups. It is important to speculate as to why this may have occurred. Firstly, children of this age may in general be more likely to report that worries and fears are present and this may prevent us from discriminating between those who are genuinely "over" anxious and those who are experiencing usual teenage concerns. This was observed by the author to some extent especially regarding the fears questionnaire on which most children indicated a phobic reaction to at least one item mentioned.

Secondly, parents of VLBW children may be more sensitive to their children's emotions than parents in the general population. Thus VLBW parents may be better in touch with their child's development following the stressful early parts of their child's life. Thirdly,

parents of VLBW children may be slightly overprotective towards their child's development especially in terms of emotions. Some literature has indeed reported that VLBW parents are more protective (O'Mara and Johnston, 1989) but the research is mixed with others reporting negative results. Information gathered through the CAPA did not support the idea that VLBW parents were overprotective during early adolescence, but this study did not gather information about mother-child relationships from early childhood.

Of these options, the author feels that the anxiety reported by parents did indeed represent a genuine difference in behaviour of VLBW children. The CAPA interview is designed in a way which allows the interviewer to code on the basis of behavioural description. If the parents of VLBW children were overestimating the child's worries, they did so in a way which exaggerated anxiety at the behavioural level. In addition, many parents were surprised to learn that some of their child's behaviour may be due to anxiety. This was especially true of somatic symptoms or separation anxiety. One would expect that overprotective parents might be more likely to enlist professional help if they identified anxieties in their children, and yet only one child (to my knowledge) was receiving psychological advice. I also considered many of the VLBW children met to be highly anxious about the study assessment.

Lastly, as specified earlier, multi-method multi-trait analysis showed stronger correlations across traits for the same respondent than for each distinct trait. This suggests that whatever the reason for parents scoring their VLBW children as higher, they may also not be discriminating between different forms of emotional outcome.

Instead, parents may be identifying a generalised difficulty in this area of psychological outcome which causes them to score their children on a number of differing items. Interestingly, this was not the case for anti-social scores.

Distribution of impairment

Rather than focusing on single aspects of development in VLBW children, both researchers and practitioners are beginning to view development more holistically. It seems more sensible to view VLBW children's impairment in this way, as has been pointed out recently by Msall and colleagues (1993). In their paper they also emphasise the lack of work on "functional status" and the "impact of disabilities". One reason for this maybe the specificity of most investigations which often focus on one problem area and cannot report on overall levels of impairment in different domains.

The one question which clinicians seem eager to answer in relation to VLBW children is whether the differences which have been reported in various studies, over various outcome areas, are caused by a general mild impairment distributed evenly across VLBW children or by the presence of one group with a number of severe impairments. This study clearly reveals four groups with varying types of outcome representing different combinations of cognitive and psychological difficulty.

Rather than perinatal factors, measuring IQ at 6 years and head circumference measurements seem to indicate the most effective predictive factors for the "normal" group, whilst IQ at six and parenting indexes may be a more accurate way of determining a poor prognosis. Although demographic factors were not strongly associated with

cluster outcome, it would appear that better incomes, housing and maternal education can act as protective factors for VLBW children. It may be that these factors (as recorded at 12) are indirect measures of other factors, less related to the standard of living of each family, but more indicative of the families "aspirations" and motivations to succeed. The combination of VLBW and a family environment which does not promote educational and social progression, may prove to be an unfavourable circumstance for longterm outcome.

This study is not the first to attempt to cluster groups of impairment in VLBW children and indeed the Vancouver study (Dunn, 1986) reported a similar analysis at their 12 year stage. However, their groupings were more specific, representing different profiles of mild brain dysfunction. For this procedure they excluded children with IQ scores of below 80.

Identifying groups of VLBW children who entered mainstream school but who still appear to be particularly impaired, may help to focus intervention in this population and to inform parents, teachers and health professionals more accurately about a child's prognosis. At present, very little has been found in the way of a predictive relationship between outcome and perinatal variables even using this overall approach to assessment, but it is hoped that defining groups of outcome in this way will ease this process in future research.

General reasons underlying psychiatric risk in VLBW children

It is of obvious importance to parents and professionals, that research attempts to identify the causes or mechanisms underlying psychiatric risk in VLBW children. There are three central reasons why VLBW children may be more at risk of psychiatric behaviours than their peers and these are considered in turn. Following this review of three main aetiological routes, a more in depth examination of particular developmental theories is presented.

Psychiatric risk in VLBW children as a neurological sequel

It is important to remember when considering neurological factors, that the cohort examined here are those without major neuro-sensory impairment, and as such underlying causes are likely to be less clear. However, some evidence from this study may indicate neurological factors. Firstly, the increased occurrence of symptoms in this cohort of VLBW children may be a sequel of neurological events which are related to being born prematurely. Whilst the term "minimal brain dysfunction" is thought to be somewhat out of date (Graham, 1991), there appears to be some evidence that some psychiatric behaviours in VLBW children, particularly ADHD (and to a lesser extent anxiety) have a neurological aetiology.

The neurological 'soft sign' score was significantly higher not only in VLBW children as a group, but also higher in those children with ADHD and anxiety in both VLBW and comparison groups combined, indicating a more immature neurological development in children meeting the clinical criteria. Shaffer et al (1985) also found these "soft signs" to relate to anxiety in their general population sample, and although there was much

overlap between groups in my analysis, the finding may suggest at least some neurological influences on adolescent outcome.

In addition, head circumference seems to play an important part even when measured at 12 years of age, especially concerning cognitive function. Head size was not only smaller in VLBW children as a group, but predicted poorer IQ scores better than VLBW status and also within the VLBW group. This in turn was found to relate to Apgar score at 5 minutes. IQ score at six was also related to general health status 5 minutes after birth and was the strongest predictor of IQ at 12 years.

Further to this, the time of artificial ventilation, birthweight and to some extent gestational age were all found to relate to ADHD within the VLBW group. This is in keeping with the report by Levy Schiff and colleagues (1994b) which found perinatal factors to relate to some psychiatric outcomes. In their study birthweight was found to be highly significantly related to anxiety score with 20% of the variance explained by this one perinatal variable.

The equal ratio of girls to boys having ADHD in this sample suggests that one is already selecting out a neurologically vulnerable group, and thus reducing the male bias for vulnerability found in the general population (Graham, 1991). However this was not the case for anxiety, with this outcome being more common in girls as reported for the general population. IQ was also found to relate to ADHD and anxiety in both groups, although not to other outcomes such as depression and behaviour, but it is unclear whether this is useful as a marker of neurological aetiology or as a direct outcome of

psychiatric symptoms. IQ and psychiatric behaviour are both likely to be affected by neurological mechanisms, but on the other hand it is possible that symptoms will directly affect an individuals performance on the WISC subtests (since many are timed) thus lowering IQ scores. This is especially true for ADHD. The high proportion of VLBW children with ADHD also experiencing generalized anxiety compared to the lack of this pattern of co-morbidity in their peers also lends itself to a neurological basis regarding these outcomes. Finally the relationship between socio-economic factors and ADHD was minimal, and was less significant than VLBW status.

Other studies have also commented on the possible neurological basis of attention deficit hyperactivity disorder (Ornoy et al, 1993; Zametkin, 1989). Some have even suggested specific neural models for the aetiology of ADHD (Voeller, 1991). Interestingly, Voeller's research also links motor control mechanisms with those relevant to ADHD.

In contrast, whilst this cohort of VLBW have been shown to be significantly more impaired in terms of motor performance compared to peers (Marlow et al, 1989; 1993; Powls et al, 1995), this was not found to relate to ADHD after accounting for IQ and low birthweight status. In addition perinatal events in this study had a minimal relationship with the psychiatric disorders in multiple regression analysis and this is unlikely to be due to ultrasound technique or assessment at birth as both followed strict routine protocols.

There is less evidence for a neurological basis regarding the increased depression symptoms found in this VLBW sample. Neither perinatal variables nor the soft sign

index were related to depression scores. This is unlike the finding from the Levy-Schiff et al study (1994b) which showed birth weight (as well as predicting anxiety) to explain nearly 12% of the variance in depression scores. IQ scores and motor impairment at 12 years were also unrelated to depression and this outcome also showed a limited relationship with these assessments at 6 years. Despite this, Rutter parent scale score, and generalised anxiety were only related to depression in the VLBW group, suggesting that both outcomes were influenced by a different cause, and were not directly causal of each other.

Psychiatric risk as an outcome of social / demographic factors

In addition to the neurological model of psychiatric outcome, research investigating such disorders in the general population reports that demographic and parent factors may be important predictors of ADHD and other difficulties. Although this study found some support for this hypothesis concerning ADHD with parental index score and house status appearing as significantly related in multiple analysis, certain psychiatric outcomes, particularly depression, may be more associated with family factors. Parents who have experienced psychiatric disturbances themselves are more likely to have children who also show a vulnerability to psychological problems (Angold, 1988) and mothers of VLBW children have in turn been reported to be more depressed than mothers of other infants (e.g. Gennaro et al, 1990).

There has been a wealth of literature reporting the increased anxiety and stress experienced by parents of VLBW children. Lukeman and Melvin (1993) review some of this research commenting that "there can be little doubt that the trauma surrounding

the birth of a small and/or sick baby can have a profound effect on parental perceptions.." (p.843). Thompson and colleagues' study (1993) showed that 48% of mothers of children who weighed less than 1,500 grams at birth were significantly psychologically distressed.

Although some studies report this anxiety to reduce fairly rapidly over time, it is likely that there is a continuing worry that the VLBW child may show "hidden difficulties" at a later age (Cottrell and Summers, 1990). It is possible therefore that either extreme anxiety surrounding the arrival and first few months, or the longterm stress may in some way transfer to the child him/herself. This possible mechanism is later discussed in terms of developmental theory.

Unfortunately, the current study was not able to ask parents for a family history. The CAPA did ask parents whether they had received professional advice for psychological problems and although this enquiry did not include recording details of the parent's problem, there was a trend for and increased proportion of parents of VLBW children to have received help. Conversely, the data does not reveal an increased incidence of parental psychological problems in children with depression symptoms in either the VLBW or comparison group as might be expected. The professional support reported by VLBW parents may have been as a result of the premature birth, rather than indicating a genetic vulnerability, and asking about indirect family would have been more useful in this respect.

It is also of particular interest that many VLBW children experience limited access to their mothers during the first six months of life. This raises the question as to whether disrupting the bonding process between mother and infant in this way could in part lead to a vulnerability to psychiatric symptoms later in life. Unfortunately, no data is available for this cohort on the level of "attachment" between mothers and their children, but again this theory is discussed fully in later sections.

In addition to depression, the poorer social competence seen in this VLBW sample may result from environmental factors. Research in the general population has revealed associations between 'attachment' status and later social behaviour and poorer living standards might also result in less well developed social skill.

The effects of a preterm birth on early mother-infant interaction has also been addressed with 89% of mothers reported as experiencing "crisis reactions" in the month following premature birth (Stjernqvist, 1992). In a commentary by the same author, VLBW babies are reported to be irresponsive and mothers to be affected adversely by anxiety, low self-esteem and shock. The commentary continues to comment that "mother-child" interaction in neonatal care should not be"disregarded" because of its potential longterm consequences (Stjernqvist, 1993).

This study also found children's parent depression scores to be particularly linked to whether a child was living with both, one or neither natural parent. It should be highlighted that this is not a measure of single or joint parenthood, as children living with one or neither natural parent may be living in a two parent family involving step

parents. It may, however, be an indirect indication of family stress or of differing parenting styles. Only a few of the usual socio-demographic factors related to psychiatric disorders in VLBW children. This is in support of Levy-Shiff and colleagues' (1994b) report which emphasises the "limited significance" of sociodemographic factors in predicting the emotional status of premature, very low birth weight children. This thesis also found mixed support for the suggestion that parent-child interaction difficulties affect development into later childhood or adolescence. Whilst VLBW children were no more likely to show any one of several parent-child difficulties, or to score higher on the "parent style index", depressed symptoms in VLBW children were more strongly related to the parent index than for comparison children.

Studies from the Infant Health and Development Program in America have shown that it is possible to enhance maternal interaction in low birth weight babies (Spiker, Ferguson and Brooks-Gunn, 1993). Another investigation reports improved feeding interaction in preterm infants after a family based intervention. Improvements include more maternal positive affect and greater maternal sensitivity to infant behaviour (Meyer et al, 1994). As both these reports emphasise, it is as yet unknown whether the small improvements noted in children who receive intervention will indeed be related to long term outcome.

Psychiatric risk as a result of other difficulties

Increased psychiatric symptoms in the VLBW children may be a direct consequence of other known sequelae of low birth weight. This cohort and others have been found to have poorer motor skills (Powls et al, 1995), lower IQ scores and poorer educational

attainment, shorter stature (Powls et al, 1996) and poorer social skills. It is highly plausible that all or any of these outcomes may encourage more depression, anxiety and oppositional behaviour than in children without these difficulties. However, the minimal relationship shown between affective disorders and IQ or motor skills at 12 years of age does not support this suggestion. It is also unlikely that the VLBW children are appearing more depressed simply because they are developing more quickly than their peers and are therefore experiencing pubertal signs earlier. Children in this study have been reported to show no differences in the number of boys or girls who had reached puberty in the two birthweight groups (Powls et al, 1996).

However, it may be that other impairments experienced by VLBW children make them less confident socially. Interestingly, in the Klebanov study cited earlier (1994), the overall "social competence" score appeared to be influenced mainly by perceived "scholastic competence" and "athletic competence" rather than perceived "social acceptance". Since the VLBW children in the present study perform more poorly both educationally and physically, this may explain some of the social impairment seen in this cohort. There is evidence that poor social adjustment is associated with other difficulties. In this study for example, it has been shown that higher rates of anxiety and depression are associated with impaired social functioning. Rifkin and colleagues (1994) have also linked poor social adjustment in low birth weight children with later affective psychosis. They found that low birth weight and poor social adjustment during childhood and adolescence were linked in a sample of adults with schizophrenia, whereas this relationship was not evident in adults being treated for affective disorders.

Developmental theories which might help explain impairments

As introduced at the beginning of this thesis, the impairments seen in VLBW children may be better understood in the context of certain developmental theories. Given the relative lack of direct neurological evidence for outcomes gained from this study, these descriptions are even more relevant to understanding the development and difficulties of VLBW children. This is particularly true of the emotional findings from this thesis, the mechanisms of which are not clear and which may be confused by parents when asked to assess their child's psychological status. ADHD seems unlikely to have been caused by any of the theories discussed below, but probably has a direct neurological base.

Firstly information processing theory may play a part, particularly concerning cognitive outcomes. The wide range of cognitive deficit seen in VLBW children seems to indicate a generalised processing problem, if it is described in this way, rather than a more modular approach where only some functions are impaired. However, the discrepancy in sight reading and reading comprehension seen in VLBW children and the difficulty they have with visual-performance tasks may indicate an additional deficit in particular executive functions or control processes of strategy formation and planning or at the encoding stage of processing.

Other studies have shown VLBW children to be poorer on language tasks which involve a large syntactic content (Grunau et al, 1990), and the poor motor skills of this cohort may also support impairment of planning or strategy function, especially concerning the ball skills section (Powls et al, 1995).

This theory might also explain some of the social difficulties described by these children in terms of a limited planning for consequences within interactions, but one might expect greater evidence of anti-social behavioural problems if this were the case. Recent theorising describing impaired socio-empathic responses in terms of certain executive function deficits (such as theory of mind: Baron-Cohen, 1995; or central coherence: Frith, 1989) also does not fit the subtle difficulties described in this study. An awareness by VLBW children of limited processing capacity might lead to anxiety about work, but the findings from this thesis suggest a more generalised form of difficulty and the emotional traits evident in some VLBW children here are harder to explain using information processing theory, although some recent work has suggested a link between impaired processing and depressive symptoms in adults (Hart and Kwentus, 1987).

Another of the theories outlined in the introduction was that of social learning theory and some of the outcomes seen in VLBW children are explained by this theory. Anxiety in particular seems an obvious candidate for a trait learned from chronic stressful and possibly overly-rigid parenting styles.

Schaefer (1959) described two dimensions of parenting style, warmth-hostility and control-permissiveness, to explore possible effects on child development. His model suggests that parents showing warm but controlling behaviour (ie. over-protective and anxious parenting) lead to children who were insecure, anxious, introverted, socially withdrawn and rule-abiding. This model would seem to fit well with data gained from the present study in terms of both plausible parent behaviour and recorded outcomes in some of the areas.

Another theory relevant to the development of VLBW children is attachment theory. This theory appears to fit the data presented here reasonably well. Firstly, VLBW children in this cohort were separated from their parents for a significant amount of time during early childhood. Secondly, some of the outcomes predicted by this theory are evident, such as poorer social behaviour, depressed mood and an increased level of insecurity and anxiety. LaFreniere and Sroufe (1985), for instance, examined a number of social skill variables in a general preschool sample. They found that secure attachment related to "affiliative" peer competence characterised by emotional warmth, peer popularity and social maturity. Children with anxious-resistant attachment histories were the least accepted by peers. Thirdly, interventions designed to address this issue have shown some effects. For example, Becker et al (1993) found that enhanced NICU environments increased the time of "alert wakefulness" in VLBW babies and commented that this may in turn increase quantity and quality of social contact. Meyer et al (1994) also found that parent intervention studies improved feeding routines including the social contact experienced by both parent and infant during these times.

Even taking into account the possible lack of validity seen in parents distinction between anxiety and depression, these outcomes "make sense" in terms of insecure attachment. Cognitive deficits have also been noted in children who are insecurely attached (Bell, 1970 & Bretherton, 1976). However, other possible outcomes were not evident in this cohort, namely those of sleep difficulties and behavioural problems. There was also no difference for the group as a whole on the parent-index (a measure of parent-child and parent-parent relationships) although this factor was a strong predictor of emotional difficulties across preterm and fullterm children combined.

No direct attachment status data is available for this cohort. Whilst some recent studies have shown an increased proportion of insecurely attached individuals in preterm groups (Mangelsdorf et al, 1996; Wille, 1991) others have failed to find strong differences in attachment between preterm and full term children (e.g., Pederson and Moran, 1996). The issue of attachment is also confounded by the fact that the sickest babies are those separated for most time.

It seems possible that some of the outcomes seen in VLBW children are a combination of mechanisms described by attachment and social learning theory. Concerning attachment theory, it is important to note that the lack of maternal input in VLBW children's early life is not that usually examined in research into bonding and attachment. In studies conducted on this subject, most have concerned parental death, adoption or hospital stays which have taken place much later in infancy. These scenarios have a distinctly different quality to the situation of VLBW children.

Firstly in two of these circumstances, the child never regains the maternal contact. Secondly all are likely to induce feelings of anger, fear and rejection. Although little is known about the emotions of very young babies, it seems unlikely that these are elements of development in the first six months of a pre-term child's life. Thus whilst in other circumstances, behavioural and sleep problems might be expected in insecurely attached children, this is not the case in VLBW children and this has been confirmed by other recent studies which show little connection between attachment and behavioural difficulties in premature children (Goldberg, Corter, Lojkasek and Minde, 1991).

It also seems likely that social learning theory adds another dimension to the results shown. It is highly plausible that the anxiety found in some VLBW and not others is mediated by family stress levels and ability to cope with the feelings associated with bringing-up a preterm child. This may explain why the parent-index was single largest contributor to anxiety scores.

Finally, whilst no obvious neurological markers can be identified from this theory, it seems sensible to speculate that subtle biological effects of being VLBW interact with both the above mechanisms. Recent theories of development strongly emphasise the interactive nature of development especially in infant-mother dyads.

VLBW children have been shown to be less responsive in their social behaviours such as smiling and babbling as well as in sucking and crying responses. Attachment theory suggests that it is these very behaviours which initiate and maintain close physical and emotional contact between mother and child. Children who are most impaired from this population may therefore be those who show the least responsive behaviour or whose parents adapt less well to these differences. Butcher and colleagues (1993) for example found that although rigidity was not related to attachment per se, less responsive infants were made more vulnerable to insecure attachment by high maternal rigidity. The finding from this study that VLBW children experiencing "pervasive" difficulties also showed less favourable parent-index scores, increased anxiety and poorer motor skills seems to support this combination of mechanisms as a possible pathway.

Intervention for VLBW children

Following the realisation that VLBW children were experiencing cognitive impairment, a number of projects set up to assess interventions with these children with some reporting successful results. One of the largest programs is the Infant Health and Development Program in the USA which provides intensive day care intervention and parental guidance. Results from this program alone have shown that maternal interaction style can affect developmental progress (Spiker et al, 1993). Other intervention studies involve adjusting the perinatal intensive care environment (e.g., Becker et al, 1993) and may lead us to look more closely at different ways of limiting impairment in VLBW children. Given the mixed aetiological picture regarding VLBW outcome, it is important that we look not only for medical solutions but that psychological and social factors are also considered in the intervention or prevention of difficulties experienced by this population.

Unfortunately, appropriate help for children with ADHD (the most prominent psychiatric problem in this group of VLBW children) is not clearly established. For this sample of children this is especially true, since few were accessing support and because individuals showing co-morbid anxiety have been identified as those least likely to respond to drug therapy (Pliska, 1989). Whilst some studies have examined the use of drug therapy for ADHD, especially in the USA, in Britain the use of medication for ADHD is less popular and more strictly controlled.

Families and teachers may re-frame ADHD, anxiety or depression related behaviours as naughtiness, laziness or eccentricity. These alternative labels are unlikely to help

children cope with every day life and may even make their situation far worse. Therefore simply a greater awareness of psychiatric outcome in VLBW children among teachers, parents and indeed in the children themselves must be of importance in combating the potential longterm impairment which ADHD and other psychiatric difficulties can cause.

This study has several implications for the delivery of health service provisions. Firstly, the long term nature of the problems of very low birth weight should mean that routine medical and support services are available to families throughout their development. Secondly, the identification of different outcome subgroups within the VLBW population may be able to guide this support or interventions.

However, even using these clusters, there are conflicting views about which groups may benefit the most from intervention. Some clinicians believe that the most severe group warrant the most attention because they are fewer in number, have the least good quality of life and are likely to be the most substantial burden on health and education services if intervention is not given. Others, however, believe that this group are difficult to remediate and therefore interventions are inefficient with this group. This line of thought argues that VLBW with minor correctable difficulties should be targeted in an attempt to increase the number of children with no identifiable impairment.

If social learning theory plays a part in the impairment seen in some VLBW children then behavioural models of intervention may be ideal for this population. It is possible for example that a weekly social skills intervention based on vicarious learning models could boost the confidence, reduce potential anxiety and depression, and enhance the

social behaviour of VLBW children if given at an earlier age. This type of intervention would prove supportive in a general sense as well as providing a more specific focus. The cluster groupings identified in this study suggest that children with less advantaged home lifestyles may benefit most from such interventions. This supports the finding by Spiker and colleagues (1993), that lower income, ethnic minority families gained most from their program based interventions.

The possible role of attachment in VLBW children points to the need for even earlier intervention strategies. Many hospitals have already updated their attitude and policy toward parental visiting and handling since this cohort were born. However it would seem that further targeting of the mother-infant relationship and bonding process may result in substantial long term gains for VLBW children. Niven, Wiszniewkski and AlRoomi (1993) showed that parents of preterm children felt difficulty in bonding with their babies especially in the immediate postnatal period. Better (ie. more responsive) dyads may result in less anxiety, emotional problems, better social skills and even higher educational and cognitive performance.

Interventions could include parent based strategies such as counselling to enable parents to feel attached to their sick child, child and parent classes, & support groups. Field (1992) suggests three different interventions including prenatal scan based information which was related to later improved neonatal outcome.

In addition practical measures such as the use of warm water mattresses rather than incubators and increased parent contact may also increase the likelihood of secure

attachment. As discussed earlier, there are some outcomes in VLBW children particularly ADHD and probably many of the cognitive problems which are unlikely to be remediated in a psychosocial way. Instead, families and professionals need accurate, clear information regarding these outcomes and appropriate educational and possibly drug related support for these difficulties.

Limitations of the study

Although this study did not experience many of the methodological problems for which other studies have been criticised in reviews of previous research, such as the lack of a matched comparison group, there were areas in which shortcomings can be identified. These fall into two categories: shortcomings which cannot or would be extremely difficult to remedy in future investigations; and problems which could be largely solved in future.

Of the first category, one difficulty is the extent to which groups are matched. Because of our lack of understanding, in general, about the causes of undesirable development it is impossible to perfectly match a group to the target sample. Matching too closely by some markers, may infact bias the sample in other ways.

Secondly, the researcher in this study was not blind to the status of the children. Whilst most of the assessments were objective or behavioural in nature, this may of course still lead to subtle differences in coding or scoring. Using a design in which the researcher visits families and children makes the process of "blinding" very problematic. Most families will inform you of the child's status very early on in the interview, and this was

also the case with many of the children assessed. In addition, the children who had been VLBW were sometimes physically different from their counterparts making it easy to identify which child was the target individual and which the comparison. With more time and resources, score sheets could have been re-marked independently without knowledge of the child's status in the study, but this would still not have overcome any biases at the actual assessment visit.

The shortcomings which could be addressed in future research consist mainly of missing areas of data collection. This study fails to report on the dynamic development of the newborn from an early stage because it is not entirely prospective in design. Much information about environmental factors are not available for this cohort which makes predictions about the cause and development of some outcomes, depression in particular, very difficult. It is also important in a study of this kind to use the same measures throughout the longitudinal follow-up stages. Unfortunately, this was not the case with the present investigation and therefore information about changes in cognitive, educational and psychological status is inconclusive or non-existent.

In addition, due to the period in which the babies in this study were born, very few subjects were either ELBW or SGA. The lack of numbers in these groups made some analyses impossible and may have hidden positive differences in other comparisons. Thus the picture concerning these subgroups is also not thoroughly addressed here. In future studies, babies who are below 1000g or who are small-for-dates will inevitably be included in samples of preterm children.

Finally this study failed to examine language development in any detail. This age group are difficult to assess in this area (because many of the available measures are designed for younger ages) and time-constraints limited the number of tests possible in this study. However, further research should examine this aspect of development in order to provide a fuller picture of development and impairment.

Summary

This study has aimed to identify differences in VLBW children (those who entered mainstream school at 6 years) when they are 12 years of age as compared to their peers. Children who were born with very low birth weights, even this population of children who are considered to be developing normally, appear to be more vulnerable to a number of problems including cognitive and psychological impairment, but not to increased behavioural (anti-social) problems at this age. The ADHD children noted in this VLBW group did not appear to have associated conduct problems. Rather than observing "catch up" phenomena in this sample, there were also trends towards a widening gap in cognitive ability between the children and their peers.

One prominent concern of medical staff working with VLBW premature infants is whether clear causes or predictive markers can be identified shortly after birth. Predictive data from this study has produced no firm conclusions about the aetiology of problems in VLBW children. However, it seems plausible from the relationships found that cognitive impairment and attention deficit/hyperactivity disorders are directly caused by being born prematurely and have a neurological basis. Emotional difficulties present with a more confused pattern and whilst they may in part result from being VLBW, these

outcomes are probably more influenced by familial or demographic factors and may be explained through a combination of attachment theory and social learning theory. Also, when examined using multi-method multi-trait analysis, these traits showed questionable validity as distinct depression or anxiety syndromes and may indicate a more generalised parental concern. At the same time, other studies such as that by Levy-Schiff and colleagues (1994b) have identified relationships between perinatal variables and later depression.

Within the VLBW children it was possible to identify four subgroups with different general outcomes - those with cognitive and psychological impairment, those with normal development, and those with either cognitive or psychological difficulties. These groups emerged whether parent or child rated questionnaires were used. Considering that all the children in this group are those for whom continued routine medical support was deemed unnecessary, the large number of children with any type of impairment must be a cause for some concern. Unfortunately, clear indicators of aetiology remained elusive even using these subgroups.

The different suggestions of causality presented here should serve to guide further research. This study, for example, was unable to examine the mother-infant bonding process in any depth, and yet it seems that this area may hold important information about the development of emotional well being. Other areas may benefit from the advanced cerebral scanning techniques now available for new born babies.

Previous studies examining psychological outcome in low birth weight children have either combined general behavioural problems (Pharaoh et al, 1994b) or have failed to find an increased frequency of affective symptoms in this population (e.g., Szatmari et al, 1990). This may be partly due to the younger age of the children in most studies. However even excluding children with obvious neurological impairment, the present study identified a number of psychiatric and cognitive risk areas. It would be interesting to follow the children comprising this cohort into late adolescence. This may reveal whether emotional disorder symptoms found at 12 are precursors for more severe psychiatric disorders or transient features in the development of VLBW children.

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Appendix 1:

Example page from the NFER Basic Mathematics Test.

Do not write here

One of the signs $>$ $=$ $<$ is missing from each of the questions below. Fill in the missing sign in the box. An example has been done for you.

$>$ means "is greater than"
$=$ means "is equal to"
$<$ means "is less than".

Example: $2 \times 4 \boxed{>} 14 \div 2$

11. $3 \times 5 \times 3 \boxed{} 2 \times 4 \times 6$ 11 .....

12. $15 - 9 \boxed{} 9 - 15$ 12 .....

13. $8 \div 15 \boxed{} 15 \div 8$ 13 .....

14. $(3 + 2) \times 8 \boxed{} (3 \times 8) + (2 \times 8)$ 14 .....

---

15. $\triangle = 5$

$\oslash$ is any number from 0 to 10.

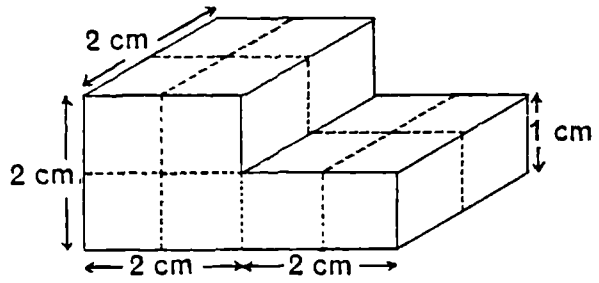
I want to find the value of $\triangle \times \oslash$.

Draw rings round the two numbers below which cannot possibly be correct answers.

45 55 35 25 65 15 .....

---

16. How many 1 cm cubes were used to build this step?



.....cubes 16 .....

TOTAL R W

Appendix 2:

Parental questionnaire including demographic questions,

income banding sheet and psychological questionnaires.

PARENTS QUESTIONNAIRE

Study No._____

SECTION 1

It would be very helpful if you could first answer a few background questions about the family.

ALL INFORMATION IS COMPLETELY CONFIDENTIAL

PLEASE BE AS ACCURATE AND HONEST AS POSSIBLE!

Parent/guardian details:

1.

Please give your relationship to child:_____
(e.g., natural mother, stepfather, aunt)

Age_____

Are you in paid employment
(please tick all that apply)

Yes, full time ☐ Yes, part time ☐ Unemployed ☐

Looking after home ☐ Other ☐

If yes please give name of job, if no please give name of last job:

_____

Age left school_____

Further education(if any)_____

_____

Which would best describe you? (please tick)

African ☐ Caribbean ☐ Bangladeshi ☐ Pakistani ☐

Indian ☐ Chinese ☐ S.E. Asian ☐ Greek ☐

Turkish ☐ Irish ☐ English/Scottish/Welsh ☐

Other White ☐ Other Black ☐

2. If you have a partner: (If not please go to question A3)

Please give their relationship to child:_____
(e.g, natural father, stepmother, uncle)

Age_____

Is he/she in paid employment?
(please tick all that apply)

Yes, full time ☐ Yes, part time ☐ Unemployed ☐

Looking after home ☐ Other ☐

If yes, please give name of job, if no please give name of last job:

_____

Age he/she left school_____

Further education (if any)_____

_____

Which would best describe him/her? (please tick)

African ☐ Caribbean ☐ Bangladeshi ☐ Pakistani ☐

Indian ☐ Chinese ☐ S.E. Asian ☐ Greek ☐

Turkish ☐ Irish ☐ English/Scots/Welsh ☐

Other White ☐ Other Black ☐

3.

How many other adults (over 18) living at the family home_____

Please list their relationship to child:
(e.g. grandmother, lodger, stepbrother etc)

_____ _____

_____ _____

4.

Please give details of all children living at home (under 18):

Age_____ sex m/f prem. y/n relation to child_____

Age_____ sex m/f prem. y/n relation to child_____

Age_____ sex m/f prem. y/n relation to child_____

Age_____ sex m/f prem. y/n relation to child_____

Age_____ sex m/f prem. y/n relation to child_____

5.

Please give details of brothers and sisters who have left home:

Age_____ sex m/f prem.y/n when left home_____

Age_____ sex m/f prem.y/n when left home_____

Age_____ sex m/f prem.y/n when left home_____

6.

Does anyone in the house regularly smoke?_____
If so, how many cigarettes smoked in total in one day?
(add together each persons cigarettes smoked)

Less than 10 ☐ 10-20 ☐ More than 20 ☐

(If known)
Did mother smoke during pregnancy? yes/no
If yes, how many cigarettes a day? (Please tick)

Less than 10 ☐ 10-20 ☐ More than 20 ☐

7.

(If known)
Natural mothers height_____ Natural fathers height_____

8.

Is the family home: Rented Council ☐

Temporary eg. B & B, hostel ☐ Rented private ☐

Tied to a job ☐ Owned or mortgaged ☐

How many rooms does it have?_____ DON'T COUNT BATHROOM TOILET HALL OR KITCHEN (unless 2 or more people regularly eat there)

Are any of the rooms shared with another family? yes/no
(Don't count lodgers)

If yes please say which ones_____

9. Family income group: please look at the family income chart attached and circle appropriate number:

1 / 2 / 3 / 4 / 5 / 6 / 7 / 8
(Please include all incoming money)

EARNINGS BRACKETS —NET

NET (TAKE-HOME) EARNINGS

PER WEEK

1	2	3	4	5	6	7	8
£49.99 or less	**£50 - £74.99**	**£75 - £99.99**	**£100 - £124.99**	**£125 - £174.99**	**£175 - £224.99**	**£225 - £274.99**	**£275 or more**

PER MONTH

1	2	3	4	5	6	7	8
£216.60 or less	**£216.70 - £324.90**	**£325 - £433.20**	**£433.30 - £541.60**	**£541.70 - £758.20**	**£758.30 - £974.90**	**£975 - £1,191**	**£1,192 or more**

PER YEAR

1	2	3	4	5	6	7	8
£2,599 or less	**£2,600 - £3,899**	**£3,900 - £5,199**	**£5,200 - £6,499**	**£6,500 - £9,099**	**£9,100 - £11,699**	**£11,700 - £14,299**	**£14,300 or more**

Child details:

10. How often has your child ever been admitted to hospital?

Never / 1-5 times / 5-10 / more than 10 times

If yes please give details

	Problem	Age first admitted	Age last admitted	Number of admissions	Has problem resolved?
e.g.	Asthma	3mths	11yrs	5	No

11.
Does your child regularly see a doctor for any reason? yes/no
If yes please give details

Problem	Age at first visit	Age at last visit	Has problem resolved?

12. Is he/she currently on any medication? yes/no
If yes please give details (name of medicine)

_____

_____

13. Has he/she ever been to any of the following?
(please tick all that apply)

Physiotherapist ☐ Psychologist ☐ Occupational therapist ☐

Child Guidance Clinic ☐ Speech therapist ☐

14. Has he/she ever failed a hearing test? yes / no
an eye test? yes / no
Does he/she wear a hearing aid ☐ glasses ☐

15. Has he/she had any of the following medical problems (tick all that apply):

Recurrent chest infections ☐ Asthma ☐ Heart defect ☐

Palpitations ☐ Epileptic fits ☐ (not with high temperature) Diabetes ☐

Recurrent cough, wheeze or shortness of breath ☐

Allergies ☐ Hay fever ☐ Eczema ☐

16. Has any immediate relative of the child (mother, father, sister, brother) had any of the following medical problems (tick all that apply):

Recurrent chest infections ☐ Asthma ☐ Heart defect ☐

Palpitations ☐ Epileptic fits ☐ (not with high temperature) Diabetes ☐

Recurrent cough, wheeze or shortness of breath ☐

Allergies ☐ Hay fever ☐ Eczema ☐

17. Has he she had any of the following operations:

Grommets ☐ Tonsils and adenoids ☐ Shunt for hydrocephalus ☐

18. Does he/she ever have to sit out of sport/games because they are too tired/breathless to continue yes / no

19.

How many different schools has your child attended?_____
(Don't count nursery school)

SECTION 2
In this section we are asking about: **health habits and behaviour**

This part of the questionnaire asks about various kinds of behaviour that many children show at some time. Please give all your answers according to the way your child has been in **the last 3 months.**

Please tell us how often each of the following happens by ticking the box under the most accurate answer.

		Not in the last 3 months	Occasionally but not as much as once a week	At least once a week
0	He/she has a persistent night cough	☐	☐	☐
1	He/she complains of headaches	☐	☐	☐
2	He/she has stomach aches or vomiting	☐	☐	☐
3	He/she has asthma or attacks of wheezing	☐	☐	☐
4	He/she wets the bed or pants	☐	☐	☐
5	He/she soils or loses control of bowels	☐	☐	☐
6	He/she has temper tantrums (that is complete loss of temper)	☐	☐	☐
7	He/she has had tears on arrival at school or refused to go into the building	☐	☐	☐
8	He/she truants from school	☐	☐	☐
HABITS				
9	Does he/she stammer or stutter?	☐	☐	☐
10	Is there any other difficulty with speech other than stammering or stuttering?	☐	☐	☐

yes please describe

_____

_____

	Not in the last 3 mths	Yes, occasionally	Yes, frequently
Does he/she ever steal things?	☐	☐	☐
If yes, does it involve:			
Minor pilfering of pens, sweets toys, small sums of money etc.	☐	☐	☐
Stealing of big things	☐	☐	☐
Stealing in the home	☐	☐	☐
Stealing elsewhere	☐	☐	☐
Stealing on his/her own	☐	☐	☐
Stealing with other children or adults	☐	☐	☐

	Not in the last 3 mths	Yes, mild	Yes, severe
Is there any eating difficulty?	☐	☐	☐
If yes does it involve:			
Faddiness	☐	☐	☐
Not eating enough	☐	☐	☐
Eating too much	☐	☐	☐

Other please describe_____

_____

	Not in the last 3 mths	Yes, mild	Yes, severe
Is there any sleeping difficulty? If yes does it involve:	☐	☐	☐
Getting off to sleep	☐	☐	☐
Waking during the night	☐	☐	☐
Waking early in the morning	☐	☐	☐

Other please describe_____

_____

	Not in the last 3 mths	Yes, occasionally	Yes, frequently
Does he/she ever hurt him/herself (that is trips falls or accidents)? If yes what injuries has he/she had in the past 3 mths:	☐	☐	☐
Bumps and bruises	☐	☐	☐
Cuts needing stitches	☐	☐	☐
Other injuries needing treatment (broken bones, burns, crushed finger, animal bites etc)	☐	☐	☐

Other please describe_____

If yes please describe

_____

_____

	Not in the last 3 mths	Yes, occasionally	Yes, frequently
11 Does he/she ever steal things?	☐	☐	☐
If yes, does it involve:			
a) Minor pilfering of pens, sweets toys, small sums of money etc.	☐	☐	☐
b) Stealing of big things	☐	☐	☐
c) Stealing in the home	☐	☐	☐
d) Stealing elsewhere	☐	☐	☐
e) Stealing on his/her own	☐	☐	☐
f) Stealing with other children or adults	☐	☐	☐

	Not in the last 3 mths	Yes, mild	Yes, severe
12 Is there any eating difficulty?	☐	☐	☐
If yes does it involve:			
a) Faddiness	☐	☐	☐
b) Not eating enough	☐	☐	☐
c) Eating too much	☐	☐	☐

d) Other please describe_____

_____

Cannot settle to anything for more than a few moments	☐	☐	☐
Tends to be fearful or afraid of new things or new situations	☐	☐	☐
Fussy or over-particular child	☐	☐	☐
Often tells lies	☐	☐	☐
Bullies other children	☐	☐	☐

there any other problems?

SECTION 3

In this section we are asking about: **thoughts and feelings**
Not all people of your child's age are the same in how they think, feel and behave. We would like you to say, **as far as you know** whether the statements below are true for your child. There are no right or wrong answers. Please answer every question even when its difficult to decide.

For each sentence tick No if you feel its not true of how your child felt in the **last 3 months**, and tick Yes if you feel it is true about how your child has felt in the **last 3 months.**

		No	Yes
1)	He/she has trouble making up his/her mind	☐	☐
2)	He/she gets nervous when things do not go the right way for him/her	☐	☐
3)	Others seem to do things more easily than he/she can	☐	☐
4)	Often he/she has trouble getting his/her breath	☐	☐
5)	He/she worries a lot of the time	☐	☐
6)	He/she is afraid of a lot of things	☐	☐
7)	He/she gets upset and angry easily	☐	☐
8)	He/she worries about what his/her parents will say to him/her	☐	☐
9)	He/she feels that others do not like the way he/she does things	☐	☐
10)	Its hard for him/her to get to sleep	☐	☐
11)	He/she worries about what other people think about him/her	☐	☐
13)	Often he/she feels like being sick	☐	☐

	No	Yes
His/her feelings get hurt easily	☐	☐
Her/his hands feel sweaty	☐	☐
He/she is tired a lot	☐	☐
He/she is worried about what is going to happen	☐	☐
Other people are happier than he/she is	☐	☐
He/she has bad dreams	☐	☐
His/her feelings get hurt easily when he/she is criticized	☐	☐
He/she feels someone will tell him/her when he/she does the wrong thing	☐	☐
He/she wakes up frightened	☐	☐
He/she worries when he/she goes to bed at night	☐	☐
It is hard for him/her to keep his/her mind on school work	☐	☐
He/she wriggles in his/her seat a lot	☐	☐
He/she is nervous	☐	☐
A lot of people are against him/her	☐	☐
He/she often worries about something bad happening to him/her	☐	☐

SECTION 4

In this section we are asking about: **things that make children afraid.** When someone is scared of something, they may panic or get in a state if they meet it. Or they may try hard to avoid the situation.

The sentences below list some things that children are often scared about. We would like you to say whether your child has been scared of each in **the last 3 months.**

If he/she has not been scared of it at all in this time then tick under No.

If he/she has been scared but did not panic or try to avoid it, tick under Yes, no panic.

If he/she has been scared of it and he/she panicked or tried to avoid it, then tick under Yes, Panic.

	No	Yes, No panic No avoidance	Yes Panic &/or avoidance
1) Having to talk to the class	☐	☐	☐
2) Going in the car or bus	☐	☐	☐
3) Ghosts or spooky things	☐	☐	☐
4) Being sent to the head teacher	☐	☐	☐
5) Being left with a baby sitter or another adult	☐	☐	☐
6) Meeting someone for the first time	☐	☐	☐
7) Going to the dentist	☐	☐	☐
8) High places like bridges or mountain	☐	☐	☐
9) Spiders	☐	☐	☐
10) A burglar might break into the house	☐	☐	☐

	No	Yes, No Panic No avoidance	Yes, Panic &/or avoidance
11) Flying in a plane	☐	☐	☐
12) Being asked to do something by a teacher unexpectedly	☐	☐	☐
13) His/her parents criticizing him/her or telling him/her off	☐	☐	☐
14) Thunderstorms	☐	☐	☐
15) Doing badly in an exam	☐	☐	☐
16) That he/she migh be hit by a car	☐	☐	☐
17) Having to go to school (being frightened of it)	☐	☐	☐
18) Dark rooms cr cupboards	☐	☐	☐
19) Having to perform in front of others	☐	☐	☐
20) Being criticized by others	☐	☐	☐
21) The sight of blood	☐	☐	☐
22) Going to the doctor	☐	☐	☐
23) Fierce looking dogs	☐	☐	☐
24) Going to bed in the dark	☐	☐	☐
25) Being alone	☐	☐	☐

	No	Yes, No panic No avoidance	Yes, Panic &/or avoidance
26) Having to stay after school	☐	☐	☐
27) Crowded or closed places (like busy shops)	☐	☐	☐
28) Lifts	☐	☐	☐
29) Getting a bee or a wasp sting	☐	☐	☐
30) Rats or mice	☐	☐	☐
31) Strangers	☐	☐	☐
32) Being separation from parents for a day or evening	☐	☐	☐
33) Using public toilets	☐	☐	☐
34) Eating in public	☐	☐	☐
35) Bats	☐	☐	☐
36) Tunnels	☐	☐	☐
37) Needles or injections	☐	☐	☐
38) Water	☐	☐	☐
39) Fire	☐	☐	☐

SECTION 5

In this section we are asking more about:**thoughts, feelings and actions.** This time, if the sentence was never true of your child **in the last 3 months** then tick under 'Not true'. If it was only sometimes true tick 'sometimes'. If it was true most of the time, tick under 'True'.

	True	Sometimes	Not true
1) He/she felt miserable or unhappy	☐	☐	☐
2) He/she didn't enjoy anything at all	☐	☐	☐
3) He/she was less hungry than usual	☐	☐	☐
4) He/she ate more than usual	☐	☐	☐
5) He/she felt so tired he/she just sat around and did nothing	☐	☐	☐
6) He/she was moving and walking more slowly than usual	☐	☐	☐
7) He/she was very restless	☐	☐	☐
8) He/she felt that he/she was no good anymore	☐	☐	☐
9) He/she blamed him/herself for things that were not his/her fault	☐	☐	☐
10) It was hard for him/her to make up his/her mind	☐	☐	☐
11) He/she felt grumpy and irritable with his/her parents	☐	☐	☐
12) He/she felt like talking less than usual	☐	☐	☐
13) He/she was talking more slowly than usual	☐	☐	☐
14) He/she cried a lot	☐	☐	☐

	True	Sometimes	Not true
15) He/she thought there was nothing good for him/her in the future	☐	☐	☐
16) He/she thought that life was not worth living	☐	☐	☐
17) He/she thought about death or dying	☐	☐	☐
18) He/she thought his/her family would be better off without him/her	☐	☐	☐
19) He/she thought about killing him/herself	☐	☐	☐
20) He/she did not want to see friends	☐	☐	☐
21) He/she found it hard to think properly or concentrate	☐	☐	☐
22) He/she thought that bad things would happen to him/her	☐	☐	☐
23) He/she hated him/herself	☐	☐	☐
24) He/she thought he/she was a bad person	☐	☐	☐
25) He/she thought he/she looked ugly	☐	☐	☐
26) He/she worried about aches and pains	☐	☐	☐
27) He/she felt lonely	☐	☐	☐
28) He/she thought nobody loved him/her	☐	☐	☐
29) He/she did not have any fun at school	☐	☐	☐
30) He/she thought he/she could never be as good as the other kids	☐	☐	☐

	True	Sometimes	Not true
31) He/she thought that he/she did everything wrong	☐	☐	☐
32) He/she did not sleep as well as he/she usually sleeps	☐	☐	☐
33) He/she slept a lot more than usual	☐	☐	☐
34) He/she was not as happy as usual even when praised or rewarded	☐	☐	☐

SECTION 6

In this section we are asking about: **behaviour and activities.**
Below are questions about breaking rules in behaviour in school. other questions are about things that are against the law or almost against the law, but that people do anyway.

This time the questions are answered slightly differently.

If your child has **never** done what the sentence describes, tick 'No'.

If your child has done it, **but not in the last 3 months** tick under 'Only before the last 3 mths'.

If your child has done it **within the last 3 months** tick the 3rd box under 'Yes in the last 3 mths'.

Has your child **ever:**	No	Only before the last 3mths	Yes in last 3 mths
1) Stolen money or other things from members of the family	☐	☐	☐
2) Skipped ("bunked off") school for a whole day	☐	☐	☐
3) Stolen a wallet or purse while the owner was not around	☐	☐	☐
4) Been kept after school when ordinary classes had finished	☐	☐	☐
5) Signed someone elses name to get money or other things he/she wanted	☐	☐	☐
6) Yelled or screamed at a teacher	☐	☐	☐
7) Taken things worth less than £15 from a shop without paying	☐	☐	☐
8) Arrived late for school in the morning	☐	☐	☐
9) Broken into a parking meter or coin box of a pay phone	☐	☐	☐
10) Purposely destroyed chairs, tables desks or other things at school	☐	☐	☐

	No	Only before the last 3 mths	Yes in last 3 mths
11) Without permission taken a bike or motorbike that didn't belong to him/her ("borrowed it")	☐	☐	☐
12) Scribbled on the school building inside or outside or on things belonging to the school (graffiti)	☐	☐	☐
13) Skipped one or two classes without an excuse	☐	☐	☐
14) Taken things worth more than £15 from a shop without paying	☐	☐	☐
15) Broken into a shop, house or flat and taken something	☐	☐	☐
16) Purposely destroyed seats in a bus, cinema or other places	☐	☐	☐
17) Sworn at a teacher to their face	☐	☐	☐
18) Purposely destroyed or broken such things as windows, benches, telephone boxes	☐	☐	☐
19) Been sent to the headteacher for something wrong she/he had done	☐	☐	☐
20) Avoided paying for such things as films, bus or train rides, or food	☐	☐	☐
21) Drank so much beer or that spirits he/she was clearly drunk	☐	☐	☐
22) Yelled or screamed at his/her mother or father to their face	☐	☐	☐

	No	Only before the last 3 mths	Yes in last 3 mths
23) Hit or slapped his/her mother or father	☐	☐	☐
24) Been suspended, excluded or expelled from school	☐	☐	☐
25) Threatened or forced someone to give him/her money, cigarettes or other things	☐	☐	☐
26) Has been picked up by the police for something he/she had done?	☐	☐	☐
27) Been in any kind of fight where he/she used a stick or weapon	☐	☐	☐
28) Run away from home for a night without his/her parents knowing where he/she was.	☐	☐	☐
29) Tormented or injured an animal just for fun (don't count insects)	☐	☐	☐
30) Thrown objects (such as stones or bottles at cars or people	☐	☐	☐
31) Carried a hidden weapon (such as a knife) other than an ordinary penknife	☐	☐	☐
32) Cheated in school exams	☐	☐	☐
33) Used marijuana/hash/pot more than once	☐	☐	☐
34) Used drugs other than marijuana/ hash/pot	☐	☐	☐
35) Bullied other children	☐	☐	☐

SECTION 7

In this section we are asking about: **How your child sees him/herself.**

We would like you to say how much you think the following statements have been true of your child **in the last 3 mths.**

Tick under the column which best describes how you believe he/she thinks about him/herself.

	Very true	True	Not sure	Not very true	Not at all
1) He/she feels that he/she is useful to have around	☐	☐	☐	☐	☐
2) He/she feels that he/she can do things as well as most people of her age	☐	☐	☐	☐	☐
3) He/she feels that he/she has not got much to be proud of	☐	☐	☐	☐	☐
4) Sometimes he/she thinks he/she is no good at all	☐	☐	☐	☐	☐
5) He/she feels that he/she is as good a person as anybody	☐	☐	☐	☐	☐
6) He/she feels that she can't do anything right	☐	☐	☐	☐	☐
7) He/she feels that when he/she does something he/she does it well	☐	☐	☐	☐	☐
8) He/she feels that he/she is not really getting anywhere with his/her life	☐	☐	☐	☐	☐