Mild Head Injury in Children:

Incidence, Etiology and Neuropsychological Sequelae

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Abstract

The present study examined the incidence, etiology and neuropsychological sequelae of head injury in an Intermediate School aged sample (11-13 years). The study was conducted in two parts. The first part examine the incidence, etiology and awareness of the consequences of head injury, this information was obtained thorough the screening questionnaire. Of the 173 participants who completed the questionnaire, 41% (42 males and 29 female) reported that they had sustained a head injury, of these, 33.8% reported sustaining more than one injury. In line with the current research, the majority of the head injuries sustained were mild. The gender difference observed in the literature were also reported in the present study, in that males not only sustained more head injuries than females, with a ratio of 1: 1.4, they also sustained more severe injuries. Sport was found to be the most common cause of head injury, with those reporting a head injury playing significantly more hours of sport per week than those who had not sustained an injury. And finally, the level of awareness of the symptoms of head injuries was investigated and it was found that those who had sustained a head injury were more aware of the consequences than the participants who had not sustained a head injury.

For part two of the study, 43 participants (24 with head injury and 19 controls) were selected to complete a variety of neuropsychological measures and behavioural rating questionnaires. The measures selected were reported to be sensitive to the effects of mild head injury and assessed long and short term memory, attention, concentration, information processing and learning. The results showed that the only statistically significant differences between the head injury and control groups were on the Interference Trial and Trials 6 and 7 of the Auditory Verbal Learning Test. In conclusion, it was found that head injury and multiple head injuries are prevalent in this age group, with the majority of injuries being light or mild. With respect to gender differences and the etiology of head injuries the findings in the present study are in line with current trends. However, small sample sizes meant that comparisons of neuropsychological functioning could not accurately be made between the severity of injuries and the number of injuries.

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Chapter 1

Introduction

Traumatic brain injury is the leading cause of death and permanent disability in children in the Western world. Incidence rates of head injury in children have produced equivocal results, with rates ranging from 150 - 450 children per 100,000 per year (Annegers, Grabow, Kurland, & Laws, 1980; Klauber, Barrett, Connor, Marshall, & Bowers, 1981). Incidence rates are often obtain through medical records, however, this does not provide an accurate account of head injuries as the majority of those who sustain mild head injuries never seek medical attention. It is estimated that over 80% of the head injuries that children (under 15 years old) sustain are mild (Fennell & Mickle, 1992). While there is no doubt as to the critical effects of severe head injuries, there is now increasing evidence suggesting that even mild head injury can lead to persisting physical, cognitive, and behavioural difficulties interrupting the child's normal development (Boll, 1983; Goldstein & Levin, 1985; Gulbrandsen, 1984; Klonoff, Low & Clark, 1977). Such difficulties include headaches, dizziness, slowed information processing, memory deficits, irritability, lowered frustration tolerance and aggressive outbursts.

While the majority of children tend to make a good recovery within a few months, there is a small but significant number who continue to experience persisting cognitive and behavioural deficits years after the injury. These deficits can have a devastating effect on the child's school functioning, in both the academic and social realms of school life (Mira, Foster-Tucker, Tyler, 1992). Deficits in cognitive functions may mean that students take longer to complete school work, have difficulty keeping up with instructions, may be easily distracted and have difficulty shifting attention from one task to another. Behavioural deficits such as acting out, non compliance and disrupting peers, may be used to divert attention away from difficulties they are experiencing in other areas (Mira et al., 1992). Teachers, and parents need to be aware of the consequences of mild head injury to allow them to prepare for any possible changes in the child's behavioural and cognitive functioning.

Many authors have suggested that children who sustain head injuries do not represent the general population (Rutter, Chadwick, Shaffer & Brown, 1980; Goldstein & Levin, 1987; Oddy, 1993). Factors which have been suggested to increase the risk of head injury include age, gender, socio-economic status and family factors, behaviour and cognitive abilities (Annegers, 1980; Carft, Shaw & Cartlidge, 1972; Klonoff, 1971; Kraus, 1995; Oddy, 1993). Previous head injury has also been suggested to be a risk factor for sustaining further injuries. Gualtieri and Cox (1991) suggest a compounding effect with an initial head injury doubling the risk of sustaining a second injury and a second head injury making a third eight times more probable.

An area, which until recently, has rarely been addressed in the literature on children is the possible cumulative damage which may occur from repeated mild head injuries. While there is a notable absence of epidemiological data examining the prevalence of multiple head injuries in children, there has been substantial research examining the effects of multiple head trauma sustained through sports. It is well established that contact sports such as soccer, rugby and boxing are associated with high risk for repeated head injuries. The majority of these studies conclude that the effects of recurrent head injuries are cumulative (Gronwall & Wrightson, 1975; Mendez, 1995). Such conclusions have important implications for children since epidemiological studies have shown that sports and recreational activities are the leading cause of head trauma in children under 15 years old.

The purpose of the current research is to establish incidence rates and the etiology (specifically examining the role of sport) of head injury and multiple head injury in an Intermediate School aged sample in New Zealand. The samples level of awareness of the consequences of head injury will also be examined as will the neuropsychological consequences of head injury. Chapter two presents the epidemiology of head injury in children with an emphasis on incidence, etiology and the risk factors. The techniques used to classify the severity of head injuries are also described. The next chapter examines mild head injury, looking specifically at the difficulties defining mild head injury, the postconcussional syndrome in children, concussion and the literature pertaining to multiple head injuries. The Bijur, Haslum and Golding (1996) study will

be critically evaluated as it is the only current research which investigates the effects of multiple head injuries in children. Chapter four reviews the neuropsychological sequelae of mild head injury and the course of recovery following MHI. Implications for schooling are presented in chapter five, a section on neuropsychological assessment issues will also be included. Chapter six summarises the literature presented in chapters two, three and four and presents the hypotheses for the present study. Chapters seven to nine cover the method, results and discussion (respectively) of the present study as well as the conclusions and recommendations arising from the present research.

Chapter 2

Epidemiology of Head Injuries in Children

The aim of this chapter is to examine the epidemiological data pertaining to head injuries in children, with an emphasis on the research regarding mild head injuries (MHI). Information on incidence and etiology are reviewed looking at New Zealand and overseas data with an examination of the differences between male and female children. The various techniques used to assess the severity of head injuries and the difficulties that arise when assessing MHI and multiple head injuries are discussed. The risk factors for sustaining a head injury are outlined looking specifically at gender, socio-economic status, family factors, the child's behaviour, their cognitive abilities and previous head injuries. The last section of this chapter presents the research on the awareness of the consequences of head injuries.

Incidence

Goldstein and Levin (1987) define incidence as "the number of new cases during a specified time period relative to the general population at risk" (p. 518). Numerous studies have attempted to estimate the incidence of head injury for both the general population and specific populations such as the pediatric age group (Annegers et al., 1980; Jagger, Levine, Jane, & Rimel, 1984; Kraus, 1987, 1995). However, due to many methodological and conceptual difficulties, it is impossible to find consensus on the true incidence rate of head injury (Fennell & Mickle, 1992).

These difficulties include the lack of a single clear definition for head injury; a variety of measures used to classify severity and differences within the measures; and estimates are often derived from medical records, however, as medical attention is infrequently sought following MHI, the true incidence is obscured (Asarnow, Satz, Light, Zaucha, Lewis, et al., 1995; Fennell & Mickle, 1992; Goldstein & Levin, 1987; Kraus, 1995). These issues need to be considered when reviewing epidemiological data, which only represent a rough estimate of the actual occurrence of head injury.

Previously reported incidence rates range from 193 - 367 per 100,000 people per year in the United States (Fennell & Mickle, 1992). Incidence for children (up to 14 years) are less clear with rates ranging from 150 - 450 children per 100,000 per year (Annegers et al., 1980; Klauber et al.,1981). Kraus (1995) in examining the various sources of incidence for childhood head injury, determined the average incidence rate to be approximately 180 per 100,000 children per year.

As few formal studies have been conducted in New Zealand, epidemiological data on the incidence of head injuries in children is sparse. Body and Leathem (1996) examined the incidence of head injuries in a New Zealand adolescent (14 years) sample and found that 41% of their sample (N= 135) had reported they had sustained a head injury of any severity, although these were predominately light/mild.

New Zealand Accident Compensation and Rehabilitation Corporation (ACC) data for the year ending June 1996, report a total of 6,858 head injuries, however, this is not broken down by age (ACC, 1996). In 1991 the number of head injuries were broken down by age for some categories, and showed that those individuals aged 10-14 years sustained 42 head injuries through motor vehicle accidents (ACC, 1991c) and 181 head injuries at home (second highest age group for this category) (ACC, 1991b). The number of head injuries sustained through sports for this age group is not available. This data needs to be examined with caution as it only includes those head injuries registered with ACC.

The area of multiple head injuries is often overlooked when evaluating the incidence of head injury, however, this is a valid area of concern as the research that is available suggests that this event is fairly prevalent. There are a limited number of studies which have attempted to estimate the prevalence rate for multiple head injuries, these have been reported to range between 4.3% and 40% depending on the sample studied (Salcido & Costich, 1992). Table 1 reports the prevalence rates reported by various studies.

Table 1:

Reported Risk/Prevalence of Multiple Head Injuries

Reference	Sample	Prevalence/Risk
Bijur et al. (1996)	UK, 10 year old children	Prevalence equated to 17%
Body & Leathem (1996)	NZ, 14 year old children	Prevalence: 20%
Sumerhina (1984)*	USSR, under 15 years old	Prevalence: 12.6%
Annegers et al. (1980)	USA, hospital data, all ages	Risk: 3 x non-head injured
Jagger et al. (1983)	USA, hospital data, adults	Prevalence: 31%
Carlsson, Svardsudd & Welin (1987)	Sweden, males, community, adults	Prevalence: 17.9%

* Cited in Salcido &Costich (1992)

Only three studies have reported on the prevalence of multiple head injuries in children, however, the results of these studies and those using adult populations suggests that this is an area that should not be overlooked. The same difficulties observed in estimating the incidence of head injuries are also applied to multiple head injuries, therefore it is important to consider these with caution.

Bell and Britton (1989) report that half of all deaths in children aged under 15 years occur from a head injury and that death from head injury rises from 10/100,000 in children aged 5-9 years up to 19/100,000 in children aged from 10-14 years. While head injury can have devastating results in children, it is widely accepted that among children (up to the age of 15 years) the majority of head injuries are mild (Asarnow et al., 1995; Fay, Jaffe, Polissar, Liao, Martin et al., 1993; Snoek, 1989). Fennell and Mickle (1992) suggest the following severity estimates for head injured children aged 0-15 years: 5% of head injuries are fatal, 6% are severe, 8% are considered moderate, and 82% of injuries are mild.

It is consistently shown in the epidemiology literature that male children (aged 5 to 14 years) have a higher incidence of head injury than female children, with the ratio

ranging from 1: 1.3 up to 1: 3.2 (Birmaher & Williams, 1994; Goldstein & Levin, 1987; Klonoff, 1971; Kraus, 1995). Kraus (1995) reports a slowly increasing rate for males after the age of 5 years with a dramatic increase between the ages of 15 and 19 years. The female rate tended to decline after the age of 3 years and then increased slightly after 12 years of age. Body and Leathem (1996), however, found that females (14 years old) outnumbered males 1.12:1 with respect to reported head injuries. The authors suggest that this result may have occurred as in New Zealand, compared to other countries, females have a higher level of participation in sports, including contact sports. Another factor which may influence this result is that all head injury severity levels were included in the study, including a large number who had not sought medical attention.

Males not only have more head injuries than females, but also tend to have more serious head injuries, as well (Begali, 1992; Birmaher & Williams, 1994). This is reflected in the fact that male children are found to be four times more likely to die from a head injury than female children (Annegers, 1983; Goldstein & Levin, 1987). Klonoff and Paris (1974) suggest that males have an increased vulnerability to head injury due to differences in stereotyped patterns such as rough play and participating in more high contact sports (i.e. rugby, soccer).

Etiology

The substantial differences in the etiology of head injuries between children and adults plays a role in the pathophysiology and severity of closed head injury. Head injuries sustained by adults tend to be high velocity injuries sustained through motor vehicle accidents, while children's injuries, which are predominately mild and sustained through falls and sporting accidents, are more likely to be of low velocity (Goldstein & Levin, 1987).

Various authors have reported that the most common cause of head injuries in children aged 5 through to 15 years include sports and recreational accidents, falls and pedestrian-motor vehicle accidents (Annegers et al., 1980; Birmaher & Williams, 1994; Body & Leathem 1996; Bond, 1986; Currie, 1993; Goldstein & Levin, 1987; Kraus & Nourjah, 1989). Body and Leathem (1996) found sports related accidents to

be the major source of head injury (38.5%) followed by collisions (26.8%) in a 14 year old sample. Further analysis revealed that those subjects who had sustained one or more head injuries also reported to play more hours of sport per week than the non-head injured sample.

New Zealand ACC statistics report that for those aged 10-14 years, a total of 1,230 injuries were sustained through sports (including swimming [435 claims], rugby [396 claims], and soccer [115 claims]). While head injuries through sports were not broken down by age, it was shown that head injuries were most prevalent in rugby and swimming (ACC, 1991a). This has important implications for children since rugby and swimming were the sports where children sustained the most injuries.

Much of the research examining the effects of multiple injuries have used athletes as samples since it is widely accepted that sports such as horse riding, rugby and soccer place individuals at high risk for repeated head injuries. This has important implications for children as sports are a common cause of head injury in those aged under 15 years. The sport which has the highest risk for head injury is horse riding (including both amateur and professional) (Bixby-Hammett, 1983).

Child abuse is also a cause of head injury in children, particularity in infants under 2 years old (Birmaher & Williams, 1994). Fennell and Mickle (1992) describe how the number of child abuse cases reported has increased by approximately 200% in recent years, and report a rate of 6.3/1000 for infants (0-2 years) and approximately 27.5/1000 for 15-17 year olds.

Risk Factors for Head Injuries

Many researchers have suggested that children who sustain head injuries do not represent the general population (Rutter et al., 1980; Goldstein & Levin, 1987; Oddy, 1984, 1993). Numerous studies have attempted to identify potential risk factors associated with head injuries in childhood, with equivocal results. However, they do all suggest the importance of examining the premorbid characteristics of both the child and their family (Goldstein & Levin, 1987).

Gender

Annegers (1983) suggeststhat males who have already sustained a head injury are twice as likely, compared to those with no head injury, to sustain a second injury. In females, the risk of a second head injury was found to be nearly as great as males (Levin, Ewing-Cobbs & Fletcher, 1989).

Age

Annegers et al. (1980) also examined the risk of recurrent head injury in relation to age, they found that for those under 14 years the risk of a subsequent head injury is doubled, for those aged 15-24 years the risk is tripled, and the risk is five times the normal risk after the age of 25 years.

Socio-Economic Status and Family Factors

Research examining the effects of socio-economic status and family factors on the risk for head injuries are equivocal. Higher rates of head injury have been found in children who lived in more congested areas, are from low SES backgrounds, and whose parents were more likely to be unemployed or to have emotional difficulties (Klonoff, 1971; Levin et al., 1989). However, other researchers have reported contradictory results suggesting these factors are not related to the incidence of head injury (Jamieson & Kaye, 1974, Klauber et al., 1981).

Behavioural Factors

Klonoff (1971) found that compared to the control group, those who had sustained a head injury did not have any pre-existing behavioural problems, or have a greater incidence of accidental injury in the past. Similar results were also reported by Gulbrandsen (1984), Partington (1960) and Donders (1992).

Further research, however, has suggested that children who sustain head injuries are more likely than controls, to have pre-existing behavioural problems (Craft et al., 1972). Post injury sequelae is suggested to be an exaggerated reflection of the child's premorbid behaviour. Children who display impulsitivity and hyperactivity are more likely to take part in risk taking behaviour which may in turn lead to head injury.

Cognitive Factors

The Rutter studies (Brown, Chadwick, Shaffer, Rutter & Traub, 1981; Chadwick, Rutter, Brown et al., 1981; Chadwick, Rutter, Shaffer & Shrout, 1981) found that along with premorbid behavioural problems, mildly head injured groups also exhibited lower premorbid academic achievement.

Previous Head Injury

The research on the risk of sustaining further injuries after the initial injury has produced equivocal results. Partington (1960) did not find an increased risk of subsequent head trauma in children who had sustained an initial injury. This result was confirmed by Klonoff (1971). Gualtieri and Cox (1991), however, estimated that the risk of sustaining a second injury was three times that of those without previous head injury, after two head injuries the risk increased to eight times the normal risk.

Classification of Head Injuries

The severity of a head injury is generally classified as either mild, moderate or severe on the basis of either length of Post-Traumatic Amnesia (PTA) or score on the Glasgow Coma Scale (GCS). PTA refers to the length of time (measured from when the injury occurred) taken for the patient to regain memory for day-to-day events (Morse & Montgomery, 1992). Asarnow et al. (1995) suggests that it is difficult to obtain a reliable measure of PTA in children as normative developmental data on temporal orientation in children is sparse.

The GCS was developed by Teasdale and Jennett (1974) and is widely used to assess the "depth and duration of impaired consciousness and coma" (p.81). Levels of ocular, verbal and motor responses are assessed and a score is given which reflects the severity of the head injury.

Duration of loss of consciousness (LOC) immediately following a head injury is an additional method for assessment of severity. It is suggested that the longer the length of unconsciousness the greater the severity of the head injury (Morse & Montgomery, 1992). This technique is commonly used in research as people often do

not know their GCS score or their duration of PTA, but are generally aware of the length of any period of unconsciousness. Use of LOC also allows people who did not seek medical attention (i.e.: did not receive a GCS or PTA score), particularly those with mild head injuries, to be assessed with the same accuracy as those with more severe head injuries. Table 2 presents the cutoff points for each assessment technique (PTA, GCS and LOC) to classify the severity of a head injury.

Table 2:

Classification of Severity of Head Injury using Various Techniques

Injury Severity	GCS Score [1]	PTA Time [2]	Length of LOC [3]
Light		less than 5 minutes	No LOC
Mild	13 - 15	5 - 60 minutes	1 - 30 minutes
Moderate	12 - 9	1 - 24 hours	30 minutes-24 hours
Severe	8 - 3	24 hours or longer	24 hours or longer

[1] Source: Lezak (1995)

[2] Source: Bigler (1990)

[3] Source: Annegers et al. (1980)

The measures reviewed here are often used to classify MHI. Satz, Zaucha, McCleary, Light, Asarnow et al. (1997) suggests, however, that these measures become unreliable or not applicable when assessing the severity of the milder head injuries, and that the unreliability of these measures increases when they are applied to children. Satz et al. (1997) goes on to suggest the various methods used to classify MHI are complicated by the transient nature of the symptoms of MHI.

While there is a variety of different approaches to assessing severity there is also great variability within each approach to define cases. For example Asarnow, Satz, & Light (1991) and Chadwick, Rutter, Brown, Shaffer & Traub (1981) both used length of PTA to classify the severity of head injury. Asarnow et al. (1991) classified MHI as those with a PTA of less than 4 hours while Chadwick, Rutter, Brown et al. (1981)

classified MHI with a PTA of less than 7 days. This large difference in the cutoff marks makes comparing the results difficult as what is considered severe in one study is considered mild in another. It is also important to note that some studies do not include a moderate head injury group, and that these cases are sometimes combined with mild head injury groups (as with the Chadwick, Rutter, Brown et al. [1981] study), making it difficult to accurately compare research.

Another factor which needs to be considered, and which is often overlooked, is whether there is a prior history of head injury. There is now increasing evidence that the effects of multiple MHI are cumulative (Gronwall & Wrightson, 1975), suggesting that it is not appropriate to compare neuropsychological results of someone with one MHI to someone with numerous MHI. Classification of head injuries needs to take into consideration the number of past head injuries and the severity of those injuries. Barnfield and Leathem (in press) have attempted to devise a reclassification system which takes into account these factors, this is presented in Table 3.

Table 3:

Criteria for Reclassifying Subjects Experience with Head Injuries

Severity	Criteria for Each Classification of Severity
Light:	Up to and including 3 light head injuries,
Mild:	4 or more light head injuries and/or 2 or less mild head injuries
Moderate:	3 or more mild head injuries and/or 2 or less moderate head injuries
Severe:	3 or more moderate head injuries and/or any severe head injuries

Note. From "Incidence and etiology of traumatic brain injury and substance use in a New Zealand prison population" by T. V. Barnfield & J. Leathem (in press). Reprinted with permission.

Awareness of the Symptoms of Head Injuries

Gouvier, Prestholdt and Warner (1988) surveyed 221 individuals (aged between 15 - 60 years) in a shopping mall on their knowledge of head injury and seatbelt safety. The researchers found that regardless of age, gender, occupational status or head

injury history, there were a high number of misconceptions about head injury. Similar results were reported by Willer, Johnson, Rempel, and Linn (1993, cited in O'Jile, Ryan, Parks-Levy, Gouvier, Betz, et al., 1994) in a replica study.

Using a college population (mean age 20.84 years), O'Jile et al., (1994) examined the possible misconceptions of the sequelae of head injuries and whether experience with head injury affected these ideas. Overall, their sample demonstrated a lower percentage of misconceptions about the consequences of head injury than the general public. They also found that the pattern of responses for the head injury and non head injury groups were similar, they go on to suggest that head injury experience does not lead to an increased knowledge of the sequelae of head injury.

Research assessing the level of awareness of the consequences following a head injury in children is limited. Leathem and Body (in press) presented 14 year old students with 2 scenarios and asked them to write down what symptoms they thought would occur after head injury. The results of this study showed that the students who had sustained a head injury were more likely to list more accurate consequences than the control group. Of the consequences reported the most common symptoms included dizziness, memory difficulties, migraines/headaches and coma/brain damage. These studies tentatively suggest that younger individuals are more likely to have a better understanding of the consequences of head injury.

Chapter Summary

Due to numerous methodological and conceptual difficulties it is impossible to obtain an accurate incidence rate of head injury (or multiple head injury) in children. However, some authors have attempted to estimate the incidence and place it at approximately 180 per 100,000 children, per year. Males are shown not only to sustain more head injuries than females but their injuries also tend to be more severe, however, overall, the majority of head injuries sustained in childhood are considered to be mild. Children under the age of 15 years often sustain low velocity injuries due to sporting accidents and falls, unlike adults whose injuries are likely to be high velocity in nature due to motor vehicle accidents. The research examining the factors which put children at high risk for head injury generally agree the gender and age

influence the risk for sustaining a head injury, or further injuries. However, with respect to other factors such as socio-economic background, previous head injury and the child's behavioural and cognitive abilities, the results are equivocal. The final section of this chapter examined the literature pertaining to the awareness of the consequences following a head injury. While there is limited research examining the awareness level in children, what is available suggests that younger individuals are likely to have a adequate understanding of the consequences. However, since the literature on this topic is sparse, further research is necessary.

Chapter 3

Mild Head Injury

This chapter aims to clarify some of the confusion which surrounds MHI. This will be done by initially discussing the difficulties with defining MHI, following which the literature regarding the postconcussional syndrome and concussion will be reviewed. These terms are synonymous with MHI and are often used interchangeably as there is much overlap in the literature. However, it is important to the discuss individual aspects of these constructs to help determine their place within the paradigm of MHI. Another complicating factor of MHI is multiple head injuries. Sport, which is a common cause of MHI in children (Kraus & Nourjah, 1989), is an activity which has often been associated with an increased risk for head injuries and repeated head injuries (Kelly & Rosenberg, 1997). The effects of multiple mild head injuries have often overlooked, however, this is a growing area of concern since the literature is now suggesting that multiple mild head injuries are cumulative (Gronwall & Wrightson, 1975Salcido & Costich, 1992). This has important implications for children since the majority of head injuries sustained in childhood are mild and since they are at risk for sustaining multiple head injuries.

Definition of Mild Head Injury

A review of the current literature on MHI shows a lack of consensus on how to define this type of injury. This leads to complications in clinical treatment and is a major cause of conflicting results in the research (Asarnow et al., 1995; Binder, 1986; Satz et al., 1997). Adding to the confusion surrounding MHI is the term itself. When taken literally it suggests that facial wounds and dental injuries are included, as they may be mild injuries to the head, however what the name neglects to suggest is that when MHI has occurred, the brain is directly involved in the injury. MHI when defined with regard to brain injury, encompasses a wide range of conditions including concussion, contusion, hemorrhage, laceration and whiplash (Kraus & Nourjah, 1989). No single clear definition is available.

The majority of research, however, chooses to define MHI by the level of severity of the injury. The severity is assessed by GCS score, PTA time and length of LOC (as previously described in chapter 2). There is little agreement on which is the most appropriate measure to use when assessing a possible MHI and severity cutoff points have ranged from No PTA to PTA of 7 hours (Chadwick, Rutter, Brown et al., 1981). It has been suggested the transient nature of the symptoms of MHI and the lack of understanding in children about head injury terms can mean that these measures of severity are unreliable when they are applied to children (Satz et al., 1997). The assessment of MHI is further complicated by multiple head injuries. It is now suggested that the effects of multiple head injuries are cumulative (Gronwall & Wrightson, 1975), suggesting that the effects of one MHI, may be substantially different in someone who has sustained four MHI in the past. This suggests that when assessing the severity of a head injury, previous head injuries need to be considered. This will be reviewed further in the section on multiple head injuries.

Postconcussional Syndrome in Children

The postconcussional syndrome (PCS) is a term which is often used to describe MHI. PCS, however, does not neatly define MHI and instead is a collection of persisting symptoms which may be observed following MHI. The symptoms of PCS in children are consistent with those reported by adults and include somatic complaints (headaches, dizziness, fatigue, blurred vision, noise intolerance and light sensitivity), cognitive difficulties (poor concentration, memory impairment, short attention span and academic problems), and emotional changes (anxiety, depression, difficulty controlling anger and irritability) (Binder, 1986; Miller & Jones, 1990; Mittenberg, Wittner, & Miller, 1997). It has been shown that the symptoms of PCS can last months or in some cases even years after the head injury (Binder, 1986).

Mittenberg et al. (1997) suggests that anxiety plays a role in the experience of symptoms of PCS in children, despite the severity of the injury. They suggest that psychological and pharmacological interventions, which are used to reduce anxiety, may also reduce the symptoms of PCS in children. Sources of anxiety following head injury in children include cerebral dysfunction, parental over-concern, and the child's

reaction to the injury. Anxiety has also been shown to maintain PCS in adults (Trahan & Ross, 1998).

Concussion

Concussion is another term which is encompassed by MHI, however, they are distinct in that there are no limits in terms of severity for concussion (Rutherford, 1989). Rutherford (1989) defines concussion as:

> Concussion is an acceleration/deceleration injury to the head almost always associated with a period of amnesia, and followed by a characteristic group of symptoms such as headache, poor memory, and vertigo.
>
> (Rutherford, 1989, p. 217).

Concussion, as mentioned above, may or may not involve loss of consciousness and is often graded as mild, moderate or severe, although there is controversy on the classification for these (American Academy of Neurology, 1997; Kelly & Rosenberg, 1997). Table 4 presents various authors grading scales for the severity of concussion.

Concussion is common in sports (contact sports in particular), but it can also result from collisions or falls from various activities. Kelly & Rosenburg (1997) argue that concussion can also occur without a direct blow to the head if there is a significant force applied to the brain, for example, from a "whiplash" injury.

There are numerous symptoms of concussion which can be observed in children, and in adults, early after the concussion or at a later stage. Early signs of concussion include confusion and disorientation, retrograde amnesia, anterograde amnesia, headaches, nausea and vomiting, and motor problems. Later signs of concussion include decreased information processing speed, short term memory impairment, irritability and depression, fatigue and sleep disturbance, and general feeling of "fogginess" (American Academy of Neurology, 1997; Kutner, Barth, Zillmer, Webbe, Echemendia, & Lovell, 1997).

Table 4:

Grading Scales for Severity of Concussion

Author	Grade 1 (Mild)	Grade 2 (Moderate)	Grade 3 (Severe)
American Academy of Neurology (1997)	No LOC, confusion and symptoms resolve in less than 15 minutes	No LOC, confusion and symptoms last more than 15 minutes	Any period of LOC
Cantu (1991)*	No LOC and PTA of less than 30 minutes	LOC less than 5 minutes or PTA between 30 minutes and 24 hours	LOC more than 5 minutes or PTA longer than 24 hours
Colorado Medical Society (1991)*	No LOC and confusion without amnesia	No LOC and confusion with amnesia	Any period of LOC

* Cited in Kutner et al. (1997)

In children, frequently observed neurobehavioural features of concussion include vacant stare, delayed verbal and motor responses, inability of focus attention, disorientation, coordination difficulties, memory deficits, and any period of LOC (Kelly & Rosenberg, 1997).

Generally concussions are regarded as minor injuries resulting in minimal brain damage, if any at all. However, Hugenholtz & Richard (1982) and Rutherford (1989) suggest that this is not the case, with many authors reporting widespread microscopic changes, including diffuse axonal shearing, petechial hemorrhages in periventricular regions, and cell loss throughout the cortical grey matter and brain stem nuclei. Following repeated head injury Hugenholtz & Richard (1982) suggest that these abnormalities may develop into gross atrophy.

Concussion in Sports: Withdrawal from play and guidelines for when to return

Concussion in sports is common and needs to be discussed separately as specific issues arise. Following a concussion the athlete needs to be closely observed and assessed at repeated intervals to determine what symptoms are present, the severity of the concussion, the effect the concussion may have on the persons performance (American Academy of Neurology, 1997; Hugenholtz & Richard, 1982). History of recent head trauma sustained through sport or other means needs to be considered when evaluating the athlete.

Following concussion, Hugenholtz & Richard (1982) suggest that it is the ability to assimilate information and act with split second timing which is often impaired. For this reason it is important that children are withdrawn from sporting activity until the effects of the concussion have ceased, to reduce the opportunity of incurring further, and possible more severe, injuries.

Various authors have suggested guidelines for when an athlete should return to play following concussion, these have been set out in Table 5. These guidelines take into consideration the severity of the concussion, the history of any recent previous head injuries, and the postconcussive symptoms the child is experiencing.

Boxing, rugby and rugby league are the only sports in New Zealand which have mandatory rules regarding concussion. In rugby union and league, following concussion, players must be seen by a doctor, they are restricted from play for three weeks and are only allowed to return following doctors clearance. In league, however, if a player is concussed three times then they are not allowed to return to the sport, unless with clearance from a neurologist or neurosurgeons (Sinclair, 1997). There are no rules specifically set out for children.

Table 5:

Return to Play Guidelines after Concussion

Author	Grade 1 (Mild)	Grade 2(Moderate)	Grade 3 (Severe)
American Academy of Neurology (1997)	Symptoms resolve within 15 minutes	Asymptomatic for 1 week	Asymptomatic for 1 week (if LOC brief) otherwise, if asymptomatic for 2 weeks.
Cantu (1991)*	Asymptomatic for 1 week	Asymptomatic for 1 week	Removed from play for a month, return if asymptomatic for 1 week
Colorado Medical Society (1991)*	Asymptomatic at rest and exertion after 20 minutes	Asymptomatic for 1 week	Remove from play for a month, return if asymptomatic for 2 weeks

*Cited in Kutner et al. (1997)

Athletes who have sustained two or more head injuries in the season are subject to longer periods of restricted activity. Alves & Polin (1995) suggest that the grade of the injury is increased by 1 for each subsequent injury. For example, an athlete who sustained an uncomplicated grade 1 injury, then later in the season sustained a grade 2 injury, would be managed as a grade 3 injury. Athletes are recommended to discontinue playing for the season (or a minimum of 3 months) if they sustain 3 injuries, or if two injuries total more than a Grade 4. While there are no guidelines specifically set out for children, it is imperative that concussion in children is taken seriously and the suggested outlines above are strictly adhered to.

Returning to sporting activities when head injury is a risk, and in particular contact sports, may lead to serious outcomes including permanent disability and death. Saunders & Harbaugh (1984) describe a 19 year old male who received a concussion in a fight. Three days after the concussion he only complained of a mild headache and was given permission to play football the next day. During this game he sustained another mild concussion, he walked from the field and collapsed. He was taken to hospital and four days later he died. It is suggested that the cumulative effects of the two relatively mild head injuries were the cause of death.

In summary, the most common cause of head injury in children is through sporting and recreational activities. Any sport has a risk of head injury (concussion), though contact sports (such as rugby, soccer and hockey) put children at a higher risk. It is necessary that a balance can be reached between the enjoyment of playing a chosen sport and ensuring the safety of the players. Adhering to suggested guidelines and recommendations for when it is safe to return to play can ensure that this balance is met.

Multiple Head Injury

Multiple head injury is also an area which needs to be examined when reviewing the literature on MHI. Sport, which is a common cause of MHI in children, is an activity which has often been associated with an increased risk for head injuries and repeated head injuries. Much of the research regarding multiple head injuries has used adult samples however, the main points of this research will be outlined to help gain a better understanding of the effects of multiple head injury. While these findings cannot be directly transferred to children, they are important to help understand what possible outcome may be.

Many of the leading studies in the field of head injury have focused on the current injury without acknowledging or taking into account any previous head injuries sustained or the severity of those injuries (Rutter et al., 1980; Klonoff et al., 1977). Head injury research tends to either exclude those with past injuries or does not screen for previous injuries at all. These studies all focus on the latest injury and any consequences which are observed are attributed to the current injury, when in fact

they may also be due, in part, to past head injuries. It is important to establish the history of previous head injury and the severity of those injuries, to help understand the possible effects they may have on a child or adolescents functioning.

Sport as an Activity of Increased Risk

Much of the research examining the effects of multiple injuries have used athletes as samples since it is widely accepted that sports such as horse riding, boxing and soccer place individuals at high risk for repeated head injuries. The sport which has the highest risk for head injury is horse riding (including both amateur and professional). Head injuries are the most frequent and most severe injuries in horse riding (Bixby-Hammett, 1983). Bruce, Schut, & Sutton (1984) suggest that 11% of riding injuries, in children and adolescents are concussions. Boxing is also a sport which multiple mild head injuries are common as the aim is to render the opponent unconscious. In boxing approximately two thirds of all serious injuries are related to the head (Mendez, 1995).

Soccer, the most widely played team sport in the world, is played by all ages and by both males and females (Abreau, Templer, Schuyler, & Hutchison, 1990; Bruce, Schut, & Sutton, 1984). It is suggested that 5-15% of all injuries in soccer occur to the head, face and neck. Heading is an important and unique component of the game, this involves the player using their head to advance the ball. It has been suggested that soccer players will head the ball on average of 6 times per game (Lohnes et al., 1994). In a New Zealand study (McKenna, Borman, Findlay, & de Boer (1986) 33% of all soccer injuries were due to heading the ball. Soccer was also found to have the second highest amount of head injuries in winter sports, rugby was first.

It is important to take into consideration these results when examining the effects of multiple head injuries in children and adolescents, as etiological studies show the leading cause of head injuries in children and adolescents is through sport and recreational activities (Kraus & Nourjah, 1989).

Effects of Multiple Head Injuries

Studies using both animal and human subjects have been conducted to examine the effects of multiple head injuries. The majority of this research suggests that the outcome of repeated head injuries are disproportionate to the severity of a single injury taken in isolation and conclude that the effects of these injuries are cumulative (Gronwall & Wrightson, 1975; Kelly & Rosenberg, 1997; Salcido & Costich, 1992).

One of the leading studies in this field was conducted by Gronwall and Wrightson (1975). This study examined 20 young adults (aged 16 -26 years) who had sustained a second concussion (10 with multiple mild and 10 with multiple severe concussions). These participants were matched with controls who had sustained only a single severe or mild concussion. The PASAT was used to test the subjects rate of information processing and was completed every ten weeks until recovery (a score 1 standard deviation of the norm for this age group). Compared to controls, the multiple concussion groups had greatly reduced information processing speed and took significantly longer to return to normal levels of information processing. Gronwall and Wrightson (1975) concluded that the effects of the concussion were cumulative.

As contact sports are associated with a high rate of repeated head injury, there is a multitude of research examining the effects of multiple head injuries through various sports such as boxing (Barth, Alves, Ryan, Macciocchi, Rimel et al., 1989; Jordan & Campbell, 1988; Mendez, 1995), soccer (Aross, 1983; Autti, Sipila, Autti, Salonen, 1997Fields, 1989; Sortland & Tysvaer, 1989; Spear, 1995; Tysvaer et al., 1991), rugby (Gibbs, 1994; Maddocks, Saling & Dicker, 1995), and horse riding (Bixby-Hammet, 1983). Various outcomes of multiple head injuries have been reported including structural alterations in the brain (central cerebral atrophy, widening of the lateral ventricles, cortical atrophy, maglignant brain swelling) (Kelly & Rosenberg, 1997; Sortland & Tysvaer, 1989), EEG abnormalities (Tysvaer et al., 1991) and difficulties with motor, behaviour and cognition including prolonged reaction time, inability to process new information (Salcido & Costich, 1992), deficits in attention, concentration, memory, judgment (Alves & Polin, 1995; Carlsson et al., 1987; Tysvaer et al., 1991).

Several studies using animals (Rinder, Olsson, Lindgren & Stalhammar, 1972; Unterhanscheidt, 1985, cited in Van Mechelen, 1994; Windle, Groat & Fox, 1944) have demonstrated that the effects of repeated mild head injuries can not only produce structural alterations in the brain, but the outcomes were comparable to a single strong concussive blow. Unlike the previously cited studies, Parkinson, West and Pathiraja (1978) report no permanent or cumulative effects after multiple mild concussion in rats.

The majority of these studies agree that the effect of multiple head injuries are cumulative, however, as many of these studies use animal and adult populations the results cannot be directly assumed to occur in children (the data presented is still important to consider as they suggest possible outcomes in children). One study, conducted by Bijur et al (1996), does directly examine the effects of multiple head injuries in children. This study will be critically review below.

Bijur, Haslum & Golding (1996) Study

This study used a large sample (1915 subjects) which was divided into three groups depending on the number of mild head injuries sustained between birth and age ten. The subjects were matched to controls who had not sustained head injuries but had received injuries to other parts of the body. They were matched according to the total number of injuries and gender.

The number and description of all injuries was reported by the mother of the child at the time the child was 5 years and 10 years old. Mild head injury was defined as a head injury reported by parents which resulted in medical care or hospitalization for less than two nights (Bijur et al., 1996). This definition suggests that the injuries needed to be sufficiently severe as to require medical attention. This definition of MHI is strict and means that many mild injuries which may have been sustained were excluded from the study.

At 10 years the child was administered three different measures. Four subtests of the British Abilities Scale (word definition, recall of digits, similarities, and matrices) were

used as a global measure of intelligence giving similar information to that which might have been obtained by the Wechsler Intelligence Scale for Children-Revised (WISC-R) and the Stanford Binet Intelligence Scale. Also administered were the Friendly Math's Test measuring various aspects of mathematics and a shortened version of the Edinburgh Reading Test (Bijur et al., 1996).

The following demographic, social and personal characteristics were examined socioeconomic status, quality of housing , mothers age, mothers psychological somatic health, number of siblings, and gender. The results indicated higher frequency of injury to any part of the body, was strongly related to a decrease in the quality of housing, a decrease in the child's socioeconomic status, a decrease in the mothers age, and an increase in the mothers psychological malaise. On the cognitive and achievement tests there was no statistically significant difference found between the head injury groups and their controls (Bijur et al., 1996).

For all groups, scores on the cognitive and academic tests decreased with increasing number of injuries (whether to the head or other parts of the body), however, no statistically significant results were found for any of the interactions between head injury groups and the controls and the number of injuries. Bijur et al. (1996) concluded that at age 10, multiple head injuries do not have an adverse effect on intelligence or academic achievement. From this study the effects of multiple mild head injuries in children are not concluded to be cumulative.

A major limitation to this study concerns the measures that were used to assess cognitive and academic functioning, in that they may not be sensitive enough to detect the subtle changes which have been shown to occur in mild head injuries. Previous studies which have shown cognitive deficits following mild head injuries have predominately used the WISC-R (Klonoff et al., 1977).

In summary, while the Bijur et al. (1996) study concluded that multiple head injuries are not cumulative, the effects of multiple head injuries in other populations (adults, athletes and animals) cannot be ignored. The leading cause of head injuries in children

is sports and recreational activities, due to the high risk of repeated head trauma in sports it is essential that further research is conducted with populations of children.

Chapter Summary

A wide range of information has been presented in this chapter, including the difficulties with defining MHI, a review of the postconcussional syndrome in children, the considerations for concussion in sports and the effects of multiple head injuries, particularly examining the Bijur et al. (1996) study. MHI is a confusing area as terms such as PCS and concussion are often used instead of MHI. This leads to confusion as these terms, while encompassed by MHI, are distinct from MHI. PCS is a collection of symptoms which may occur following MHI, these include headaches, dizziness, memory impairment, irritability and anxiety. Research suggests that the symptoms found in children are consistent with those reported by adults, and as with adults, anxiety can maintain these symptoms. Concussion is distinct from MHI in that there are no severity limits placed on concussion. Concussion is an acceleration/deceleration injury and is also characterised by a collection of symptoms including confusion and disorientation, amnesia, headaches, fatigue and vertigo. Concussion in sports is common in children and guidelines for returning to play following a head injury were examined. While there are no specific guidelines established for children, what guideline are available need to be adhered to. Multiple head injuries are also observed in children, however, little research as been conducted with these populations. One large study conducted by Bijur et al. (1996) reported that multiple head injuries did not have a cumulative effect in their 10 year old sample. However, this is the only study of its type and with the vast amount of literature suggesting that the effects are cumulative, it is necessary that further research is conducted to clarify this area.

Chapter 4

Neuropsychological Sequelae of Mild Head Injury

Boll, in his 1983 review of the literature regarding mild head injury (MHI) in children, challenged traditional views and highlighted the need for an increase in scientific and public heath attention of MHI. Boll concluded:

> Mild head injury is a quiet disorder. It is common, typically bloodless and without call for significant medical intervention. It seems even more quiet because the noise it does make (its symptoms) are often attributed to other causes. Nevertheless, the disruption in coping capacity and attendant breakdown in usual behavioural patterns cause more psychosocial and academic-economic hardship than have begun to be appreciated
>
> (Boll, 1983, pp. 74).

There is increasing evidence that suggests that MHI can produce lasting deficits, however, many authors (Boll, 1983: Butterbaugh, Roochvarg, Slater-Rusonis, Miranda, & Heald, 1993; Gulbrandsen, 1984; Segalowitz & Brown, 1991;) there are also various studies which suggest otherwise (Bijur et al., 1990; Craft et al., 1972; Fletcher et al., 1990; Papero, Prigatano, Snyder & Johnson, 1993; Rutter et al., 1980). The discrepancies in the results may be due to a variety of factors, including a lack of consistent definition for mild, moderate and severe head injuries, differences in assessment measures, controlling for pre-injury factors and variations in ages studied (Asarnow et al., 1995).

This chapter will outline the common neuropsychological sequelae associated with MHI as well as discuss the literature which suggests that the deficits observed following MHI are due to other circumstances. A review of the studies specifically examining the adverse academic outcomes in children following MHI will also be presented. The last section will discuss the course of recovery which is typically observed following MHI.

Neuropsychological Sequelae of Mild Head Injury

This section will outline the common neuropsychological sequelae following MHI, looking specifically at physical, cognitive and behaviour/emotional outcomes.

Physical

Morse and Montgomery (1992) report that MHI is associated with diffuse axonal injury rather than focal or systemic injuries and that these changes are irreversible. Common physical complaints following MHI include headaches, nausea, dizziness, double vision and fatigue (Boll, 1983). Typically within six weeks post injury improvements are reported in physical symptoms, however, there are a significant proportion of those with MHI whose symptoms continue to persist for months, even years after the injury and seriously affect them returning to normal routines.

Cognitive

Prigatano & Fordyce (1986) define cognition as the ability to process, store, retrieve and manipulate pieces of information to solve problems. Many aspects of cognitive functioning are commonly affected following MHI, these included speed of information processing, attention and concentration, memory and learning, initiation and planning, judgment, perception, and abstract reasoning, and communication (Prigatano & Fordyce, 1986; Schapiro & Sacchetti, 1993). Each of these cognitive processes will be discussed specifically examining symptoms observed after MHI in children.

Information Processing

Information processing (how much and how rapidly information is processed) is often slowed following MHI, this is suggested to be the primary consequence of the diffuse axonal shearing which is sustained due to the injury (Gronwall, 1989; Lezak, 1995). Lezak (1995) describes how slowed information processing is often seen in attentional deficits such as poor concentration, distractibility, difficulty doing more than one task at a time and increase time taken to complete simple tasks. Information processing deficits can also have a profound impact on social adjustment.

Attention and Concentration

Attention and concentration are commonly affected following MHI, this includes problems with selective, alternating and divided attention as well as difficulty sustaining concentration on a task. These difficulties lead to problems following a conversation, completing tasks and performing more than one task at a time (Schapiro & Sacchetti, 1993). It is suggested that the attention deficits observed following MHI are primarily the result of slowed information processing (Gentilini, Nichelli, & Schoenhuber, 1989).

Memory and Learning

Regardless of the severity of the injury, memory and learning are commonly affected following head injury. Recall of prior knowledge (retrograde memory) is rarely affected as is short term memory, however, difficulties with retrieving new information (anterograde-declarative) are often reported, particularly when there is a delay between presentation of new information and attempted retrieval (Morse & Montgomery, 1992; Schapiro & Sacchetti, 1993). Morse & Montgomery (1992) suggest that both poor incidental memory and compromised executive functions affect learning and different components of problems solving

Initiation and Planning

MHI can also affect the executive functions of initiation, planning and self regulation, these difficulties have typically been associated with frontal lobe damage. They are often observed in conjunction with other symptoms, resulting from frontal lobe damage including lack of motivation, difficulties with problem solving and mental flexibility, difficulty shifting set from one task to another and impaired capacity for self-control (Schapiro & Sacchetti, 1992). Deficits in initiation and planning are often manifested in organisational problems.

Judgment, Perception and Abstract Reasoning

Other executive areas which may be affected following MHI are judgment, perception and abstract reasoning. Difficulties with abstract reasoning can make it difficult to distinguish between relevant and irrelevant information (Begali, 1992). Visual-motor and visual-perceptual problems may also be exhibited following MHI in

children. Constructional tasks are completed poorly showing a disorganised and fragmented approach to the task. Distortions, misperceptions and directional problems are common (Begali, 1992; Morse & Montgomery, 1992).

Communication

Difficulties in communication have also been observed following MHI in children. Language difficulties include object naming, verbal fluency, understanding complex auditory material and difficulty with written language tasks (Chadwick et al., 1981; Fennell & Mickle, 1992).

Behavioural and Emotional Sequelae

Numerous behavioural, personality and emotional problems have been attributed to MHI in children, these include irritability, moodiness, discipline problems, sleep disturbances, aggressive outbursts, lowered frustration tolerance, hyperactivity, social withdrawal, lowered resilience to stress and apathy (Beers, 1992; Boll, 1983; Farmer, Singer, Mellits, Hall, & Charney, 1987; Jaffe, Brink, Hays, & Chorazy, 1990; Michaud, Rivara, Jaffe, Fay, & Dailey, 1993; Oddy, 1993).

Increased irritability is considered the most common behavioural complaint following MHI. Children can be described as moody, argumentative, always 'on edge', and may overreact even with the slightest provocation. Schapiro & Sacchetti (1993) describe how coping with new, unfamiliar or unexpected situations is difficult for those with MHI and this, together with any cognitive difficulties they may be experiencing, not only exacerbates their deficits, but also adds to their disability.

Several factors are suggested to affect the rate at which psychiatric disorders occur, these include the severity of the injury, type of damage, locus of the injury, age at the time of the injury, premorbid behaviour, psychosocial status, parental emotional stability and premorbid intellectual and academic status (Begali, 1992; Jaffe et al., 1995; Lord-Maes & Obrzut, 1996; Rutter, 1981). Begali (1992) goes on to suggest that the locus of the injury, age at the time of the injury and gender are related to the type of psychiatric disorder that occurs.

Adverse Academic Outcomes Following Mild Head Injury

There have been numerous studies which specifically examine the educational outcomes of children with MHI, those identifying adverse outcomes are presented in Table 6.

Table 6: Adverse Academic Outcomes *following MHI in Children*

Author	MHI Sample	Outcomes
Wrightson, McGinn & Gronwall (1995)	78 pre school children with	At one year and six months post injury, MHI children performed lower than controls on a tests involving visual closure
Segalowitz & Brown (1991)	192 students (13-20 years old)	Increased rate of speech difficulty, attention deficits and difficulty with maths
Gulbrandsen (1984)	56 children (9-12 years old)	At baseline, significant differences were found in all but 3 neuropsychological tests
Horowitz et al. (1983)	154 children (0-7 years at time of injury)	Elevated rate of headaches, dizziness and bed wetting; 47% below normal range of scholastic progress
Klonoff et al. (1977)	Follow up of 231 children from Klonoff & Paris (1974), 5 years post injury (mainly MHI)	15.4% of those under 9 at time of injury and 17.9% of those over 9 years had failed a grade; 10.3% of those under 9 years and 2.6% of those over 9 years required special education; 12.8% of those over 9 years had experience successive school failures or had left school
Klonoff & Paris (1974)	884 children up to 16 years old (mainly MHI)	11% reported academic difficulties one year after injury; 17% had difficulties two years after injury

While these studies found that academic achievement was compromised following MHI, there were numerous studies which produced equivocal results (Bawden, Knights & Winogron, 1985; Bijur et al., 1990; Chadwick, Rutter, Brown et al., 1981; Fletcher et al., 1990)

Alternative Explanations for Adverse Outcomes

While the literature presented above suggest that mild head injury can cause changes in a child's cognitive and behavioural functioning, there are, however, a number of authors who suggest that the persisting cognitive and behavioural changes observed following mild head injury are due to circumstances other than the head injury itself.

Bijur et al. (1990) found that cognitive changes were common in children with various injuries and concluded that children with head injuries were not specially affected by their trauma. Casey et al. (1986, cited in Wrightson et al., 1995) suggests that parental overreaction and family dysfunction need to be considered as these may also be a factor.

Many researchers (Brown et al., 1981; Craft et al., 1972; Fletcher et al., 1990) have suggested that reports of behavioural changes after MHI may be largely due to preexisting difficulties. Brown et al. (1981) found that the children with MHI had a higher rate of premorbid behavioural problems than the severely head injured or orthopedic groups. After the injury, there was no increase in the rate of psychiatric disorders in the MHI or orthopedic groups.

It is suggested by Rutter (1981) that children who have behavioural difficulties such as being impulsive and overactive are more likely to engage in dangerous play activities which result in head injuries. He goes on to suggest that it is the child's behaviour that causes the head injury, rather than the head injury causing the behaviour. Personality and behavioural problems observed following MHI in children are suggested to reflect an exaggeration of the child's premorbid difficulties (Fennell, & Mickle, 1992; Schapiro & Sacchetti, 1993).

Rutter et al. (1980) argues that the cognitive deficits observed following the injury are not proportional to the severity of the injury. They suggest that these deficits were present before the injury as the changes observed do not show the typical pattern of loss and recovery which is associated with CNS damage. They conducted a longitudinal study of children (age 5-14) to examine the extent, nature and recovery course of any cognitive and behavioural impairment and also to establish the premorbid functioning and identify a threshold of injury. The sample consisted of 28 severely head injured children, 29 mildly head injured children and 28 controls. The results showed a marked cognitive recovery phase for the severely head injured group, there was no such recovery phase for the mild head injured group.

Course of Recovery following MHI in Children

The rate of recovery is unique to the individual and can vary dramatically, as can the amount of recovery made. However, some general observations can be made regarding recovery from MHI. Many authors (Begali, 1992: Boll, 1983; Morse & Montgomery, 1992) agree that physical and sensory deficits tend to show signs of recovery shortly after sustaining MHI, and may be resolved within a few weeks to a couple of months after the injury, while cognitive deficits in the areas of language, memory, and attention can persist for months, even years following the injury (Boll, 1983). While the majority of children with MHI show significant recovery of functioning early after the injury, there is however, a small but significant proportion of children with MHI who continue to experience cognitive and behavioural deficits years after the injury.

Chapter Summary

This chapter reviewed the neuropsychological sequelae of MHI. It was shown that cognitive functions such as information processing, attention and concentration difficulties, memory and learning, and initiation and planning can all be affected following MHI in children. Behavioural and emotional changes are also common, these include aggressive outbursts, lowered frustration tolerance, and disinhibited behaviour. While the studies examining the academic effects of MHI have produced equivocal results, it is not possible to ignore the large amount of literature which has

reported academic difficulties following MHI. While a multitude of literature reports that cognitive and behavioural deficits exist there are, however, some authors who suggest that these cognitive and behavioural changes are due to circumstances other than the injury, such as parental overreaction, family dysfunction or that they were present before the accident. The final section of this chapter examines the course of recovery following MHI. While the rate of recovery is unique to the individual, there are some general observations that can be made. These include that physical and sensory deficits may resolve within a few weeks to months, while, cognitive and behavioural deficits may last months to years following the injury.

Chapter 5

Implications for Schooling

While the majority of children who sustain MHI tend to make a good recovery within a few months, there is a small but significant number who continue to experience persisting cognitive and behavioural deficits years after the injury. These deficits, which can have a devastating impact on the child's schooling, include fatigue, slowed information processing, memory impairments, poor concentration, short attention span, irritability, and aggressive outbursts. This chapter will review the neuropsychological sequelae mentioned in the previous chapter, specifically examining the difficulties observed at school, in the classroom and in the playground. These difficulties will also be compared the difficulties faced by children with learning disabilities. The final two sections will review the assessment issues and outline the needs of head injured children when they return to school.

Returning to the Classroom

Often the full impact of the head injury is not apparent immediately after the injury, it is when the child returns to school that deficits can be observed. These deficits, however, may be attributed to other causes as children with MHI often make a good physical recovery, masking any cognitive and behavioural deficits, which may lead to expectations for adequate functioning (Johnson, 1992). This section will discuss the implications on schooling of the neuropsychological sequelae reviewed previously.

Cognitive/Academic Difficulties

Furlonger & Johnson (1989) describe classroom learning abilities as being multifactoral. These factors include motor skills, visual perception, sensorimotor integration, verbal and non-verbal memory, language, verbal and non-verbal reasoning, and social adaptability. All these factors can be affected following head injuries which in turn lead to significant cognitive impairments disrupting the students academic success.

There are a multitude of deficits observed in the literature which can have devastating effects on the child's future academic success. Among the most prominent effects of mild head injury is slowed information processing, including attention deficits and slowed reaction times. Information processing is particularly important as it is necessary for dealing with the demands of everyday life, and specifically at school where emphasis is often placed on the speed of response for successful completion of tasks (Beers, Goldstein & Katz, 1994; Boll & Barth, 1983; Gronwall, 1989; Kinsella, Prior, Sawyer, Murtagh, Eisenmajer et al., 1995). Slowed information processing can mean the student takes longer to copy work off the board, has difficulty keeping up with the teacher when instructions are given in class and/or may not be able to follow conversations. Being able to respond quickly can affect the child's performance across a variety of cognitive domains.

New learning ability is directly affected by sustained attention and concentration. Difficulties in these areas may mean the student is easily distracted, cannot concentrate on class work, and may have difficulty shifting attention from one task to another. Memory deficits can also have an ongoing effect on new learning. Any limitations on a child's capacity for learning new information can dramatically affect their capacity for profiting from further education, even if this limitation is relatively minor. Those with MHI may have difficulty remembering names, times to meet people, homework set, and phone numbers (Ewing-Cobbs, Fletcher, & Levin, 1986, cited in Kinsella et al., 1995; Mira et al., 1992).

Psychomotor speed, visual spatial impairments can also make returning to school difficult. Students may have difficulty finding their way through school buildings or finding a section in a book. Difficulties summarising and separating relevant facts from information highlight any problems the students has with organisation following the injury (Mira et al., 1992).

Ewing-Cobbs & Fletcher (1987) describe arithmetic abilities as being the most vulnerable to change during the initial stages of recovery. It is suggested that difficulties in arithmetic may reflect other difficulties the child is suffering such as trouble focusing and sustaining attention and inability to organise work independently.

Behavioural Problems

The behavioural sequelae which were discussed in the previous chapter (including irritability, moodiness, discipline problems, aggressive outbursts and social withdrawal) can have serious implications for the student, their peers and the teacher in the classroom. Inappropriate behaviours at school may indicate anxiety and confusion in the child, or it may be used to divert attention away from others areas where they are having difficulty, such as in their school work. Complex behaviour can be disrupted, this can lead to a lack of self-direction, making it difficult to start or stop activities without assistance, or have difficulty concentrating, making it difficult to focus on activities or follow instructions, these behaviour may be interpreted by the educators as a lack of motivation, inattentive, laziness, and uncooperative on the part of the child (Furlonger & Johnson, 1989; Mira et al., 1992).

Mira et al. (1992) suggest that some students are unable to recognise any cognitive, physical or behavioural deficits that have occurred after their injury. For example disinhibited behaviour is a common deficit, students may say or do things that are not socially appropriate such as swearing and acting aggressively towards others. They may act in this way without realising that their behaviour is inappropriate or has changed from before the injury. This type of behaviour, as well as aggression, poor impulse control and depression can make it difficult for children to maintain friends, children become isolated and often withdraw from their peers. Relationships with peers are also commonly affected following head injury.

In summary, cognitive and behavioural deficits can have a significant impact on the students school life, having serious implications for both their academic success and their social life. Disruptive behaviours, commonly observed following head injury, can be used to divert attention away from their difficulties in their school work and in turn can lead to rejection by peers, and frustration in educators.

Comparison of Students with Head Injuries to those with Learning Disabilities

Children with head injuries are more likely to be inappropriately classified as having a learning disorder than with any other disorder. While head injured children do experience specific learning problems, the difference is that the difficulties observed in children with learning disorders are the result of congenital or perinatal complications, biochemical imbalances, or maturational or motivational influences (Begali, 1992).

A learning disability has been defined as:

> "a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest in an imperfect ability to listen, think, speak, read, write, spell or do mathematical calculations. The term includes such conditions as perceptual handicaps, brain damage, minimum brain dysfunction, dyslexia and developmental aphasia."
>
> (Obrzut & Hynd, 1990, pp. 167).

Brain injury is included as one of the qualifying conditions in the above definition of learning disability, this however, refers to minimum brain injury due to congenital or perinatal complications. Begali (1992) goes on to suggest that the deficits associated with congenital or perinatal influences are less dramatic than the sequelae associated with brain injury, which is produced by an external cause. There are, however, some difficulties that head injured students face which resemble the difficulties faced by students with learning disorders.

Similarities between Head Injured and Learning Disordered Students

Head injured and learning disabled students both have difficulty learning new information, difficulty processing information efficiently and at normal rates, display uneven academic and cognitive profiles, they often have difficulty with attention, impulse control, strategic thinking and may also lack age appropriate social skills. Both groups are also seen to benefit from some similar teaching techniques, these techniques

include task analysis, teaching to strengths, applied behaviour analysis, social skill instruction and a focus on metacognition (Ylvisaker, Szekeres, & Hartwick, 1992).

Differences between Head Injured and Learning Disordered Students

Despite having similar academic and cognitive profiles, the differences between these groups, outlined below, may mean that what is taught in a classroom for learning disabled students may not adequately meet the needs of the head injured child . Unlike children with learning disabilities, head injured children are more likely to show a greater degree of overall confusion, disorientation and episodic memory impairment early in their recovery. While children with learning disabilities may have difficulty acquiring surface language skills and core academic skills, these (over learned) skills are often retained following a head injury. The prognosis for head injured students is also often superior to learning disabled students due to the significant improvements that head injured students make over time (Ylvisaker, et al., 1992).

Beers et al., (1994) examined the neuropsychological differences between students with learning disabilities and students with mild head injuries. They compared 3 groups of college students (35 learning disordered students; 25 mildly head injured students; 22 controls) using a comprehensive battery of neuropsychological, psychological and academic achievement tests. The results showed that the learning disabled and MHI groups had difficulties with different tasks, the learning disabled students performed poorly on the linguistically oriented psychoeducational tests, while the MHI students displayed cognitive deficits in visual spatial skills and in the area of attention, memory and novel problem solving. Beers et al. (1994) conclude that the two groups would benefit from differing education curriculums. They suggest the students with learning disorders may profit from the traditional remedial education while cognitive rehabilitation in areas such as memory, attention and problem solving may be beneficial to students with MHI.

Assessment in the School Setting

Mira et al. (1992) describe the assessment process as critical in the development of effective educational programmes for head injured children. Two aspects of assessment

which are unique to head injured children include (1) the need for multiple assessments at set intervals to follow the recovery of the child and (2) neuropsychological assessment measures need to be utilised to establish the most accurate level of the child's current functioning at that time.

Neuropsychological Assessment

Neuropsychological assessment following head injury in children identifies the child's strengths and weaknesses, provides a comprehensive overview of the child's current cognitive functioning, assists in predicting outcome and allows goals for rehabilitation to be developed (Begali, 1992, Lord-Maes & Obrzut, 1996; Mira et al., 1992). It is suggested that many cognitive deficits, often identified with neuropsychological assessment are often not detected following other methods of assessment (Johnson, 1992).

The main approaches to neuropsychological assessment are a fixed or flexible battery of normed and standardized tests. There are fixed batteries which are specifically used for the assessment of children, such as the Halstead-Reitan Neuropsychological Test Battery for Children (HNBC), but the flexible batteries are more client-oriented and domain specific (Begali, 1992). They use a variety of psychological, neuropsychological and special ability measures to examine specific areas of suspected dysfunction in children.

Regardless of the approach the neuropsychological assessment should include a full history of the child's premorbid level of functioning, comparison of preinjury and post injury functioning and identifying any premorbid pre-existing conditions, such as behavioural/emotional disorders, which may affect the assessment (Begali, 1992; Morse & Montgomery, 1992). This information can be gathered from the child, their parents, the referrer, and from other sources such as the child's teacher.

The key functions which should be examined following head injury in children include:

a) Intelligence
    - verbal
    - nonverbal
b) Attention/Concentration
    - visual
    - auditory
c) Communication
    - spoken vs. written
    - speech vs. language
d) Memory
    - short-term and long-term
    - verbal and nonverbal
    - episodic and semantic
    - visual and auditory
e) New Learning Ability
f) Abstract Reasoning and Judgment
g) Orientation
h) Manual Dexterity/Laterality
i) Academic Achievement
j) Personality/Adjustment
k) Perception (visual, auditory, tactile functions)
    - sensory
    - visual-motor
l) Behaviour (in a variety of settings)

(Begali, 1992, pp. 103)

Head injured children are likely to make rapid changes in their cognitive functioning the first few years after the injury. The results of the initial assessment can be used as a baseline to follow progress, this and further assessments need to be interpreted with the understanding that further recovery may occur. Multiple assessments are necessary to follow recovery and to ensure realistic goals of rehabilitation programmes are maintained and updated when necessary. Follow up assessments are suggested to be completed every 3 to 6 months for the first year after the injury (Begali, 1992: Mira et al., 1992). Tests scores can be inflated by practice and this also needs to be recognised when interpreting any follow up assessments.

Special Considerations for Testing Children

Head injury, particularly in children, is associated with limited endurance often due to attention and concentration deficits, this has specific limitations for testing. Testing sessions should be short, conducted when the child is most alert, and need to be completed in a quiet room away from distractions (Morse & Montgomery, 1992). Performance, however, in a distraction free environment does not accurately reflect their performance in a normal environment such as the classroom where there are numerous distractions.

Tests need to measure a range of memory deficits to identify which memory processes are affected. It may also be necessary to repeat test instructions (where appropriate) after the test is administered. Special testing considerations are necessary for children who have difficulties with expressing themselves, understanding and processing complex instructions and word-finding problems. Considerations include using tasks which require multiple choice answers or pointing responses and those that have simple instructions or a demonstration trial (Morse and Montgomery, 1992).

As mentioned previously, children with head injuries may display a number of behavioural and emotional difficulties (including irritability, impulsive responding, lack of initiation and low frustration tolerance), these difficulties can interfere with the neuropsychological assessment process. Providing structure, setting limits, encouragement to get started or continue with tasks, frequent breaks, and careful pacing of difficult and easy tasks are suggested by Morse & Montgomery (1992) to help to reduce the interference of behavioural and emotional difficulties.

Special Education for School Re-entry

Teachers and other educators play a vital role in the rehabilitation process of the head injured student. This section will examine the planning that is necessary to help students re-enter school following a head injury (of any severity), the intervention strategies used and the barriers that may impede successful school re-entry.

Planning for Re-entry to School

Mira et al. (1992) suggests 8 critical elements that should be in place when the student returns to school. These include:

(1) *The provision for students safety*: The student may require increased supervision due to changes in behaviour which may put students at risk for further injuries.

(2) *Staff training:* Staff need to be informed about the changes in the student and about the effects of head injury in general.

(3) *Individualised programme:* A programme needs to be established which is specific to the student which takes into account their deficits sustained following the injury.

(4) *A controlled environment:* An environment which allows one-to-one instruction without interruption from other students and staff.

(5) *The provision of any special equipment that is needed.*

(6) *Design and implementation of behavioural management programmes:* To assist with any behavioural problems that have developed following the injury.

(7) *Knowledge of the resources that are available to schools:* Educators need to be aware of the resources available to them in the school and community, as well as the organisations which work with people with head injuries.

(8) *Support for staff*: Support should be available for those educators working with students who have sustained head injuries.

(Mira et al., 1992, pp. 45).

It is essential for the success of educational programmes that realistic goals are set and that these goals are updated when necessary. Programmes need to be individualised for the child and should aim to maximise learning and allow for continuing progress. Developing programmes need to take into consideration the students current level of functioning, the school, family and community supports and any factors which may interfere with the success of the programme (Mira et al., 1992).

Intervention Strategies

Intervention strategies take into consideration the unique needs of the student. They may include cognitive rehabilitation, behaviour modification techniques, physical education, social skills training and/or speech and language therapy.

The goal of cognitive retraining is to improve the students cognitive functioning so they can function as effectively as possible following head injury. Cognitive retraining can be conducted in isolation away from other children and activities, however, it is more effective when conducted in settings where functional skills are applied (i.e.: in the classroom). Skills learnt are more likely to become generalised when the students are allowed as practice these skills as possible in a variety of settings (Mira et al, 1992).

Behaviour modification techniques are useful to manage difficult behaviours following head injury, these require (1) the manipulation of antecedent and environmental variables and (2) a restructuring of the consequences that follow specific behaviours. Begali (1992) goes on to suggests that techniques used must be simple and persistent and delivered as soon as the behaviour occurs. Behaviour management programmes need to be closely monitored, consistent and the student should be involved in all aspects of developing the programme.

Barriers that can impede the successful school reintegration

There are several barriers that can impede the success of returning to school. These include lack of staff understanding of the consequences and needs of head injured children; lack of individual education programmes and flexibility within these programmes; lack of resources to help plan educational programmes; and lack of planning (Mira et al., 1992).

Chapter Summary

This chapter has attempted to summarise the vast amount of research examining the neuropsychological effects of MHI and the implications these have on a students school functioning. Deficits in cognition can mean students have difficulty keeping up in class, following conversations, copying work off the board quickly, and difficulty shifting attention from one task to another. When complex behaviours are interrupted difficulties with self direction, difficulty starting and stopping activities without assistance and difficulty focusing can be observed. However, these behaviours may

be inappropriately interpreted, by educators and caregivers as a lack of motivation, uncooperative and laziness on the part of the child. Children with head injuries share some similarities in deficits with students who have learning disabilities, however, the differences between these groups suggests that they may benefit from differing educational curriculums. Assessment issues were discussed emphasising the need to acknowledge particular limitations the student may be facing during testing, such as limited endurance, attention difficulties, memory problems and behaviour which may effect the outcomes of the results. The final section reviewed the literature on the elements which may need to be in place when the student returns to school, as well as discussed the barriers which may impede the students success, such as lack of flexibility of educational programmes, lack of resources, lack of planning and a lack of understanding of the needs of the student.

Chapter 6

The Present Study

The previous chapters have shown that head injury, and in particular MHI, is a frequent occurrence in children. Although it is estimated that between 150 and 450 children per 100,000 sustain a head injury every year (Annegers et al., 1980; Klauber et al., 198[illegible] Kraus, 1995), the actual incidence rate is unknown as, following MHI, many individuals often do not seek medical attention. The etiology of head injuries in children is substantially different to that seen in adults. While adults are more likely to sustain head injuries through motor vehicle accidents, for children, the most common cause of head injury is reported to be sports and recreational accidents and falls (Annegers, 1980: Kraus & Nourjah, 1989). The majority of the research agrees that not only are males up to 3 times more likely to sustain a head injury, but they also sustain more severe head injuries (Birmaher & Williams, 1994). The present study aims to establish the incidence rate and etiology of head injuries and compare these results between males and females and to the published research.

Current research is beginning to acknowledge the possible cumulative effects of multiple head injuries. Depending on the sample studied, incidence rates for multiple head injuries range between 4.3% and 40% (Salcido & Costich, 1992). It has been suggested that an initial head injury doubles the risk of sustaining a second head injury and a second injury makes a third eight times more probable (Gualtieri & Cox, 1991; Annegers et al., 1980). The effects of multiple head injury have been extensively studied using samples who are involved in sports such as boxing and soccer. The majority of these studies are in agreement that the effects of multiple head injury are cumulative (Gronwall & Wrightson, 1975; Mendez, 1995; Tysvaer et al., 1991). This has important implications for children as sports and recreational accidents are reported to be the most common cause of head injury.

For children under the age of 15 years 80-90% of all head injuries are considered to be mild. This, and with the growing evidence reporting that following MHI

significant physical, cognitive and behavioural changes occur, means that this is not a topic that can be overlooked. The sequelae commonly observed following MHI include headaches, dizziness, fatigue, blurred vision, poor concentration, short attention span, slowed information processing, memory difficulties, academic problems, and deficits in the executive functions of initiation and planning (Begali, 1992; Morse & Montgomery, 1992; Schapiro & Sacchetti, 1993). The behavioural and emotional changes observed after MHI include irritability, anxiety, depression, difficulty controlling anger, and lower frustration tolerance (Boll, 1983; Jaffe et al., 1990; Michaud et al., 1993; Oddy, 1993). These sequelae have been observed to last for up to three years post-injury.

Very little research has been conducted which examines the awareness of the symptoms following head injury. The studies using mainly adult populations found that there were a high number of misconceptions regarding the consequences of head injury in the general public. It was also reported that individuals who had sustained a head injury or had a close relative or friend who had sustained an injury, were not more likely to be aware of the symptoms (O'Jile et al., 1994; Gouvier et al., 1988; Willer et al., 1993, cited in O'Jile et al., 1994). This was not so for younger populations, a more recent study of adolescents in New Zealand found that head injured participants were more likely to list more accurate consequences than the control group who had not sustained a head injury (Body & Leathem, in press). The present study aims to examine the level of awareness of the consequences of head injury to help clarify these results.

Much of the literature reviewed supports the view that mild head injury can lead to serious cognitive and academic difficulties which in turn can result in significant disruption to their school life. Difficulties include short attention span, impairment of psychomotor speed and visual-spatial skills, difficulty solving unfamiliar problems and learning new information (Beers et al., 1994; Boll & Barth, 1983; Kinsella et al., 1995; Mira et al., 1992). Behavioural problems which may be displayed, diverting attention away from difficulties they are having in school, included inappropriate classroom behaviour, acting out, non compliance, and disrupting peers. Often the full impact of the head injury is not apparent immediately after the injury, it is when the

child returns to school that deficits can be observed. However, these deficits may be attributed to other causes as following head injury individuals often make a good physical recovery, overshadowing any cognitive and behavioural deficits, this can lead to expectations for adequate functioning (Johnson, 1992).

In summary, the aim of the present study is to examine the incidence and etiology (specifically examining the role of sport) of head injuries in an Intermediate School aged sample (11 to 13 years old). The awareness of the consequences of head injury was assess and comparisons were made between those with and without head injury. The neuropsychological functioning of a group of head injured participants were compared to the control group with no head injuries.

All students from Tamatea Intermediate School were invited to take part in Part One of the study. Part One consisted of a screening questionnaire that included questions about awareness of the symptoms of head injury, involvement in recreational activities and history of head injury. From this questionnaire 24 students who reported sustaining a head injury and 19 students without head injury were selected to take part in Part Two of the study. Part Two involved the administration of four neuropsychological measures and two behavioural questionnaires which assessed various aspects of behavioural and cognitive functioning. Part Two involved students, their parents and teachers.

Hypotheses

Part One: The Screening Questionnaire

Hypothesis 1:

30% of the sample will report that they have sustained a head injury.

This hypothesis is based on the results reported by Segalowitz & Brown (1991). The authors used self report measures with an adolescent sample (14-18 years) and reported that 31.2% of their sample reported a head injury.

Hypothesis 2:

Of the reported head injuries, 80% - 90% will be classified as mild according to the criteria outlined in the method section.

Fay et al. (1993) and Fennell & Mickle (1992) have suggested that just over 80% of all head injuries sustained in children under 15 years old are mild. Snoek (1989) agrees that the majority of head injuries sustained in childhood are mild, however, he suggests that the rate is more likely to be 90%.

Hypothesis 3:

Of those who have reported sustaining a head injury, 17% will have sustained more than one head injury.

This hypothesis is based on the study conducted by Bijur et al. (1996) who reported that of the subjects (10 years old) who reported having sustained a head injury, 17% reported having sustained more than one injury throughout their lifetime.

Hypothesis 4:

There will be a significantly higher proportion of males than females reporting head injuries, with a ratio of 1: 2.2.

This is based on the data reported by Kraus (1995) who suggests that males report more head injuries with a ratio of approximately 1: 2.2. This ratio lies between the ratios reported by Klauber et al. (1981) (1: 1.5) and Kraus & Sorenson (1984) (1: 3.2).

Hypothesis 5:

Males will have experienced more severe head injuries than females, according to the severity classification criteria outlined in the method section.

This hypothesis was based on the vast literature (Annegers, 1983; Begali, 1992, Birmaher & Williams, 1994; Goldstein & Levin, 1987) which are unanimous that males sustain more severe injuries than females.

Hypothesis 6:

The major source of head injury for this sample is likely to be sport and recreational activities, followed by falls.

This hypothesis is based on the literature reporting that for children aged between 5 and 15 years old the most common causes of head injury are sports and recreational accidents (including bicycling accidents) and falls. (Annegers et al., 1980; Body & Leathem, 1996; Kraus & Nourjah, 1989).

Hypothesis 7:

Head injured students will play on average more hours of sport per week than non-head injured students.

As sport is considered to be the main cause of head injury in this population, it is therefore suggested that children who sustain head injuries are likely to take part in and play more sport than children who do not play sport. Body & Leathem (1996) examined this hypothesis and found that head injured students did play on average more hours of sports per week than controls.

Hypothesis 8:

Head injured students will show a higher level of awareness of the symptoms of head injury than those who have not sustained a head injury.

This was based on the findings of Body and Leathem's (1996) research, which found that children who have sustained a head injury were likely to report more accurate symptoms of head injury than those who had not sustained a injury.

Part Two: Neuropsychological Battery

Hypothesis 9:

Head injured participants will perform at lower levels, than non-head injured participants on the neuropsychological measures and receive lower ratings on the Child Behaviour Checklist (CBCL) and the Teacher Report Form (TRF).

This hypothesis is based on the vast research which reports that head injury, including mild head injury, can produce persisting cognitive deficits (Boll, 1983; Gulbrandsen, 1984; Klonoff, et al., 1977).

Hypothesis 10:

The scores on the neuropsychological measures, and the ratings on the CBCL and the TRF will be proportional to the severity of the head injury sustained, i.e.: those who sustain a severe injury are likely to perform at lower levels and receive lower ratings than those with mild head injuries.

It is widely accepted that the effects of a head injury increase with the increasing severity of a injury. An individual who has sustained a severe head injury is likely to perform at much lower levels than an individual who has sustained a mild head injury.

Hypothesis 11:

Those students with multiple head injuries will perform at lower levels on the neuropsychological measures, and receive lower ratings on the CBCL, and TRF than those with a single head injury.

This hypothesis is based on the literature which reports that the effects of multiple head injuries are cumulative (Carlsson et al., 1987; Gronwall & Wrightson, 1975; Salcido & Costich, 1992).

Chapter 7

Method

Research Setting

All students from Tamatea Intermediate School in Napier were invited to take part in this study. The school is co-educational and consists of Form One and Two students (aged 10-13 years old), with a total school population of 335 students. Napier (population: 55,000) is situated on the east coast of the North Island, New Zealand.

Ethical Issues

This study was designed in accordance with the ethical guidelines of the New Zealand Psychological Society and was approved by the Massey University Human Ethics Committee, the Tamatea Intermediate School Principal and Board of Trustees.

The main ethical issues to be considered were informed consent and confidentiality. To ensure that the participants knew their rights, information sheets and consent forms were provided to all participants. These were designed in accordance with the Massey University Human Ethics Committee. Information sheets were developed for each part of the study for students (see Appendices I, II), parents (see Appendices III, IV) and teachers (Appendix V). The information sheets described the aims and the method of the study to allow participants to choose whether they wished to take part. Each participant who wished to take part was asked to sign and date the consent forms (see Appendices VI, VII) attached to the information sheets, to indicate they understood their rights as a research participant. For Part One of the study, parents were asked to sign a permission form (see Appendix VIII) indicating whether they agreed for their child to take part in the study. Voluntary participation was emphasized and no rewards were offered contingent on participation. Participants were informed that they did not have to take part even if their parents had given permission.

Confidentially was assured at all times and strictly enforced. No student, teacher or parent had access to any questionnaires or the results of the neuropsychological measures. The neuropsychological measures were administered in a private room away from distraction, other students and staff at the school. All questionnaires and results were kept in a locked filing cabinet.

Part One: Administration of the Screening Questionnaire

Participants

The aim was to have all the students in the school answer the screening questionnaire. Parent information sheets and permission forms were sent home to all 335 students in the school. Of these, 182 students returned the permission forms and had permission to take part in the study from their parents. A total of 48 parents indicated they did not agree for their child to take part in the study and 101 students did not return their permission forms.

Of the 182 students whose parents gave consent, 173 completed the initial questionnaire, 2 declined to take part and 7 students were absent from school the day the questionnaires were completed.

The demographic characteristics of the sample who completed the screening questionnaire are presented in Table 7.

Table 7:

Demographic Characteristics of the Participants (N=173) who Completed the Screening Questionnaire

Characteristics	N	%
Gender		
Male	83	48
Female	90	52
Ethnicity		
European	126	72.8
Maori	12	7.0
Maori/European	3	1.7
Pacific Islander	4	2.3
Other	28	16.2
Age		
11	56	32.4
12	90	52.0
13	27	15.6
Involved in Sport		
Yes	144	83.2
No	29	16.8
Head Injury Sustained		
Yes	71	41
No	102	59

Measure

The screening questionnaire was developed specifically for this study (see Appendix IX) and surveyed four topic areas: (1) basic demographics; (2) sport and hobbies; (3) awareness of head injury symptoms and; (4) head injury history. Since the school time table was made up of 45 minute periods, the questionnaire was designed to be completed within this time as each class was allocated one period to complete the questionnaire.

(1) Basic Demographics

Information was gathered on gender, age and ethnicity to examine the hypotheses concerning head injury rates, differences between males and females, to accurately compare each participants performance on the neuropsychological measures to the correct age norms, and to help match controls to the head injury group for part two of the study.

(2) Sports and Hobbies

Information on what sports and hobbies the participants were involved in and how long they engaged in these activities per week was gathered to examine the hypothesis which looks at the differences in hours of sports played per week between the groups. Hobbies were included so horse-riding and other activities with a high risk for sustaining head injuries were reported.

(3) Awareness of Head Injury Symptoms

Information was gathered on the participants understanding of the symptoms which may be associated with head injury. This was added as research in this area is sparse. Participants were asked whether they thought each of the symptoms listed was caused "*often*", "*sometimes*", "*never*" or "*don't know*" following a head injury.

(4) Head Injury History

Participants were asked to describe any head injuries that they had sustained. They were asked how each injury occurred, whether they saw a doctor or nurse, whether they had time off school, the duration of unconsciousness and what problems they experienced, if any, following the injury. Length of unconsciousness was included as

the method of estimating the severity of each injury. A definition of head injury was not included so that the participants could write down any times they thought they had sustained a head injury.

Procedure

Teachers had the study explained to them and had the opportunity to ask any questions. Following this information sheets were sent home to parents of each student in the school outlining the study and what would be involved. Parents were asked to indicate on the attached permission form whether they wanted their child to take part and were asked to return the completed permission form to school. All students were given an information sheet as well as having the details of the study explained to them. They were also given the opportunity to ask questions. Two weeks after the parent information sheets were sent home, the questionnaires were completed in the school. Each class was visited in turn. Questionnaires were handed out to all students whose parents had consented for them to take part, students whose parents had not given their permission and those who had not returned their forms were given blank paper and asked to do something quietly at their desks. Those students whose parents had declined their participation were not identifiable to other students, as all students were handed something. Once all the questionnaires were handed in the students were thanked for their participation.

Criteria for Categorisation of the Severity of Head Injuries

Each reported head injury was analysed individually and the severity was estimated on the following criteria:

No Head Injury: No head injury reported

Light Head Injury: Head trauma reported with no loss of consciousness

Mild Head Injury: Head trauma with loss of consciousness between 1 and 30 minutes

Moderate Head Injury: Head trauma with loss of consciousness between 30 minutes and 1 hour

Severe Head Injury: Head trauma with loss of consciousness of more than 24 hours

Participant Selection Criteria for Part Two

Participants were selected for the head injury group according to the following criteria:

- Any participant who had sustained a head injury classified as moderate or severe,
- Any participant who indicated they had sustained multiple head injuries.

These criteria were applied until a sample of 25 participants were obtained.

Part Two: Administration of the Neuropsychological Measures

Participants

43 participants were selected based on the information obtained in the initial questionnaire, this was made up of 24 students who had indicated they had sustained one or more head injuries and 19 students were selected as controls. Participants were matched for the control group on age, gender and ethnicity.

Table 8 outlines the demographic characteristics of the 43 participants who were involved in the second part of the study.

Table 8:

Demographic Characteristics of the 43 Participants who Completed the Neuropsychological Measures.

	Head Injury Group		Control Group	
	N	%	N	%
Gender				
Male	15	62.5	10	52.6
Female	9	37.5	9	47.4
Ethnicity				
European	19	79.2	15	78.9
Maori	5	20.8	--	--
Maori/European	--	--	1	5.3
Pacific Islander	--	--	1	5.3
Other	--	--	2	10.5
Age				
11	8	33.3	4	21.1
12	12	50.0	10	52.6
13	4	16.7	5	26.3
Sport				
Yes	21	87.5	15	78.9
No	3	12.5	4	21.1
Education (Average Grade)				
B	5	20.8	8	42.1
C	13	54.2	6	31.6
Unknown	6	25.0	5	26.3

Note. A dash (--) indicates no participants included in this category.

Measures

A brief selection of neuropsychological measures were selected which were suggested to be sensitive to the areas of functioning that can be impaired by head injury and in particular mild head injury. The measures comprised the following:

(1) Rey-Osterrieth Complex Figure Test (CFT) (Rey, 1941; Osterrieth, 1944)

(2) Rey Auditory Verbal Learning Test (AVLT) (Lezak, 1995; Rey, 1964)

(3) Children's Paced Auditory Serial Addition Task (CHIPASAT) (Johnson, Roethig-Johnston, & Middleton, 1988).

(4) Digit Symbol (Subtest of the Wechsler Intelligence Scale for Children-III [WISC-III]) (Wechsler, 1992)

(5) Child Behaviour Checklist (Achenbach & Edelbrock, 1983).

Parent Report Form (CBCL)

Teacher Report Form (TRF)

Rey-Osterrieth Complex Figure Test (CFT)

The CFT was developed by Rey (1941) and later standardized by Osterrieth (1944). This non verbal memory test was selected to provide information on short and long term visual memory, planning and organisational skills, visuospatial constructional ability and problem solving strategies (Spreen & Strauss, 1993; Lezak, 1995; Mayes & Warburg, 1992; Waber & Holmes, 1986). The CFT is sensitive to mild TBI when assessing memory and learning.

This test requires the subject to copy the figure and then without prior warning, they are asked to reproduce it from memory, both after a 3 minute delay and a 30 minute delay. The procedure for this test is outlined in Appendix X. Various scoring methods aim to reflect both quantitative and qualitative (item distortion and misplacement, approach or style and level of organisation) aspects of the subject performance (Bauer, Tobais & Valenstein, 1993; Mayes & Warburg, 1992). The CFT has well established qualitative and quantitative norms for children (Kolb & Whishaw, 1996 ; Spreen & Strauss, 1993). Spreen & Strauss (1993) describe how younger children commonly copy the figure using a piecemeal fashion, not recognising the large rectangle. As age increases the strategy used becomes more

configurational and organised, often beginning with the large rectangle, then completing the details in relation to this. Adult levels in the copy trial are said to be reached around 13 years of age. While errors are rare in the copy trial, they are commonly seen in the recall trials. Up to the age of 9 years, a piecemeal approach is often used when recalling the figure, this approach may result in an accurate copy, however recall tends to be poor. It is suggested that those with head injury may not perceive the large rectangle, may forget elements easily and may repeat elements (Lezak, 1995).

Digit Symbol

The digit symbol is a performance subtest of the Wechsler Intelligence Scale for Children, III (WISC-III) which is suitable for children aged 6 through to 16 years 11 months and 30 days (Wechsler, 1992). This test measures impairment in concrete symbol processing, the ability to learn new information, short term memory, motor and information processing speed, attention and sequencing and precision (Gillberg, 1995). This subtest of the WISC-III was chosen as it is suggested to be more sensitive than other subtests to the effects of brain injury, even when there is only a brief loss of consciousness.

The digit symbol consists of a worksheet with divided boxes, each with a randomly assigned number printed in the top box and an empty box underneath. A key is provided which shows each number paired with a individual symbol. The subject is asked to pair each number on the worksheet with the correct symbol and write this in the empty box underneath the number. Children's norms are available (Wechsler, 1992). See Appendix XI for the test instructions.

Rey Auditory Verbal Learning Test (AVLT)

The AVLT was selected to provide information on short term auditory memory, long term auditory memory, recognition memory, new learning and susceptibility to interference (Mayes & Warburg, 1992; Rey, 1964; Spreen & Strauss, 1992). For this measure the participant is read a list of 15 words (List A) and then asked to repeat as many words as they can. This process is repeated with the same list of words for 5 trials. Following this, the participant is read a second list of words (List B) and asked

to recall as many words from the second list as they can. The participant is then asked to recall as many words from the first list of words as they can (the list is not presented to them). The last trial is completed 20 minutes later and the participant is again asked to recall as many words from the first list. On completion of the delay trial, the participants are then presented with a sheet with all the words from both lists as well as other similar words printed on it. They are asked to circle as many words as they can see that were in the first list (see Appendix XII, for test instructions). Children's norms are provided by Forrester and Geffen (1991).

Children's Paced Auditory Serial Addition Task (CHIPASAT)

The CHIPASAT is based on the adult test, the Paced Auditory Serial Addition Task (PASAT). It was developed to assess auditory verbal attention and the capacity and rate of information processing in children (Dyche, & Johnson, 1991a, 1991b; Johnson, et al., 1988). This measure is appropriate for children aged 8 to 14 years and norms are available for these age groups (Johnson et al., 1988).

This test consists of a prerecorded audio tape which delivers the standard instructions and the trials. The participant is asked to add successive numbers in pairs and then give the answer aloud before the next number is presented. They are instructed to add the first number to the second number, the second number to the third number and so on. There are 5 trials of 61 single digit numbers, for each trial the numbers are presented at slightly faster rates (2.8-, 2.4-, 2.0-, 1.6-, and 1.2- second intervals). The numbers for the CHIPASAT are arranged so that no answer will exceed 10. For the test scoring sheet see Appendix XII.

Child Behaviour Checklist (CBCL) and Teacher Report Form (TRF)

The CBCL and the TRF were developed by Achenbach and Edelbrock (1983) to assess both parents (CBCL) and teachers (TRF) perceptions of a child's behaviour. It is suitable for children aged between 4 and 16 years old (Ewing-Cobbs & Fletcher, 1990). Both checklists cover a broad range of symptoms and attributes that are related to a child's social and academic competence. Among the behaviours that are assessed e anxiety, social withdrawal, immaturity, hyperactivity, frustration tolerance and depression. Separate scores are also provided for an overall evaluation

of the child's internalising and externalising behaviours (Asarnow et al., 1995; Ewing-Cobbs & Fletcher, 1990; Kaplan, Sadock & Grebb, 1994). These checklists were chosen for the present study as they assess behavioural problems which are often associated with head injuries such as impulsivity, aggression, social withdrawal, and inattention. The reliability and validity for these measures are well established, and normative data, derived from large samples, is available for all ages (Archenbach & Edelbrock, 1983; Barkley, 1988).

The CBCL (see Appendix XIV) consists of 118 items which the parent is asked to rate the described behaviours on a scale of 0 (not true), 1 (sometimes true), and 2 (often true) for their child. The TRF (see Appendix XV) asks the teacher to rate the described behaviours on the same scale, however, the TRF consists of 113 items and only includes behaviours which are observed in school.

Procedure

Participants were given an information sheet and consent form outlining part two of the study and also a consent form. The main points of the information sheet were outlined following which the participants had the opportunity to ask any questions. Once the student consent forms were returned, parents were phoned and had the details of the study explained to them, they had the opportunity to ask questions. If they were interested in taking part, an information sheet, consent form and CBCL was sent home to them. Parents were given the opportunity to meet with the researchers to complete the CBCL, all declined in favor of having the questionnaire sent to them. A stamped envelope was included for returning the questionnaire. Teacher information sheets and consent forms were handed out at this time.

Once parental permission (via consent form) had been obtained participants were invited to complete the neuropsychological measures. The administration took approximately 40 minutes and took place during school time. The tests were conducted in a quiet room away from distraction, noise and other students.

The tests were administered in the following order:

(1) CFT Copy
(2) Digit Symbol
(3) CFT 3 minute Recall
(4) AVLT Trials 1 to 6 and Interference Trial
(5) CHIPASAT
(6) AVLT Trial 7 and Recognition Trial
(7) CFT 30 Minute Recall

Each participant was tested individually and was thanked for their participation. Participants were asked not to discuss the details of the measures with other students.

After testing was completed, the participants teacher was given a copy of the Teacher Report Form which they were asked to complete.

The data was analysed using the SPSS analysis package.

Chapter 8

Results

Part One: Information Obtained from the Screening Questionnaire

The aim of Part One is to determine the incidence rates, etiology (particularly examining the role of sport) and awareness level of the symptoms of head injury.

Hypothesis One:

30% of the sample will report that they have sustained a head injury.

Results showed that 71 (41%) of the 173 participants (50.1% males and 32.2% females) reported to have sustained a head injury of some description in their lifetime, this equates to an annual incidence rate of 3.4%. Excluding light head injuries, 35 (20%) of the sample had sustained at least one mild, moderate or severe head injury, which reduced the annual incidence rate to 1.7%. A total of 112 head injuries were sustained.

The participants with light head injuries were included in the head injury group in the present study as research suggests that the effects of multiple head injuries are cumulative, therefore it is important to acknowledge all head trauma despite the severity. However, results excluding light head injuries will also be presented where necessary to make comparisons with previous research. All results will be presented including light head injuries, unless specified.

Hypothesis Two:

Of the reported head injuries, 80%-90% will be classified as mild or light according to the criteria outlined in the method section.

The results of this study are slightly higher than the hypothesis with 93.6% of the 112 injuries sustained being mild or light in severity. Table 9 shows the number of head injuries sustained in each of the four severity categories.

Table 9:

Number and Percentage of the Severity of the 112 Head Injuries Sustained.

Severity of Head Injury	Number	Percentage	Cumulative Percentage
Light	62	55.2	
Mild	43	38.4	93.6
Moderate	6	5.4	99
Severe	1	1	100

Hypothesis Three:

Of those who have reported sustaining a head injury, 17% will have sustained more than one head injury.

Of the 71 participants who reported sustaining a head injury, 24 (33.8%) participants reported that they have sustained more than one head injury. Table 10 shows the frequency and percentage of head injuries sustained by the 71 participants. When light head injuries are excluded, 10 (28.6%) of the 35 participants reporting a mild, moderate or severe head injury, reported to have sustained more than one injury.

Table 10:

Number and Percentage of the Number of Head Injuries Sustained by the 71 Participants.

Number of Head Injuries	Number	Percentage	Cumulative Percentage
One	47	66.2	
Two	13	18.3	
Three	8	11.3	29.6
Five	3	4.2	33.8

Data on the severity and number of the head injuries sustained is presented in Table 11. This table shows that 112 head injuries of varying severity were sustained by the 71 participants who reported sustaining an injury.

Table 11:

Number and Severity of Head Injuries Sustained by the 71 Participants

Number of Head Injuries	Light	Mild	Moderate	Severe
One	37	21	4	1
Two	7	4	1	--
Three	2	3	--	--
Four	--	--	--	--
Five	1	1	--	--
Total [1]	47	29	5	1

Note. A dash (--) indicates that no participants are included in this category.

[1] The total is more than 71 as some participants are included in more than one category i.e.: someone sustained one light head injury and one moderate head injury and are therefore represented twice in this table.

The literature reviewed in previous chapters discusses the importance of taking into consideration both the number and the severity of head injury, however, there are few guidelines for classifying head injuries taking these factors into consideration. One study (Barnfield & Leathem, in press) has attempted to reclassify head injuries considering these factors, this reclassification system will also be used for the present study. The reclassification criteria are presented in Table 12.

Table 12:

Criteria for Reclassifying Participants Experience with Head Injury

Severity	Criteria for Each Classification of Severity
Light:	Up to and including 3 light head injuries,
Mild:	4 or more light head injuries and/or 2 or less mild head injuries,
Moderate:	3 or more mild head injuries and/or 2 or less moderate head injuries,
Severe:	3 or more moderate head injuries and/or any severe head injuries.

Note. From "Brain Injury" by T. V. Barnfield & J. Leathem (in press). Reprinted with permission.

The number and percentage of participants in each of the severity groups before and after reclassification are present in Table 13. As a result of reclassification the number of subjects in the light and mild groups decreased while the number of participants in the moderate (11.3%) group increased. Using the reclassification criteria means that no participant is included in more than one category.

Table 13:

Number and Percentage of Light, Mild, Moderate and Severe Head Injuries Sustained by 71 Participants, Before and After Reclassification.

Reclassification	Light	Mild	Moderate	Severe
Before [1]	47 (66.2%)	29 (40.8%)	5 (7%)	1 (1.4%)
New Rational	36 (50.7%)	25 (35.2%)	9 (12.7%)	1 (1.4%)

[1] Does not total 100% due to multiple head injuries

All data from this point forward will be classified with the above classification system.

Hypothesis Four:

There will be a significantly higher proportion of males than females reporting head injuries, with a ratio of approximately 1: 2.2.

Of the 71 participants who sustained head injuries 42 (59%) were male and 29 (41%) were female, giving a ratio of 1: 1.4. When light head injuries are excluded the ratio is increased to 1: 2.7, with 24 males sustaining a head injury compared to 9 females. Of the total 112 head injuries sustained, males sustained 72 while females sustained 40, this gives a male to female ratio of 1: 1.8.

Hypothesis Five:

Males will experience more severe head injuries than females.

To compare severity three methods were used, (1) the number and percentage in each severity group, (2) LOC and; (3) the amount of multiple head injuries. While, the only severe head injury was sustained by a female participant, males did experience more severe injuries overall. Table 14 shows the number and percentage of males and females in each of the severity groups after reclassification. Results also showed that males (88%) were more likely to report lost consciousness for a period, compared to females (48%). Males (40%) were also shown to have reported to have sustained more multiple head injuries than females (24%).

Table 14:

Number (and Percentage) of Males (N=42) and Females (N=29) in each Severity Group after Reclassification.

Gender	Light		Mild		Moderate		Severe	
Males	18	(42.9)	18	(42.9)	6	(14.2)	--	--
Females	18	(62.1)	7	(24.1)	3	(10.4)	1	(3.4)

Note. A dash (--) indicates that no participants are included in this category.

Hypothesis Six:

The major source of head injury for this population is likely to be sport and recreational activities , followed by falls.

The overall results support this hypothesis, with sporting and recreational accidents (26.8%) the most common cause of head injury, followed closely by falls (25%) and collisions (19.6%). However, these results do need to be considered cautiously as insufficient detail was provided to determine the cause of injury for 15 of the head injuries. The major cause of head injuries in males was also sport (31%), followed by falls (25%) and collisions (18.1%). This trend was not followed by females with falls (25%) making up the major cause of head injuries, followed by collisions (22.5%) and sport (20%). Figure 1 shows the sources of the 112 head injuries sustained. Appendix XVII presents the number of head injuries sustained with respect to specific sports.

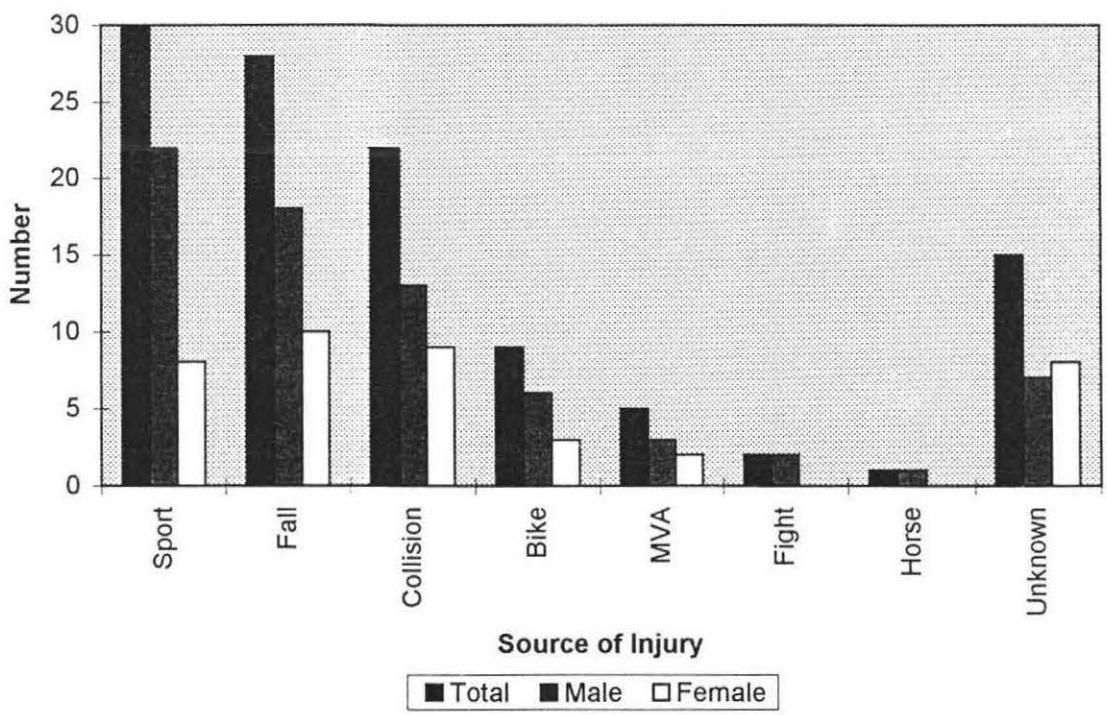

Figure 1:

Source of Head Injury for Males, Females and Overall.

Hypothesis Seven:

Head injured students will play on average more hours of sport per week than non-head injured students.

A significant difference was found between those with and without head injury in the average hours spent playing sport each week ($t\ [171] = 3.058$, $p = 0.03$). On average the head injured students spent 3.9 hours each week playing some form of sport, compared to 2.9 hours played by those without head injuries. A significant result was also found between the hours of sport played per week between males and females ($t\ [171] = 4.327$, $p = 0.000$), with males playing on average 4 hours of sport per week compared to females who played on average 2.6 hours of sport per week.

Hypothesis 8:

Participants with head injury will show a higher level of awareness of the symptoms of head injury than those who have not sustained a head injury.

The participants overall responses for the awareness of head injury symptoms were classified into one of three categories: aware; slightly aware; and not aware (of the consequences of head injury). Participants were considered 'aware' if they correctly identified between 8 and 11 symptoms; those who correctly indicated 5 to 7 symptoms were classified as 'slightly aware'; and those who correctly identified up to 4 symptoms were classified as 'not aware'. The participants who had sustained a head injury were shown to be more aware than those with a head injury (see Figure 2).

A 2x2 Chi square analysis revealed that the participants with head injuries were significantly more aware then the participants without a head injury ($X^2\ [2, N = 172] = 8.601$, $p<.05$).

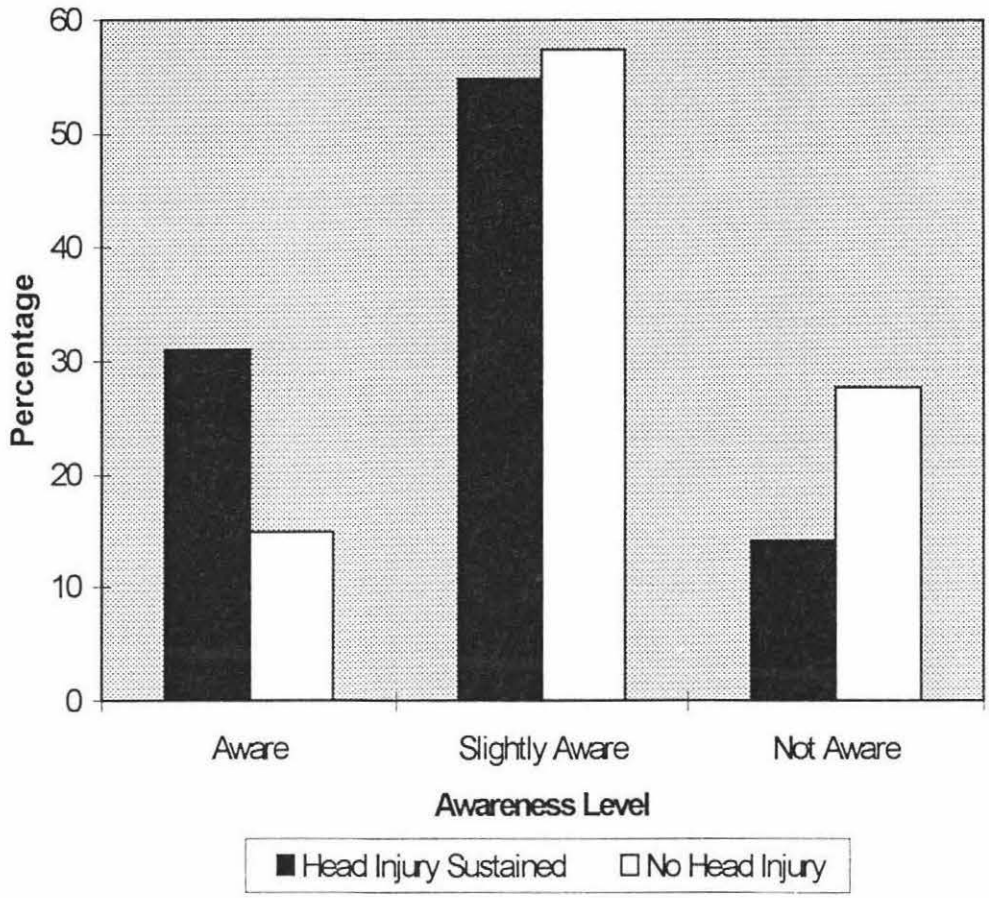

Figure 2:

Percentage of Participants With and Without Head Injury in each of the Awareness Level Groups.

For all symptoms, excluding 'headaches', the non head injury group were more likely to respond with 'don't know' when asked whether the symptoms could occur following a head injury. The percentages responding 'don't know' for the head injury and non head injury groups are presented in Figure 3.

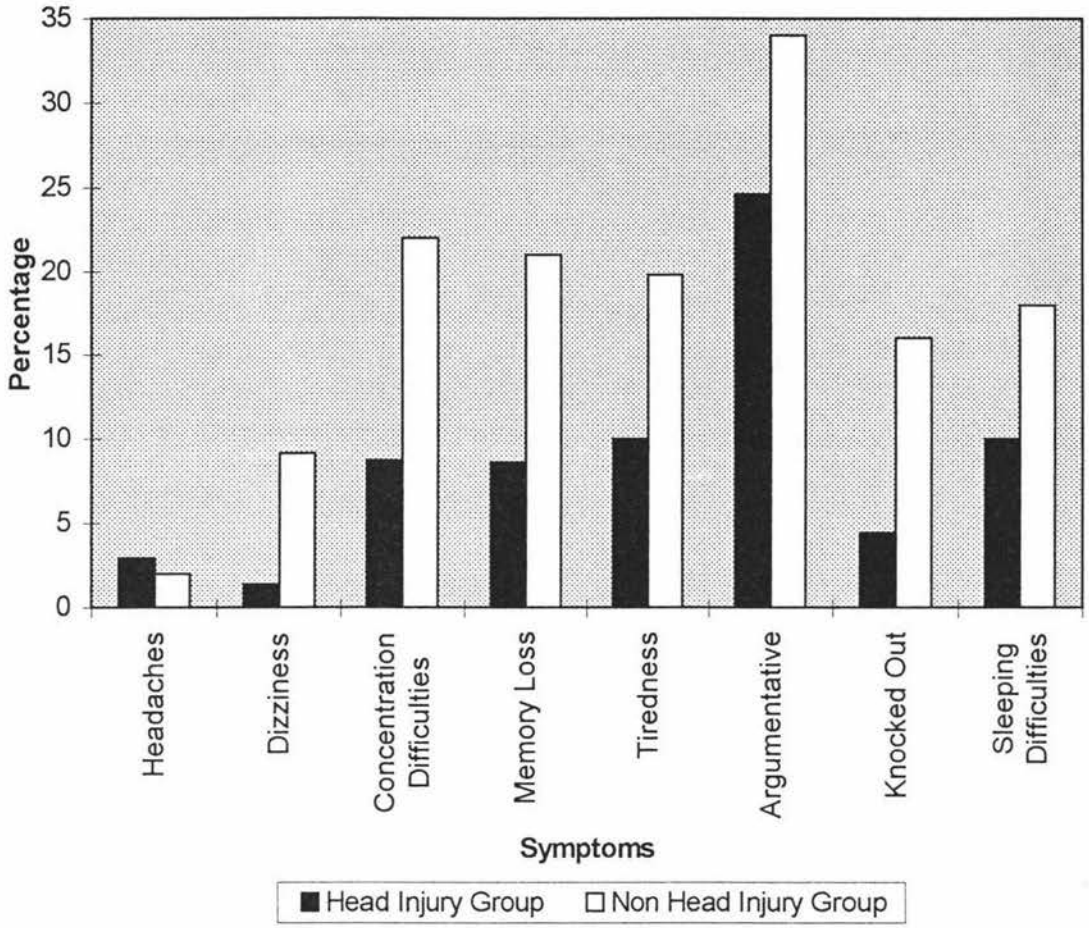

Figure 3:

Percentages in Each Group who Responded 'Don't Know' to Each of the Symptoms

Participants were also given the opportunity to add any other problems that they thought are associated with head injuries. 32.4% of the head injured participants and 27.5% of the non head injured participants suggested further possible symptoms. A summary of these are presented in table 15.

Other possible symptoms indicated by the non head injury group included severe outcomes such as brain damage, coma and paralysis. Vision difficulties, such as seeing spots and blurred vision, and migraines were the most common symptom suggested by the head injury group.

Table 15:

Problems Suggested by Each Group to be Associated with Head Injuries.

Symptom	Head Injury Group	Non Head Injury Group
Brain Damage	2	10
Paralyzed	1	8
Coma	0	7
Seeing Spots/Vision Blurring	5	0
Moody	3	2
Migraines	3	0
Nausea	2	1
Balance & walking difficulties	2	1
Head Throbbing	2	1
Fainting	1	2
Epilepsy	2	0
Concussion	2	0
Death	2	0
Don't function properly	1	1
Weakness	0	2
Breathing Difficulties	1	0
Swelling	0	1
Physical Appearance	0	1

Part Two: Neuropsychological Assessment of 43 Participants

Participants were selected for Part Two of the present study based on the information obtained in initial questionnaire and using the selection criteria developed for the present study. The sample for part two did not differ significantly in mean age, ethnicity and gender from the sample in part one. The number and severity of the head injuries sustained by this sample are presented in Appendix XVIII(a) and shows the majority of head injuries are light and mild. Appendix XVIII(b) presents the samples head injuries before and after reclassification. Table 16 shows the number of male and female participants in the head injury and control groups. The range of statistical analysis was restricted as the numbers in each group are particularly small.

Table 16:

Number and Percentage of Male and Female Participants in Each Group

Gender	Head Injury Group		Control Group	
	N	%	N	%
Male	15	62.5	10	52.6
Female	9	37.5	9	47.4

Results compared to Norms

During neuropsychological assessment, it was observed on certain tasks that all subjects were performing at higher levels (and in one case lower) than the norms for the measures. Accordingly, it was decided to compare the overall results of the present study to the appropriate age norms. The results of the independent t tests are presented in Table 17 and show that the participants in the present study performed at a significantly lower level on the 30 delayed recall of the CFT. Significant results were also found on all trials of the CHIPASAT and on the copy trial of the CFT, however, this time the participants of the present study performed significantly higher than the norms.

Table 17:

Results on the Neuropsychological Measures Compared to Norms

Measures	Present Study	Norms	*t*	*p*
AVLT [a]				
1	6.2	6.2	0.1	1.1
2	8.1	8.3	0.8	0.4
3	10.1	9.7	1.2	0.2
4	11	11.4	1.5	0.1
5	11.4	11.5	0.5	0.6
Interference	5.6	5.7	0.3	0.7
6	9.5	9.5	0.2	0.9
7	8.9	9.6	2.0	0.1
Recognition	14.1	14.5	1.8	0.8
CFT [b]				
Copy Trial	33.5	30.2	10.9	.000*
30 minute Delay	18.2	23.2	5.6	.000*
Digit Symbol [c]	9.8	10	3.7	0.7
CHIPASAT [d]				
2.4 score	39.8	33.8	3.9	.000*
2.0 score	33.6	28.3	4.5	.000*
1.6 score	27.9	23.1	4.3	.000*
1.2 score	19.2	16.6	2.6	.01*

* Denotes a statistically significant result

[a] From Forrester & Geffen (1991)

[b] From Spreen & Strauss (1993)

[c] From Wechsler (1993)

[d] From Johnson et al. (1988)

Hypothesis 9:

Head injury group will perform at lower levels, than the control group on the neuropsychological measures, and receive lower ratings on the Child Behaviour Checklist (CBCL) and the Teacher Report Form (TRF).

As presented in Table 18 significant differences were found between the head injury and control groups in Trials 6, 7 and the Interference Trial of the AVLT, with the head injured group performing at significantly lower levels than the control group.

There were no significant differences observed in the mean scores for the head injury group and the control group on the CBCL and TRF. Six parents identified behavioural difficulties in their children (two were in the head injury group and four were in the control group). Teachers reported behavioural difficulties in two of the participants, both were part of the control group.

Table 18:

Comparison of Head Injured and Control Groups on the Neuropsychological Measures

Measures	Head Injury Group	Control Group	*t*	*p*
AVLT Trials				
1	6.0	6.5	1.3 [a]	0.2
2	7.8	8.4	1.1	0.3
3	9.7	10.6	1.4	0.2
4	10.9	11.1	0.4	0.7
5	11.1	11.7	1.3	0.2
Interference	5.0	6.4	2.4 [a]	0.02*
6	8.8	10.3	2.2	0.04*
7	8.3	9.8	2.4	0.02*
Recognition	14.0	14.3	0.8	0.4
CFT				
Copy	33.0	34.2	1.9	0.1
3 Minute Delay	17.9	18.7	0.4	0.7
30 Minute Delay	18.3	18.1	0.1	0.9
Digit Symbol	51.3	54.7	1.2	0.2
CHIPASAT				
2.8 score	43.8	49.0	1.8	0.1
2.4 score	38.6	41.5	1.0	0.3
2.0 score	32.5	35.1	1.1	0.3
1.6 score	27.2	28.8	0.7	0.5
1.2 score	18.9	19.5	0.3 [a]	0.8

* Denotes statistically significant result

[a] Levene's test of equality of means indicated that the means were not equal, thus the unequal means t-value, degrees of freedom, and p-value were used.

The mean performances between the head injury and control groups on the AVLT, compared to the norms from Forrester and Geffen (1991) are shown in Figure 4. This shows that while the head injury group performed at lower levels than the control group and the norms, the learning curves were similar.

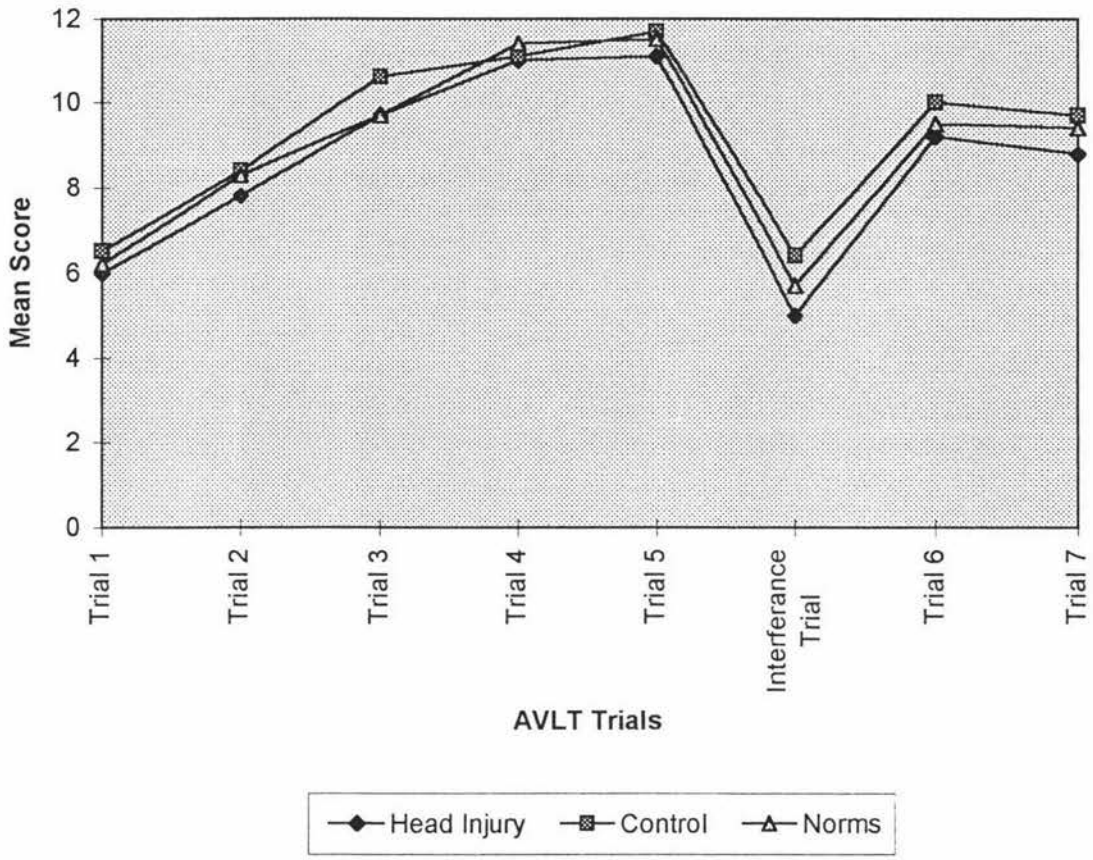

Figure 4:

Mean Performance of Head Injury and Control Groups on the AVLT compared to the Norms from Forrester and Geffen (1991).

Hypothesis 10:

The scores on the neuropsychological measures, and the ratings on the CBCL and the TRF will be proportional to the severity of the head injury sustained, i.e.: those who sustain a severe injury are likely to perform at lower levels and receive lower ratings than those with a mild head injury.

For this hypothesis, the head injury group was divided into two categories: severe head injuries and mild injuries. The severe head injury group consisted of those

students sustaining severe and moderate injuries (after reclassification) and the mild head injury group included those participants with mild and light head injuries (after reclassification). The results found no significant differences between the mild (N=13) and severe (N=6) head injury groups across any of the neuropsychological measures or in ratings on the CBCL and the TRF.

Hypothesis 11:

Those participants with multiple head injuries will perform at lower levels on the neuropsychological measures, the CBCL and the TRF than those with a single head injury.

Only 7 subjects in the sample sustained a single head injury and because those who had sustained multiple head injury had sustained injuries of varying severity levels, it was difficult to accurately compare the two groups. Therefore it was not possible to test this hypothesis.

Chapter 9

Discussion

Part 1: The Screening Questionnaire

Incidence of Head Injury

The percentage of participants who reported to have sustained a head injury during their lifetime (41%) was slightly higher than the Segalowitz and Brown (1991) study (31.2%), this was due to the higher number of males reporting a head injury in the present study (50% compared to 36.9%). The female percentages for the studies are equal. The reasons for the differences in the percentages of males reporting head injuries may be due to the classification of severity and the inclusion of light head injuries in the study. However this is unclear, as the Segalowitz and Brown (1991) study does not outline the method used to classify the severity of head injuries, or state whether light head injuries are included.

While the annual prevalence of head injuries for the present study (3.4%) is higher than that reported by Segalowitz and Brown (1991) (2%), it is within the 3-4% per year range reported by overseas studies and New Zealand ACC Statistics.

Multiple Head Injury

Of the 71 participants who reported sustaining a head injury, 24 (33.8%) reported having sustained more than one. While this is within the range (4 to 40%) reported by Salcido and Costich (1992), it is higher than the studies which specifically examine children. A study of children (under 15 years old) in the USSR conducted by Sumerhina (1984, cited in Salcido & Costich, 1992) reported that 12.6% of their sample had sustained multiple injuries, and a slightly higher percentage (17%) was found by Bijur et al. (1996). An explanation for the differences in results may be that the Sumerhina (1984, cited in Salcido & Costich, 1992) and Bijur et al. (1996) studies only included head injuries which had come to medical attention, this means that many light and mild head injuries were not included in their studies. In the present study,

the majority of the participants with head injuries did not seek medical attention and were found to have sustained predominately light or mild injuries, therefore inflating the multiple head injury rate. When light head injuries are excluded in the present study, the percentage of participants reporting multiple head injuries (28.6%) is still higher than published research, however, this is more in line with the results of a similar study conducted by Body and Leathem (1996) who found that 20% of their sample sustained multiple head injuries.

Reclassification

With the large number of participants (33.8%) reporting multiple head injuries it was necessary to address the issue of classifying the participants experience with head injury accurately, taking into account the current injury and the number and severity of any past head injuries. Consideration of the current injury without acknowledgment of prior head injury history, can lead to inaccurate findings, as this injury may not be the most severe injury the individual has suffered and therefore any sequelae which are observed may be due, in part, to past injuries, rather than the current injury. For the present study the reclassification system devised by Barnfield & Leathem (in press) was used to identify a more accurate account of the participants head injury history. This classification system was developed out of the literature which suggests that the effect of multiple head injuries are cumulative, it takes into account both the number of past head injuries sustained and the severity of those injuries.

Gender Differences

The results of the present study are in line with current trends with respect to the proportion of males and females sustaining injuries. Males were found to report more head injuries with a ratio of 1: 1.4, this is at the lower end of the reported ratios which have ranged from 1: 1.3 (Klauber et al., 1981) up to 1: 3.2 (Kraus et al., 1984). However, a majority of these studies obtain their ratios from medical records, which as mentioned previously, often do not include an accurate account of light and mild had injuries. When light head injuries are excluded from the present study the ratio rises to 1: 2.7, this is still within the range of ratios reported in the literature, however,

this is at the opposite end of the range. This ratio is identical to that found by Annegers et al. (1980). As a large percentage of participants sustained multiple head injuries, it is important to examine the male/female ratio of the total number of injuries sustained. The ratio equates to 1: 1.8, which is, again, within the ranges reported above.

Numerous researchers (Annegers, 1983; Begali, 1992; Birmaher & Williams, 1994; Goldstein & Levin, 1987) have reported that males tend to sustain head injuries which are more severe compared to their female counterparts. The present study showed that while the only severe head injury was sustained by a female participant, overall, males did sustain more severe head injuries than females. Segalowitz and Brown (1991) found that of those who had reported head injuries, males were more likely to have reported periods of unconsciousness than females, this was also seen in the present study, however the difference was more significant (88% of the males compared to 48% of the females).

As it has been suggested that the effects of multiple head injuries are cumulative, the number of multiple head injuries was also used as an indicator of the severity of injuries. Again, of those who had reported sustaining a head injury, males (40%) were shown to have sustained more multiple head injuries than females (24%).

Etiology

As was predicted, overall, the major source of head injury in this sample was sport followed by falls and collisions. While this was true for male participants, however, the major cause of head injuries in the female participants was falls closely followed by collisions and then sport. These results are in line with other studies examining similar age groups (Annegers et al., 1980; Body & Leathem, 1996; Kraus, 1995; Kraus & Nourjah, 1989). However, the results of the present study do need to be considered with caution as the cause of 15 (8 females and 7 males) of the head injuries sustained could not determined due to lack of information.

Since sport is the major cause of head injury for this age group (Annegers, et al., 1980; Kraus, 1995; Kraus & Nourjah, 1989) it was suggested that those participants

with head injuries are more likely to play, on average, more hours of sport per week than those participants without head injuries. This hypothesis was supported, in that a significant difference was found in the average hours of sport played per week between those with and without a head injury. Body and Leathem (1996) also examined this hypothesis and found a significant difference. Male participants were also found to play significantly more hours of sport per week than female participants.

Severity of Injuries

The majority of head injuries sustained in the sample were light or mild (93.6%), this percentage is slightly higher than the 80-90% reported by Fay et al. (1993), Fennell and Mickle (1994) and Snoek (1989). The differences may be due to the method of reporting injury. The cited studies gathered data from medical records which often do not include a true account of light and mild head injury cases, therefore the reported percentage of light and mild cases may be lower than the actual incidence. The present study used self report in which participants were able to describe any head injuries they had sustained (of any severity), head injury was not defined allowing participants to report any time they had thought they had sustained an injury, this may have meant that the number of light and mild head injuries reported was inflated.

Level of Awareness

The results examining the participants level of awareness of the symptoms of head injury are similar to those found by Body and Leathem (in press). Participants who had sustained a head injury were more likely, than those without head injury, to accurately indicate whether a particular symptom occurred following a head injury. For the present study, this meant that the percentage of head injury participants (31%) in the 'aware' category was twice the percentage of the participants without head injury (14.9%). The results were reversed for the 'not aware' category in which the percentage of those without head injury (27.7%) was almost twice that of those participants with head injury (14.4%).

These findings are contrary to the study conducted by O'Jile et al. (1994) who found no significant differences in the number of misperceptions about the consequences of

head injury between those with and without prior experience of head injury. Body and Leathem (in press) suggest that this may be due to the difference in data collection methods of their study and the O'Jile study. However, the method used in the present study is similar to that used by O'Jile et al. (1994), in that participants were asked to endorse a list of possible symptoms, as well as listing any other symptoms they thought may occur. The age of participants were significantly different in these studies however, children and adolescent samples were used in the present study (11 - 13 year olds) and in Body and Leathem (in press) (14 years old), while O'Jile et al (1994) surveyed a sample of university students with a mean age of 20.84 years old.

While O'Jile et al. (1994) found that overall there was no significant differences in the responses between the participants with and without previous head injury experience, they did find that, overall, their sample demonstrated a lower percentage of misconceptions about the consequences of head injury compared to the general population. These findings are inconsistent with the findings of Gouvier et al. (1988) whose participants were aged between 15 - 60 years, suggesting that age may be a factor in these differences.

Part Two: Neuropsychological Assessment of the Sample of 43 Subjects

Comparisons between Head Injury Group, Control Group and Norms

Rey Complex Figure Test (CFT)

No significant differences were found between the means scores for the head injury and control groups on the CFT. However, significant differences were found between the overall performance of the participants in part two of this study compared to the norms for the copy trial and the 30 minute delay trial. Overall, the participants performed significantly higher than the norms on the copy trial, the reverse is true for the 30 minute delay.

For the copy trial the majority of the participants used a piecemeal approach to the task. Often the participants copied the outside of the figure then piece by piece added details, often in no particular order. While this meant the mean scores on the copy trial were high, this was not so for the recall trial in which this approach le. to frequent errors and distortions. The approach used by the participants in the present study is in line with the current research which suggests that children, up to the age of 13 years old, often adopt a piecemeal approach to the copy trial (Spreen & Strauss, 1993). As age increases the strategies used become more organised, often beginning with the large rectangle following which details are completed in relation to this.

For the recall trial, many participants altered their approach to the task and were seen to complete the large rectangle first and then attempted to add any details they could recall. While this strategy is said to be more effective in recalling information, it may have been affected by the initial piecemeal approach to the copy trial, therefore yielding low mean scores.

Digit Symbol

The digit symbol was chosen as it is suggested to be the most sensitive of all subscales of the WISC-III (Wechsler, 1993) to impairments often observed following mild head injury. However, in the present study there was no significant differences in the mean score on the digit symbol between the head injury and control groups as well as between the mild and severe head injury groups. Both groups performed within the normal range for their age group, suggesting that overall the participants in the present study had little impairment in concrete symbol processing, short term memory, sequencing, precision and information processing speed.

Rey Auditory Verbal Learning Test (AVLT)

For trials 1 to 6 and the recognition trial the head injury group performed at lower levels than the control group, however, these results were not significant, this meant that the learning curves for the two groups were similar. Significant differences in the mean scores were found on the interference trial, and trials 6 and 7. Participants in the head injury group recalled fewer words immediately after the interference trial and after the 20 minute delay period, suggesting that they were affected more by the

interference list and the tasks performed before recall (CHIPASAT) than the control participants. While the head injury group had difficulty recalling words at trial 6 and 7, the results of the recognition trial were within the normal rates, suggesting that verbal retrieval problems may exist.

Sophisticated strategies were adopted by 3 female participants who made up a story with the words to help themselves to remember. This proved to be an effective strategy as all three participants performed above the average of the total sample on this task. Many other participants (from both groups) tried to remember the words by pairing them together, repeating them in their head, memorizing words on each end of the list (primacy and recency effects) and by recalling words that they had not said before first, while these approaches may aid in recall they are not as effective as devising a story with the words.

Children's Paced Auditory Serial Addition Task (CHIPASAT)

As with the majority of the previous measures, no significant results were found between the head injury and control groups on any of the CHIPASAT trials. However, with this measure, both groups performed significantly higher than the norms for this age group (Johnson et al., 1988). This indicates that overall, the participants were not seen to have any impairments with their capacity and rate of information processing speed (as measured by this task). It is unclear why this result occurred. Limited research and literature is available on this measure, with only one set of norms published. Further research may be necessary to evaluate the normative data that is available and the validity of this measure.

It is also interesting to note that many participants reported that they found the test hard and thought they would not score very highly on it. Seven participants declined to complete the measure, or asked to stop prior to completion, for similar reasons. The participants were observed to be anxious while completing this task, in particular when they missed numbers or realised they had answered incorrectly.

Child Behaviour Checklist (CBCL) and Teacher Report Form (TRF)

The results of the CBCL showed that six parents identified their children as having behavioural difficulties on one of the 10 dimensions, two of these children were from the head injury group, while four were part of the control group. Only two teachers reported difficulties in children, both were from the control group. Overall the comparisons between teacher and parent ratings produced significant results on five of the dimensions (anxious, delinquent, internalising, somatic and withdrawn), with parents rating their children higher than teachers on all dimensions. While there may be differences between parent and teacher ratings, the majority of these fell within the normal range for the child's age group.

Severity of Injuries

To test for the effects of the severity of the injuries, participants in the head injury group were divided into 'severe' and 'mild' head injury groups. No statistically significant differences were found between the two groups on any of the measures. The results need to be considered with caution as the number of participants in each group were very low and unequal.

A possible explanation for this may be that those participants indicating they had lost consciousness, may have overestimated the length of time they were unconscious, therefore increasing the severity of the injury. This is a problem often encountered when using self report and loss of consciousness as the measures for determining whether an injury was sustained and the severity of that injury. Self reporting injuries, and in particular lifetime prevalence rate, are prone to difficulties with remembering. The participants may have remembered they lost consciousness, but may have needed to estimate the length of this.

Recommendations for Future Research

Further research examining the role of sport in the etiology of head injuries in New Zealand children would allow accurate comparisons, rather than comparing research to overseas data. This is unacceptable as there are significant differences in the types of sports played, rules for sports and in the populations which participate in sporting

activities (i.e.: in New Zealand females play significantly more sport than in some overseas countries, such as USA). An examination of the safety mechanisms in place for different sporting activities and the effectiveness of these mechanisms, may lead to a better understanding of the role sport has to play in the etiology of head injuries.

Prevalence rates of multiple head injuries sustained in childhood, through sports and other activities, are scarce. The present study showed a high incidence of multiple head injuries, however it was difficult to compare this to literature as only three studies have reported on multiple head injuries in children. The existence of multiple head injury leads to the question of accurately classifying injuries. With the exception of the Barnfield and Leathem (in press) study, there appears to be no literature which offers an alternative classification system for individuals with multiple head injuries. Due to the vast literature which reports that the effects of multiple head injuries are cumulative, it is essential that when classifying an individuals head injury, the number and severity of past head injuries are also accounted for. Further research developing a classification system and the validity of this system is essential.

The level of awareness of the consequences of head injury is an area where more research is necessary. When using a similar approach to that used in the present study, it would be useful if further information on the participants experience with head injury was obtained, i.e.: whether they had sustained any head injuries or whether any family members or friends have sustained an head injury. It would also be interesting to gauge the understanding of the consequences of head injury of parents and teachers.

The present study, due to lack of time, did not include any measure where the child could report on their perception of their current level of functioning. One measure which could be included is the Patient Competency Rating Scale (PCRS). Another is the children's version of the CBCL, this would provide an interesting comparison of parent and teacher reports.

A larger sample needs to be used for the second part of the study to help with clarification of the results. A larger sample would enable accurate comparisons to be

made on neuropsychological measures between those participants with and without head injury as well as comparing participants with single and multiple head injuries.

The tests selected for this study were chosen as they are suggested to be sensitive to the effects of mild head injury, this was not indicated in the results. Using a wider range of neuropsychological measures, again, which specifically tap the common impairments of mild head injury, may help to identify those participants who are having difficulties.

Summary and Conclusions

The aim of the present study was to examine the incidence, etiology and neuropsychological sequelae of head injury in a Intermediate school aged sample. It was shown that 41% of the sample reported that they had sustained at least one head injury (of any severity), of these, 33.8% reported sustaining multiple head injuries. These rates were higher than the published research, which are possibly due to the high number of light and mild head injuries sustained (93% of all injuries).

The gender differences observed in the literature were also observed in the present study. Males were more likely to sustain head injuries with a ratio of 1: 1.3 and overall, males tended to sustain more severe head injuries. The etiology reported in the present study is also in line with the current research with sports making up the cause of the majority of head injuries sustained, this was followed by falls and collisions.

The results examining the level of awareness of the consequences of head injury were similar to those found in previous research with children. Overall, the majority of the participants were aware of the common symptoms following head injury, such as headaches, dizziness and concentration difficulties. It was also shown that the participants who had experienced a previous head injury were more likely to accurately indicate whether a symptom may occurred following head injury, than those participants who had not sustained an injury.

While many of the results of part one of the study reflected the current literature, part two did not follow the reported trends, with no significant differences found on the majority of the measures (with the exception of the Interference trial and trails 6 and 7 on the AVLT). However, interesting results on the CHIPASAT were obtained indicating that future research examining this measure may be necessary.

The present study has found that head injury, and multiple head injury, are a common occurrence in school age children. More research regarding the role of sports, the level of awareness and the effects of head injury and multiple head injuries is essential to gain a better understanding in this area.

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Appendix I

Information Sheet for Students (Part One of the Study)

Head Injury Study at Tamatea Intermediate School

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FACULTY OF
SOCIAL SCIENCES

DEPARTMENT OF
PSYCHOLOGY

Information Sheet for Students
(Part One of Study)

You are being asked to take part in a study about head injuries. The study is being run by Erika Broome, a student at Massey University, and Dr. Janet Leathem. The study is in two parts. In the first part, you will be asked to complete a 15 minute questionnaire. It asks what you do in your spare time, what you know about head injuries and it also asks questions about any head injuries you may have had.

You do have a choice about whether you take part in this study or not. If you do decide to take part in this study, you have the right to stop answering questions any time you want and can also choose to not answer any particular questions. You can withdraw from the study at any time. It is assumed that filling in the questionnaire means you agree to take part.

Based on the answers on the questionnaire, a small group of students will be invited to take part in the second part of the study. These students will be given another Information Sheet describing what will happen. You do not have to take part in the second part of the study.

Remember all your answers are private, your name will not be written on the questionnaire, code numbers will be used instead. At the end of the study all the questionnaires and results will be destroyed. When we write up the study, there will be no way that anyone can find out what you said or what your answers were.

You also have the right to ask any questions about the study. If you have any questions or are unsure about anything in this information sheet please talk to the researcher while she is at your school or contact her on 835 4881.

Thank you for your cooperation.

Erika Broome
Researcher

Janet Leathem
Senior Lecturer

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FACULTY OF
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Appendix II

Information Sheet for Students (Part Two of the Study)

Head Injury Study at Tamatea Intermediate School

Information Sheet for Students
(Part Two of Study)

Recently you filled in a questionnaire about head injuries. I am now ready to start the second part of the study and you are being asked now whether or not you wish to take part. This time you will be asked to spend 30-40 minutes with me doing five different tasks. These tasks are not like your normal school tests but are designed especially to measure such things as learning and memory. The results of these tasks are **not** for your school. The study will also involve your parent or guardian, and your teacher, who will be asked to complete a short questionnaire.

The results of this study are private. However, if I find that you are having difficulties on some of the tasks, I will need to discuss this with you and your parents.

All information will be kept in locked file drawers which only the researcher and her supervisor will have access to. At the end of the study all the results will be destroyed. When we write up the study, there will be no way that anyone can identify what you said or what your answers were.

Remember, you do not have to take part in this part of the study. If you do decide to take part, you have the right to stop completing the tasks at any time. You can also withdraw from the study at any time.

I will also need to contact your parents to ask them for their permission for you to be involved in the second part of the study. If you are happy for me to phone your parents, and would like to be involved in the second part of this study, please fill in the consent form and hand it into your teacher. If you agree to participate, I will contact you over the next week to make a good time to meet with you.

If you have any questions you can talk to me while I am at your school or phone me on 878 4802.

Yours faithfully,

Erika Broome
Researcher

Janet Leathem
Senior Lecturer

Appendix III

Information Sheet for Parents (Part One of the Study)

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FACULTY OF
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Letter to Parent/Guardians

(Part One of Study)

Dear Parents/Guardians,

My name is Erika Broome, I am a graduate psychology student at Massey University. I am conducting a study, as part of my Masters thesis, which will involve students from Tamatea Intermediate School. I am interested in the incidence rates, causes and outcomes of head injuries, and the students' own understanding of head injury and its consequences. There are two parts to the study. I would like your permission for your child to participate in the first part of this study.

In the first part of this study, participants will be asked to complete a 15 minute questionnaire which asks about the causes and outcomes of any head injuries they may have sustained. It also asks some general questions about the students interests and what problems they think are associated with head injuries.

Based on the results of the initial questionnaire, a small group of students will be invited to take part in the second part of the study. If your child is selected, you will be contacted closer to the time with information about what is involved and given the opportunity to decline their participation.

You child does not have to complete the questionnaire. He/she will be informed that they can stop completing the questionnaire at any time. All information collected will be treated confidentially and not passed onto the school. Code numbers, identifiable only to the researcher and her supervisor, will be used on the permission form and questionnaire. Your child's identity will protected in the writing up of the thesis, no names or identifying information will be published.

This study has been approved by the Human Ethics Committee at Massey University and by the Tamatea Intermediate School Board of Trustees. If you have any questions about the study please contact me on 878 4802. My supervisor, Dr. Janet Leathem, can be contacted at the Massey University Psychology Clinic on (06) 350 4131.

I would greatly appreciate it if you could return the attached permission slip indicating whether you would like your son/daughter to participate in the study.

Thank you for you time

Yours sincerely,

Erika Broome
Researcher

Janet Leathem
Senior Lecturer

Appendix IV

Information Sheet for Parents (Part Two of the Study)

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FACULTY OF
SOCIAL SCIENCES

Incidence and Etiology of Multiple Head Injuries and Related Functional Impairments in a New Zealand Intermediate Aged sample

Information Sheet for Parents/Guardians
(Part Two of Study)

Recently your son/daughter completed a questionnaire at school as part of a study on head injuries. Your son/daughter has been selected to take part in the second part of this study which is aimed at identifying the outcomes of head injuries. Some of the students who have been selected have sustained head injuries, others have not.

Your child will be asked to complete some short tasks which are designed especially to measure aspects of their learning, such as memory. These will take 30 minutes to complete. We would also like you to complete a short questionnaire which asks about your child's behaviour, this will take approximately 30 minutes to complete. Your child's teacher will also be asked to complete a similar questionnaire about their behaviour at school.

The results of these tasks and questionnaires are confidential to the person who is answering them, however if we find that your child is having difficulties on some of the tasks we will need to arrange a time to meet with you to discuss these difficulties and what action may need to be taken to follow these up.

All information obtained will be kept in locked file drawers which only the researcher and her supervisor will have access to. At the end of the study all the questionnaires and results will be destroyed. When the study is written up there will be no way that anyone can identify your child's or your responses.

You have the right to decline to participate. If you do decide to take part in this study, you have the right to refuse to answer any particular questions and the right to withdraw from participating at any time. You also have the right to ask any questions about the study.

This study is being conducted by Erika Broome and Dr. Janet Leathem from the Psychology Department at Massey University. If you have any questions you can contact the Erika on 878 4802, or alternatively you can contact Janet on (06) 350 4131 at the Massey University Psychology Clinic.

Thank you for your cooperation

Erika Broome
Researcher

Dr. Janet Leathem
Senior Lecturer

Appendix V

Information Sheet for Teachers (Part Two of the Study)

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FACULTY OF
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Incidence and Etiology of Multiple Head Injuries and Related Functional Impairments in a New Zealand Intermediate Aged sample

Information Sheet for Teachers
(Part Two of Study)

Recently some students in your class completed a questionnaire, as the first part of a study on head injuries. This study is aimed at examining the incidence rates, causes and outcomes of head injuries, and the students own understanding of head injury and its consequences. Some students in your class have been selected to take part in the second part of this study.

For the second part of this study we would also like you to complete a short questionnaire which asks questions about particular students behaviour. This will take approximately 30 minutes to complete.

Your responses are confidential. However, if a particular student is seen to have behavioural problems we may need to meet with you and the students parent to discuss this and what action needs to be taken.

All information will be kept in locked file drawers which only the researcher and her supervisor will have access to. At the end of the study all the questionnaires and results will be destroyed. When the study is written up, there will be no way that anyone can identify what your answers were.

You have the right to decline to participate. If you do decide to take part in this study, you have the right to refuse to answer any particular questions and the right to withdraw from participating at any time. You also have the right to ask any questions about the study.

This study is being conducted by Erika Broome and Dr. Janet Leathem from the Psychology Department at Massey University. If you have any questions you can contact the Erika on 878 4802, or alternatively you can contact Janet on
(06) 350 4131 at the Massey University Psychology Clinic.

Thank you for your cooperation,

Erika Broome
Researcher

Dr. Janet Leathem
Senior Lecturer

Appendix VI

Student Consent Form (Part Two of the Study)
Head Injury Study at Tamatea Intermediate School

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DEPARTMENT OF
PSYCHOLOGY

Consent Form for Students
(Part Two of Study)

I have read the information sheet and Erika has explained the study to me. I was allowed to ask questions about the study and understand what its about. I understand that I may ask further questions at any time.

I also know that I can withdraw from the study at any time, or not answer any questions I don't want to answer.

I agree to provide information to the researchers on the understanding that it is private and confidential.

I agree to take part in this study under the conditions set out on the information sheet.

Signed: _____

Name: _____

Date: _____

I would like to receive a summary of the results of this study Yes / No

Please send the summary of the results to the following address:

_____

_____

_____

_____

Appendix VII

Parent/Teacher Consent Form (Part Two of the Study)

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SOCIAL SCIENCES

DEPARTMENT OF
PSYCHOLOGY

Incidence and Etiology of Multiple Head Injury and Related Functional Impairments in a New Zealand Intermediate Aged Sample.

Consent Form for Parents/Guardians and Teachers

I have read the information sheet and have had the details of the study explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I understand that I am free to withdraw from the study at any time, or to decline to answer any particular questions in the study.

I agree to provide information to the researchers on the understanding that it is completely confidential.

I agree to participate in this study under the conditions set out on the information sheet.

Signed: _____

Name: _____

Date: _____

I would like to receive a summary of the results of this study Yes / No (circle one)

Please send the summary of the results to the following address:

_____

_____

_____

_____

Appendix VIII

Parental Permission Form (Part One of the Study)

Parent Permission Form

(Part One of Head Injury Study)

I _____ agree/do not agree (please cross one out) for my son/daughter to be in part one of the study on head injuries

Students name: _____

Students teacher: _____

Room number: _____

Signed: _____

Phone number: _____

Appendix IX
The Screening Questionnaire

Head Injury Questionnaire
Private and Confidential

This questionnaire is for everyone. Please answer all the questions carefully and honestly. All your answers are private and only the two researchers will see them. If you do not understand something, please ask the researcher or your teacher. It is assumed that filling in the questionnaire mean you agree to take part. You do not have to answer any questions you do not want to answer.

Are you:	Male / Female (circle)
Are you:	European / Maori / Pacific Islander / Other (circle)
Age:	10 11 12 13 (circle one)
Form Teacher:	_____
Form:	One / Two (circle)

1. Do you play any sports? Yes / No (circle)

   If yes, please write down what sports you play and how often:

   Sport: _____

   Hours spent playing each week, including practice:

   ½ hours / 1 hour / 1 ½ hours / 2 hours / 2 ½ hours / 3 hours or more (circle)

   Sport: _____

   Hours spent playing each week, including practice:

   ½ hours / 1 hour / 1 ½ hours / 2 hours / 2 ½ hours / 3 hours or more (circle)

2. Do you have any interests / hobbies?

   If yes, please write down what your hobby is and how much time you spend per week:

   Hobby: _____

   Hours spent playing each week, including practice:

   ½ hours / 1 hour / 1 ½ hours / 2 hours / 2 ½ hours / 3 hours or more (circle)

   Hobby: _____

   Hours spent playing each week, including practice:

   ½ hours / 1 hour / 1 ½ hours / 2 hours / 2 ½ hours / 3 hours or more (circle)

3. Here is a list of some problems. How often do you think each one is caused by a head injury? Please circle your answer:

How often are these problems caused by a head injury:

Headaches	Often / Sometimes / Never / Don't Know
Knocked out	Often / Sometimes / Never / Don't Know
Blindness	Often / Sometimes / Never / Don't Know
Memory loss	Often / Sometimes / Never / Don't Know
Cannot write	Often / Sometimes / Never / Don't Know
Tiredness	Often / Sometimes / Never / Don't Know
Argue a lot	Often / Sometimes / Never / Don't Know
Unable to talk	Often / Sometimes / Never / Don't Know
Hearing problems	Often / Sometimes / Never / Don't Know
Dizziness	Often / Sometimes / Never / Don't Know
Hair falls out	Often / Sometimes / Never / Don't Know
Do better at school	Often / Sometimes / Never / Don't Know
Problems sleeping	Often / Sometimes / Never / Don't Know
Get into lots of fights	Often / Sometimes / Never / Don't Know
Problems concentrating	Often / Sometimes / Never / Don't Know

What other problems are caused by head injury: _____

_____

_____

4. Have you ever had a head injury? YES / NO

If YES, please go on to the next page

If NO, you may finish here, thank you for answering these questions

5. How many head injuries have you had? 1 2 3 4 5 or more

6. Please describe each head injury:

Head Injury One:

(a) Describe how you hurt your head: _____

_____

(b) How old were you: _____

(c) Did you see a doctor or nurse? YES / NO

(d) Did you have time off school? YES / NO

(e) Were you knocked out? YES / NO

If YES, how long were you knocked out for: _____

(f) Did you have any problems afterwards? YES / NO

If YES, what problems did you experience: _____

_____

Head Injury Two:

(a) Describe how you hurt your head: _____

_____

(b) How old were you: _____

(c) Did you see a doctor or nurse? YES / NO

(d) Did you have time off school? YES / NO

(e) Were you knocked out? YES / NO

If YES, how long were you knocked out for: _____

(f) Did you have any problems afterwards? YES / NO

If YES, what problems did you experience: _____

_____

Head Injury Three:

(a) Describe how you hurt your head: _____

_____

(b) How old were you: _____

(c) Did you see a doctor or nurse? YES / NO

(d) Did you have time off school? YES / NO

(e) Were you knocked out? YES / NO

If YES, how long were you knocked out for: _____

(f) Did you have any problems afterwards? YES / NO

If YES, what problems did you experience: _____

_____

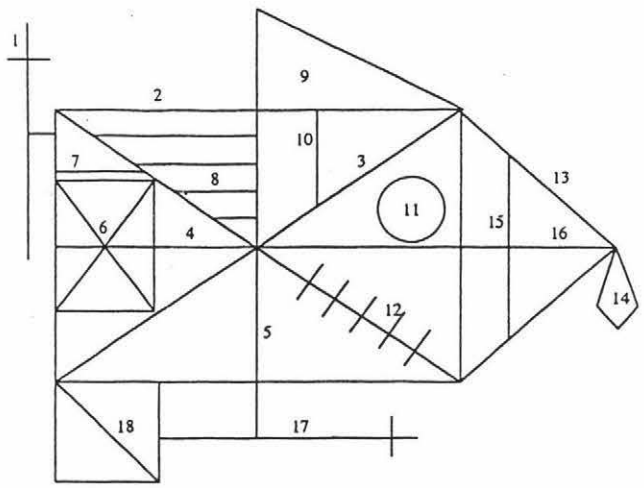
Please use the back of this page to describe any ore head injuries you have had

Thank you for answering this questionnaire

Appendix X

Rey-Osterrieth Complex Figure Test

Rey-Osterrieth Complex Figure



	Copy	3" Delayed Recall	30" Delayed Recall
1. Cross upper left corner, outside rectangle	.....	.....	.....
2. Large rectangle	.....	.....	.....
3. Diagonal cross	.....	.....	.....
4. Horizontal midline of 2	.....	.....	.....
5. Vertical midline of 2	.....	.....	.....
6. Small rectangle in 2 to left	.....	.....	.....
7. Small line above 6	.....	.....	.....
8. Four parallel lines in 2, upper left	.....	.....	.....
9. Triangle above 2, upper right	.....	.....	.....
10. Small vertical line in 2, below 9	.....	.....	.....
11. Circle with 3 dots, in 2	.....	.....	.....
12. Five parallel lines in 2, crossing 3, lower right	.....	.....	.....
13. Sides of triangle attatched to 2, on right	.....	.....	.....
14. Diamond attatched to 13	.....	.....	.....
15. Vertical line in 13, parallel to right side of 2	.....	.....	.....
16. Horizontal line in 13, continuing 4	.....	.....	.....
17. Lower cross, attatched to 5	.....	.....	.....
18. Square attatched to 2, lower left, with diagonal line	.....	.....	.....

	Placed properly	Placed Poorly
Correct	2	1
Distorted or incomplete but recognizable	1	.5
Absent, not recognizable	0	0

(Rey, 1941; Osterrirth, 1944)

Appendix X

Rey-Osterrieth Complex Figure Procedure

Procedure for the Copy Trial

The participants were presented with the a blank sheet of paper and a pen. The researcher placed the complex figure in front of the participant and instructed him/her to copy the figure as accurately as they could. As the participant was copying the figure the researcher unobtrusively reproduced the participants drawing, numbering the details in the order they were drawn and their direction. The time taken to complete the task was taken. The figure and the participants reproduction were removed at the completion of the trial.

Procedure for the 3 and 30 Minute Delay

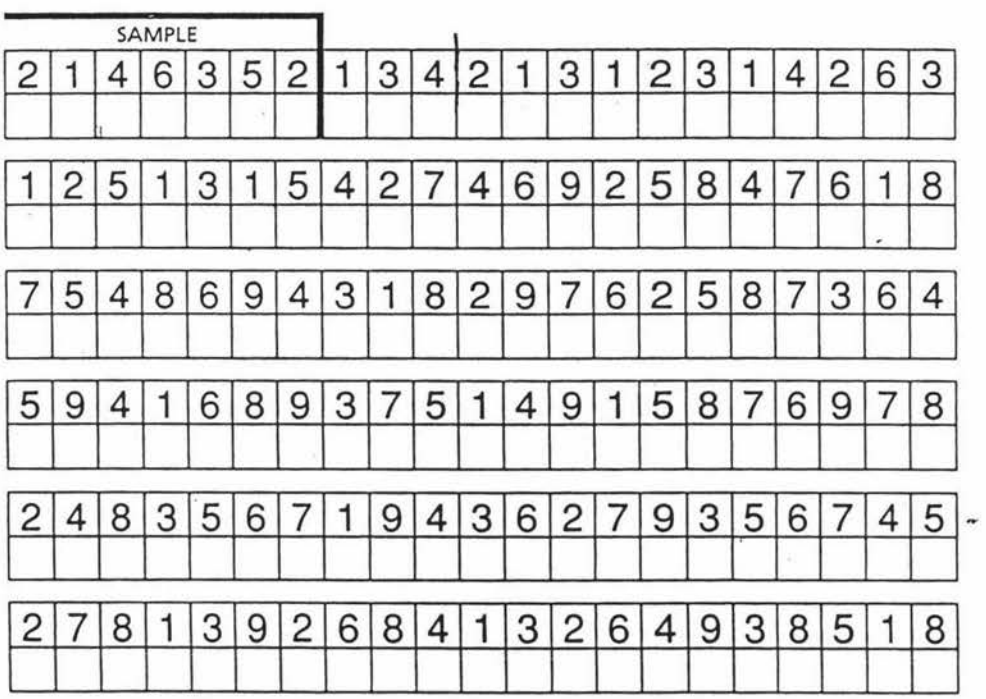
Three minutes after the copy trial was completed the subject was presented with a blank sheet of paper and a pen and asked to redraw the figure from their memory. As with the copy trial the participants drawing was reproduced by the researcher and the time taken to complete the figure were recorded. At the completion of the trial the participants drawing was removed. Thirty minutes after the 3 minute delay trial the participant was asked to reproduce the figure again from their memory. This trial was recorded and timed by the researcher. The test was scored using the method outline in Spreen and Strauss (1992).

Appendix XI

Digit Symbol Subtest from the WISC-III

Digit Symbol Worksheet

B



(Wechsler, 1992)

Appendix XI

Procedure for the Digit Symbol

The worksheet was placed in front of the participant with a pen and the following instructions were read aloud by the researcher. Where necessary the relevant feature were pointed out to the participant:

"Look at these divided boxes, notice that each has a number on the upper part and a special mark on the lower part. Every number has its own mark. Now look down here where the boxes have numbers in the top part but the squares at the bottom are empty. You are to put in each of the empty squares the mark that should go there, like this. Here is a 2; the 2 has this mark. So I put it in this square, like this. Here is a 1; the 1 has this mark. So I out it in this square. This number is a 3; the 3 has this mark. So I put it in this square. Now you fill in the squares up to this heavy line" (Wechsler, 1992).

Any errors made were corrected then the following instructions were read:

"When I tell you to start, you do the rest of them. Begin here and fill in as many squares as you can, one after the other, without skipping any. Keep working until I tell you to stop. Work as quickly as you can without making any mistakes. When you finish this line go on to this one." (Wechsler, 1992).

The participants were then instructed that they could begin.

Appendix XII

Rey Auditory Verbal Learning Test

Auditory Verbal Learning Test

Rey Auditory-Verbal Learning

A	B	C
Drum	Desk	Book
Curtain	Ranger	Flower
Bell	Bird	Train
Coffee	Shoe	Rug
School	Stove	Meadow
Parent	Mountain	Harp
Moon	Glasses	Salt
Garden	Towel	Finger
Hat	Cloud	Apple
Farmer	Boat	Chimney
Nose	Lamb	Button
Turkey	Gun	Key
Colour	Pencil	Dog
House	Church	Glass
River	Fish	Rattle

	1	2	3	4	5	I	6	7 (Delayed)
1.	____	____	____	____	____	____	____	____
2.	____	____	____	____	____	____	____	____
3.	____	____	____	____	____	____	____	____
4.	____	____	____	____	____	____	____	____
5.	____	____	____	____	____	____	____	____
6.	____	____	____	____	____	____	____	____
7.	____	____	____	____	____	____	____	____
8.	____	____	____	____	____	____	____	____
9.	____	____	____	____	____	____	____	____
10.	____	____	____	____	____	____	____	____
11.	____	____	____	____	____	____	____	____
12.	____	____	____	____	____	____	____	____
13.	____	____	____	____	____	____	____	____
14.	____	____	____	____	____	____	____	____
15.	____	____	____	____	____	____	____	____

Rey, 1964

Appendix XII

Procedure for Trials 1 to 7 and the Interference Trail

The following procedure was used for all participants. The researcher began by saying:

"I am going to read a list of words. Listen carefully, for when I stop you are to say back as many words as you can remember. It doesn't matter in what order you repeat them. Just try to remember as many as you can." (Lezak, 1983, p.423).

The first list of 15 words was read by the researcher at the rate of one word per second. All words the participants recalled were recorded, in the order they were recalled, including repeated words and words not on the list. When the participant could not recall any more words the following instructions were read to the participant:

"Now I am going to read the dame list again, and once again when I stop I want you to tell me as many words as you can remember, including the words you said the first time. It doesn't matter in what order you say them. Just say as many words as you can remember whether or not you said them before." (Lezak, 1983, p.423).

All words the participant recalled were recorded by the researcher. The same list of words was read for the next three trials (a total of 5 trials in all) and was preceded by the second set of instructions. Once the participant had completed the fifth trial the following instructions were given::

"Now I'm going to read a second list of words. This time, again, you are to say back as many words of this second list as you can remember. Again, the order in which you say these words does not matter. Just try to remember as many words as you can." (Lezak, 1983, p.424).

All words were recorded by the researcher including any repeated words, words from the first list, or words that were wrong. When the participant could recall no more words, they were asked to recall any words they could remember from the first list, without the list being read to them. All words the participant recalled were recorded.

Appendix XII

Procedure for the Delayed Recall and Recognition Trials

Delay Recall Procedure

After a 20 minute delay the participants were asked to recall as many words as they could from the first list. Again, all words recalled, including repeated words, words from the first list and wrong words were recorded.

Recognition Trial Procedure

Immediately following the delayed recall trial the participants were presented with a single sheet of paper with five columns of 50 words printed on it. This list randomly arranged with all 15 words from the fist and second lists and a list of words which were phonetically or semantically similar to the words in the first and second lists. Participants were asked to circle as many words they could recognise from the first list.

INSTRUCTIONS: PLEASE CIRCLE ALL THE WORDS YOU REMEMBER FROM THE FIRST LIST

BELL	HOME	TOWEL	BOAT	GLASSES
WINDOW	FISH	CURTAIN	HOT	STOCKING
HAT	MOON	FLOWER	PARENT	SHOE
BARN	TREE	COLOR	WATER	TEACHER
RANGER	BALLOON	DESK	FARMER	STOVE
NOSE	BIRD	GUN	ROSE	NEST
WEATHER	MOUNTAIN	CRAYON	CLOUD	CHILDREN
SCHOOL	COFFEE	CHURCH	HOUSE	DRUM
HAND	MOUSE	TURKEY	STRANGER	TOFFEE
PENCIL	RIVER	FOUNTAIN	GARDEN	LAMB

Appendix XIII

Children's Paced Auditory Serial Addition Task

Record Forms

CHILDREN'S PACED AUDITORY SERIAL ADDITION TASK

NAME:

AGE:

DATE OF BIRTH:

DATE OF TEST:

RESULTS SUMMARY

	TRIAL: 2.8	2.4	2.0	1.6	1.2
NUMBER CORRECT:					
DEVIATION FROM NORM:					
ERRORS:					
OMISSIONS:					
SEQUENCE:					

DEMONSTRATION

2 3 1 4
5 4 5

PRACTICE

1 3 4 2 5 3 2 4 1 1 3
4 7 6 7 8 5 6 5 2 4

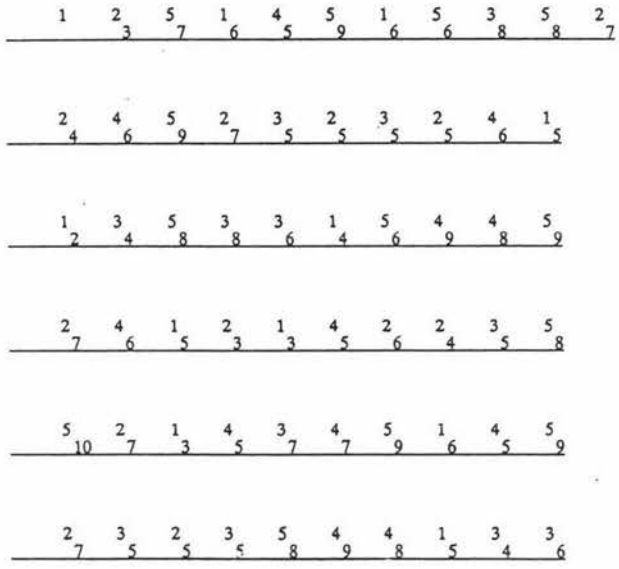
REPEAT

1 3 4 2 5 3 2 4 1 1 3
4 7 6 7 8 5 6 5 2 4

(Johnson, Roethig-Johnston, & Middleton, 1988).

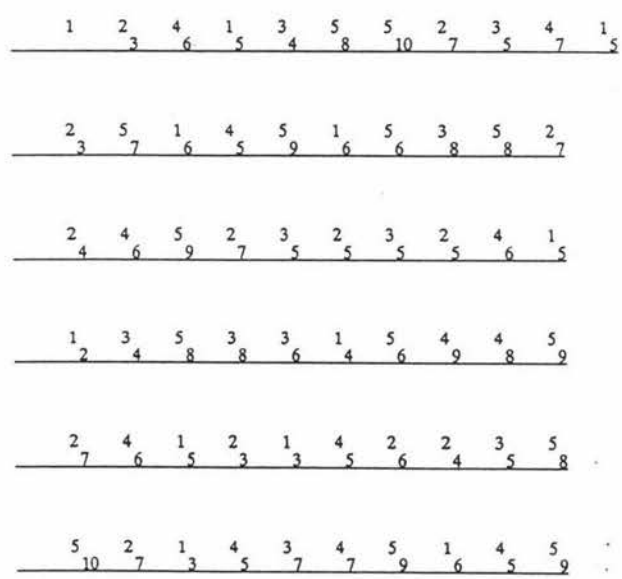
Appendix XIII

CHIPASAT 2.8



NUMBER CORRECT:
DEVIATION FROM NORM:
ERRORS:
OMISSIONS:
SEQUENCE:

CHIPASAT:2.4



NUMBER CORRECT:
DEVIATION FROM NORM:
ERRORS:
OMISSIONS:
SEQUENCE:

(Johnson, Roethig-Johnston, & Middleton, 1988).

Appendix XIII

CHIPASAT: 2.0

2	1	4	2	2	3	5	5	2	1	4	
	3	5	6	4	5	8	10	7	3	5	
3	4	5	1	4	5	2	3	2	3		
7	7	9	6	5	9	7	5	5	5		
5	4	4	1	3	3	2	4	1	1		
8	9	8	5	4	6	5	6	5	2		
3	2	4	3	1	5	1	2	4	1		
4	5	6	7	4	6	6	3	6	5		
3	5	5	2	3	4	1	2	5	1		
4	8	10	7	5	7	5	3	7	6		
4	5	1	5	3	5	2	2	4	5		
5	9	6	6	8	8	7	4	6	9		

NUMBER CORRECT:
DEVIATION FROM NORM:
ERRORS:
OMISSIONS:
SEQUENCE:

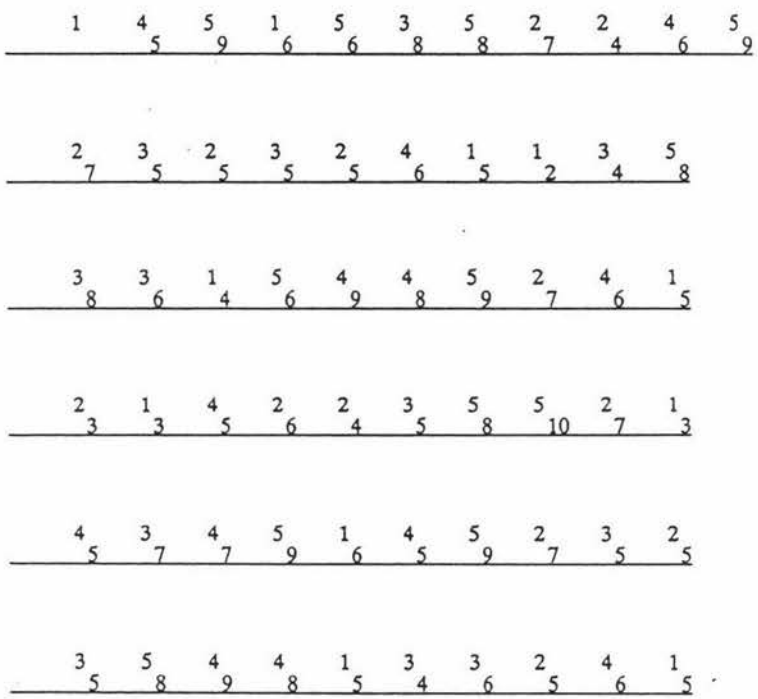
CHIPASAT: 1.6

1	4	5	2	3	2	3	5	4	4	1	
	5	9	7	5	5	5	8	9	8	5	
3	3	2	4	1	1	3	2	4	3		
4	6	5	6	5	2	4	5	6	7		
1	5	1	2	4	1	3	5	5	2		
4	6	6	3	6	5	4	8	10	7		
3	4	1	2	5	1	4	5	1	5		
5	7	5	3	7	6	5	9	6	6		
3	5	2	2	4	5	2	3	2	3		
8	8	7	4	6	9	7	5	5	5		
2	4	1	1	3	5	3	3	1	5		
5	6	5	2	4	8	8	6	4	6		

NUMBER CORRECT:
DEVIATION FROM NORM:
ERRORS:
OMISSIONS:
SEQUENCE:

Appendix XIII

CHIPASAT: 1.2



NUMBER CORRECT:
DEVIATION FROM NORM:
ERRORS:
OMISSIONS:
SEQUENCE:

Procedure for the Children's Paced Auditory Serial Addition Task

The participants were informed that this task was prerecorded onto a tape and that the tape explained the instructions of the task. The tape was played and the participants listened to the instructions and attempted the practice trials. If they showed that they understood the instructions, they continued onto the trials. If they did not understand how to complete the task, then the instructions were played again and the participant attempted the practice trails again.

Appendix XIV

Child Behaviour Check List

CHILD BEHAVIOR CHECKLIST FOR AGES 4-18

For office use only
ID #

CHILD'S NAME

SEX ☐ Boy ☐ Girl | AGE | ETHNIC GROUP OR RACE

TODAY'S DATE Mo.____ Date____ Yr.____ | CHILD'S BIRTHDATE Mo.____ Date____ Yr.____

GRADE IN SCHOOL ____

NOT ATTENDING SCHOOL ☐

Please fill out this form to reflect *your* view of the child's behavior even if other people might not agree. Feel free to write additional comments beside each item and in the spaces provided on page 2.

PARENTS' USUAL TYPE OF WORK, even if not working now. *(Please be specific—for example, auto mechanic, high school teacher, homemaker, laborer, lathe operator, shoe salesman, army sergeant.)*

FATHER'S TYPE OF WORK: _____

MOTHER'S TYPE OF WORK: _____

THIS FORM FILLED OUT BY:

☐ Mother (name): _____

☐ Father (name): _____

☐ Other—name & relationship to child: _____

I. Please list the sports your child most likes to take part in. For example: swimming, baseball, skating, skate boarding, bike riding, fishing, etc.

☐ None

Compared to others of the same age, about how much time does he/she spend in each?

	Don't Know	Less Than Average	Average	More Than Average
a. _____	☐	☐	☐	☐
b. _____	☐	☐	☐	☐
c. _____	☐	☐	☐	☐

Compared to others of the same age, how well does he/she do each one?

	Don't Know	Below Average	Average	Above Average
a. _____	☐	☐	☐	☐
b. _____	☐	☐	☐	☐
c. _____	☐	☐	☐	☐

II. Please list your child's favorite hobbies, activities, and games, other than sports. For example: stamps, dolls, books, piano, crafts, cars, singing, etc. (Do not include listening to radio or TV.)

☐ None

Compared to others of the same age, about how much time does he/she spend in each?

	Don't Know	Less Than Average	Average	More Than Average
a. _____	☐	☐	☐	☐
b. _____	☐	☐	☐	☐
c. _____	☐	☐	☐	☐

Compared to others of the same age, how well does he/she do each one?

	Don't Know	Below Average	Average	Above Average
a. _____	☐	☐	☐	☐
b. _____	☐	☐	☐	☐
c. _____	☐	☐	☐	☐

III. Please list any organizations, clubs, teams, or groups your child belongs to.

☐ None

Compared to others of the same age, how active is he/she in each?

	Don't Know	Less Active	Average	More Active
a. _____	☐	☐	☐	☐
b. _____	☐	☐	☐	☐
c. _____	☐	☐	☐	☐

IV. Please list any jobs or chores your child has. For example: paper route, babysitting, making bed, working in store, etc. (Include both paid and unpaid jobs and chores.)

☐ None

Compared to others of the same age, how well does he/she carry them out?

	Don't Know	Below Average	Average	Above Average
a. _____	☐	☐	☐	☐
b. _____	☐	☐	☐	☐
c. _____	☐	☐	☐	☐

(Achenbach & Edelbrock, 1983).

Appendix XIV

V. 1. About how many close friends does your child have? (Do not include brothers & sisters) ☐ None ☐ 1 ☐ 2 or 3 ☐ 4 or more

2. About how many times a week does your child do things with any friends outside of regular school hours? (Do not include brothers & sisters) ☐ Less than 1 ☐ 1 or 2 ☐ 3 or more

VI. Compared to others of his/her age, how well does your child:

	Worse	About Average	Better	
a. Get along with his/her brothers & sisters?	☐	☐	☐	☐ Has no brothers or sisters
b. Get along with other kids?	☐	☐	☐	
c. Behave with his/her parents?	☐	☐	☐	
d. Play and work by himself/herself?	☐	☐	☐	

VII. 1. For ages 6 and older—performance in academic subjects. If child is not being taught, please give reason _____

	Failing	Below average	Average	Above average
a. Reading, English, or Language Arts	☐	☐	☐	☐
b. History or Social Studies	☐	☐	☐	☐
c. Arithmetic or Math	☐	☐	☐	☐
d. Science	☐	☐	☐	☐
Other academic subjects—for example: computer courses, foreign language, business. Do *not* include gym, shop, driver's ed., etc. e. _____	☐	☐	☐	☐
f. _____	☐	☐	☐	☐
g. _____	☐	☐	☐	☐

2. Is your child in a special class or special school? ☐ No ☐ Yes—what kind of class or school?

3. Has your child repeated a grade? ☐ No ☐ Yes—grade and reason

4. Has your child had any academic or other problems in school? ☐ No ☐ Yes—please describe

When did these problems start?

Have these problems ended? ☐ No ☐ Yes—when?

Does your child have any illness, physical disability, or mental handicap? ☐ No ☐ Yes—please describe

What concerns you most about your child?

Please describe the best things about your child:

Appendix XIV

Below is a list of items that describe children and youth. For each item that describes your child **now or within the past 6 months**, please circle the **2** if the item is **very true** or **often true** of your child. Circle the **1** if the item is **somewhat** or **sometimes true** of your child. If the item is **not true** of your child, circle the **0**. Please answer all items as well as you can, even if some do not seem to apply to your child.

0 = Not True (as far as you know) **1 = Somewhat or Sometimes True** **2 = Very True or Often True**

0 1 2 1. Acts too young for his/her age
0 1 2 2. Allergy (describe): _____
_____
0 1 2 3. Argues a lot
0 1 2 4. Asthma
0 1 2 5. Behaves like opposite sex
0 1 2 6. Bowel movements outside toilet
0 1 2 7. Bragging, boasting
0 1 2 8. Can't concentrate, can't pay attention for long
0 1 2 9. Can't get his/her mind off certain thoughts; obsessions (describe): _____
_____
0 1 2 10. Can't sit still, restless, or hyperactive
0 1 2 11. Clings to adults or too dependent
0 1 2 12. Complains of loneliness
0 1 2 13. Confused or seems to be in a fog
0 1 2 14. Cries a lot
0 1 2 15. Cruel to animals
0 1 2 16. Cruelty, bullying, or meanness to others
0 1 2 17. Day-dreams or gets lost in his/her thoughts
0 1 2 18. Deliberately harms self or attempts suicide
0 1 2 19. Demands a lot of attention
0 1 2 20. Destroys his/her own things
0 1 2 21. Destroys things belonging to his/her family or others
0 1 2 22. Disobedient at home
0 1 2 23. Disobedient at school
0 1 2 24. Doesn't eat well
0 1 2 25. Doesn't get along with other kids
0 1 2 26. Doesn't seem to feel guilty after misbehaving
0 1 2 27. Easily jealous
0 1 2 28. Eats or drinks things that are not food—***don't*** include sweets (describe): _____
_____
0 1 2 29. Fears certain animals, situations, or places, other than school (describe): _____
_____
0 1 2 30. Fears going to school
0 1 2 31. Fears he/she might think or do something bad
0 1 2 32. Feels he/she has to be perfect
0 1 2 33. Feels or complains that no one loves him/her
0 1 2 34. Feels others are out to get him/her
0 1 2 35. Feels worthless or inferior
0 1 2 36. Gets hurt a lot, accident-prone
0 1 2 37. Gets in many fights
0 1 2 38. Gets teased a lot
0 1 2 39. Hangs around with others who get in trouble
0 1 2 40. Hears sounds or voices that aren't there (describe): _____
_____
0 1 2 41. Impulsive or acts without thinking
0 1 2 42. Would rather be alone than with others
0 1 2 43. Lying or cheating
0 1 2 44. Bites fingernails
0 1 2 45. Nervous, highstrung, or tense
0 1 2 46. Nervous movements or twitching (describe): _____
_____
0 1 2 47. Nightmares
0 1 2 48. Not liked by other kids
0 1 2 49. Constipated, doesn't move bowels
0 1 2 50. Too fearful or anxious
0 1 2 51. Feels dizzy
0 1 2 52. Feels too guilty
0 1 2 53. Overeating
0 1 2 54. Overtired
0 1 2 55. Overweight
56. Physical problems without known medical cause:
0 1 2 a. Aches or pains (*not* headaches)
0 1 2 b. Headaches
0 1 2 c. Nausea, feels sick
0 1 2 d. Problems with eyes (describe): _____
_____
0 1 2 e. Rashes or other skin problems
0 1 2 f. Stomachaches or cramps
0 1 2 g. Vomiting, throwing up
0 1 2 h. Other (describe): _____
_____

Please see other side

Appendix XIV

0 = Not True (as far as you know) 1 = Somewhat or Sometimes True 2 = Very True or Often True

0 1 2 57. Physically attacks people
0 1 2 58. Picks nose, skin, or other parts of body (describe): _____
_____
0 1 2 59. Plays with own sex parts in public
0 1 2 60. Plays with own sex parts too much
0 1 2 61. Poor school work
0 1 2 62. Poorly coordinated or clumsy
0 1 2 63. Prefers being with older kids
0 1 2 64. Prefers being with younger kids
0 1 2 65. Refuses to talk
0 1 2 66. Repeats certain acts over and over; compulsions (describe): _____
_____
0 1 2 67. Runs away from home
0 1 2 68. Screams a lot
0 1 2 69. Secretive, keeps things to self
0 1 2 70. Sees things that aren't there (describe):
_____
_____
0 1 2 71. Self-conscious or easily embarrassed
0 1 2 72. Sets fires
0 1 2 73. Sexual problems (describe): _____
_____
_____
0 1 2 74. Showing off or clowning
0 1 2 75. Shy or timid
0 1 2 76. Sleeps less than most kids
0 1 2 77. Sleeps more than most kids during day and/or night (describe): _____
_____
0 1 2 78. Smears or plays with bowel movements
0 1 2 79. Speech problem (describe): _____
_____
0 1 2 80. Stares blankly
0 1 2 81. Steals at home
0 1 2 82. Steals outside the home
0 1 2 83. Stores up things he/she doesn't need (describe): _____
_____
0 1 2 84. Strange behavior (describe): _____
_____
0 1 2 85. Strange ideas (describe): _____
_____
0 1 2 86. Stubborn, sullen, or irritable
0 1 2 87. Sudden changes in mood or feelings
0 1 2 88. Sulks a lot
0 1 2 89. Suspicious
0 1 2 90. Swearing or obscene language
0 1 2 91. Talks about killing self
0 1 2 92. Talks or walks in sleep (describe): _____
_____
0 1 2 93. Talks too much
0 1 2 94. Teases a lot
0 1 2 95. Temper tantrums or hot temper
0 1 2 96. Thinks about sex too much
0 1 2 97. Threatens people
0 1 2 98. Thumb-sucking
0 1 2 99. Too concerned with neatness or cleanliness
0 1 2 100. Trouble sleeping (describe): _____
_____
0 1 2 101. Truancy, skips school
0 1 2 102. Underactive, slow moving, or lacks energy
0 1 2 103. Unhappy, sad, or depressed
0 1 2 104. Unusually loud
0 1 2 105. Uses alcohol or drugs for nonmedical purposes (describe): _____
_____
0 1 2 106. Vandalism
0 1 2 107. Wets self during the day
0 1 2 108. Wets the bed
0 1 2 109. Whining
0 1 2 110. Wishes to be of opposite sex
0 1 2 111. Withdrawn, doesn't get involved with others
0 1 2 112. Worries
113. Please write in any problems your child has that were not listed above:
0 1 2 _____
0 1 2 _____
0 1 2 _____

PLEASE BE SURE YOU HAVE ANSWERED ALL ITEMS.

UNDERLINE ANY YOU ARE CONCERNED ABOUT.

Appendix XV

Teacher Report Form

TEACHER'S REPORT FORM

For office use only
ID #

Your answers will be used to compare the pupil with other pupils whose teachers have completed similar forms. The information from this form will also be used for comparison with other information about this pupil. Please answer as well as you can, even if you lack full information. Scores on individual items will be combined to identify general patterns of behavior. Feel free to write additional comments beside each item and in the space provided on page 2.

PUPIL'S NAME			
PUPIL'S SEX ☐ Boy ☐ Girl	PUPIL'S AGE	ETHNIC GROUP OR RACE	
TODAY'S DATE Mo.____ Date____ Yr.____		PUPIL'S BIRTHDATE (if known) Mo.____ Date____ Yr.____	
GRADE IN SCHOOL	NAME OF SCHOOL		

PARENTS' USUAL TYPE OF WORK, even if not working now. *(Please be as specific as you can—for example, auto mechanic, high school teacher, homemaker, laborer, lathe operator, shoe salesman, army sergeant.)*

FATHER'S TYPE OF WORK: _____

MOTHER'S TYPE OF WORK: _____

THIS FORM FILLED OUT BY:

☐ Teacher (name) _____

☐ Counselor (name) _____

☐ Other (specify) name: _____

I. How long have you known this pupil?_____ months

II. How well do you know him/her? 1. ☐ Not Well 2. ☐ Moderately Well 3. ☐ Very Well

III. How much time does he/she spend in your class per week?

IV. What kind of class is it? (Please be specific, e.g., regular 5th grade, 7th grade math, etc.)

V. Has he/she ever been referred for special class placement, services, or tutoring?
☐ Don't Know 0. ☐ No 1. ☐ Yes—what kind and when?

VI. Has he/she ever repeated a grade?
☐ Don't Know 0. ☐ No 1. ☐ Yes—grade and reason

VII. Current school performance—list academic subjects and check appropriate column:

Academic subject	1. Far below grade	2. Somewhat below grade	3. At grade level	4. Somewhat above grade	5. Far above grade
1. _____	☐	☐	☐	☐	☐
2. _____	☐	☐	☐	☐	☐
3. _____	☐	☐	☐	☐	☐
4. _____	☐	☐	☐	☐	☐
5. _____	☐	☐	☐	☐	☐
6. _____	☐	☐	☐	☐	☐

(Achenbach & Edelbrock, 1983).

Appendix XV

VIII. Compared to typical pupils of the same age:	1. Much less	2. Somewhat less	3. Slightly less	4. About average	5. Slightly more	6. Somewhat more	7. Much more
1. How hard is he/she working?	☐	☐	☐	☐	☐	☐	☐
2. How appropriately is he/she behaving?	☐	☐	☐	☐	☐	☐	☐
3. How much is he/she learning?	☐	☐	☐	☐	☐	☐	☐
4. How happy is he/she?	☐	☐	☐	☐	☐	☐	☐

IX. **Most recent achievement test scores** (if available):

Name of test	Subject	Date	Percentile or grade level obtained

X. **IQ, readiness, or aptitude tests** (if available):

Name of test	Date	IQ or equivalent scores

Does this pupil have any illness, physical disability, or mental handicap? ☐ No ☐ Yes—please describe

What concerns you most about this pupil?

Please describe the best things about this pupil:

Please feel free to write any comments about this pupil's work, behavior, or potential, using extra pages if necessary.

Appendix XV

Below is a list of items that describe pupils. For each item that describes the pupil **now or within the past 2 months**, please circle the 2 if the item is **very true** or **often true** of the pupil. Circle the 1 if the item is **somewhat** or **sometimes true** of the pupil. If the item is **not true** of the pupil, circle the 0. Please answer all items as well as you can, even if some do not seem to apply to this pupil.

0 = Not True (as far as you know) 1 = Somewhat or Sometimes True 2 = Very True or Often True

0 1 2 1. Acts too young for his/her age
0 1 2 2. Hums or makes other odd noises in class

0 1 2 3. Argues a lot
0 1 2 4. Fails to finish things he/she starts

0 1 2 5. Behaves like opposite sex
0 1 2 6. Defiant, talks back to staff

0 1 2 7. Bragging, boasting
0 1 2 8. Can't concentrate, can't pay attention for long

0 1 2 9. Can't get his/her mind off certain thoughts; obsessions (describe):_____

_____

0 1 2 10. Can't sit still, restless, or hyperactive

0 1 2 11. Clings to adults or too dependent

0 1 2 12. Complains of loneliness

0 1 2 13. Confused or seems to be in a fog
0 1 2 14. Cries a lot

0 1 2 15. Fidgets
0 1 2 16. Cruelty, bullying, or meanness to others

0 1 2 17. Daydreams or gets lost in his/her thoughts
0 1 2 18. Deliberately harms self or attempts suicide

0 1 2 19. Demands a lot of attention
0 1 2 20. Destroys his/her own things

0 1 2 21. Destroys property belonging to others
0 1 2 22. Difficulty following directions

0 1 2 23. Disobedient at school
0 1 2 24. Disturbs other pupils

0 1 2 25. Doesn't get along with other pupils
0 1 2 26. Doesn't seem to feel guilty after misbehaving

0 1 2 27. Easily jealous
0 1 2 28. Eats or drinks things that are not food—don't include sweets (describe):_____

_____

0 1 2 29. Fears certain animals, situations, or places other than school (describe): _____

_____

0 1 2 30. Fears going to school

0 1 2 31. Fears he/she might think or do something bad
0 1 2 32. Feels he/she has to be perfect

0 1 2 33. Feels or complains that no one loves him/her
0 1 2 34. Feels others are out to get him/her

0 1 2 35. Feels worthless or inferior
0 1 2 36. Gets hurt a lot, accident-prone

0 1 2 37. Gets in many fights
0 1 2 38. Gets teased a lot

0 1 2 39. Hangs around with others who get in trouble
0 1 2 40. Hears sounds or voices that aren't there (describe):

_____

0 1 2 41. Impulsive or acts without thinking
0 1 2 42. Likes to be alone

0 1 2 43. Lying or cheating
0 1 2 44. Bites fingernails

0 1 2 45. Nervous, high-strung, or tense
0 1 2 46. Nervous movements or twitching (describe):

_____

0 1 2 47. Overconforms to rules
0 1 2 48. Not liked by other pupils

0 1 2 49. Has difficulty learning
0 1 2 50. Too fearful or anxious

0 1 2 51. Feels dizzy
0 1 2 52. Feels too guilty

0 1 2 53. Talks out of turn
0 1 2 54. Overtired

0 1 2 55. Overweight
56. Physical problems without known medical cause:
0 1 2 a. Aches or pains
0 1 2 b. Headaches
0 1 2 c. Nausea, feels sick
0 1 2 d. Problems with eyes (describe): _____

_____

0 1 2 e. Rashes or other skin problems
0 1 2 f. Stomachaches or cramps
0 1 2 g. Vomiting, throwing up
0 1 2 h. Other (describe): _____

_____

Please see other side

Appendix XV

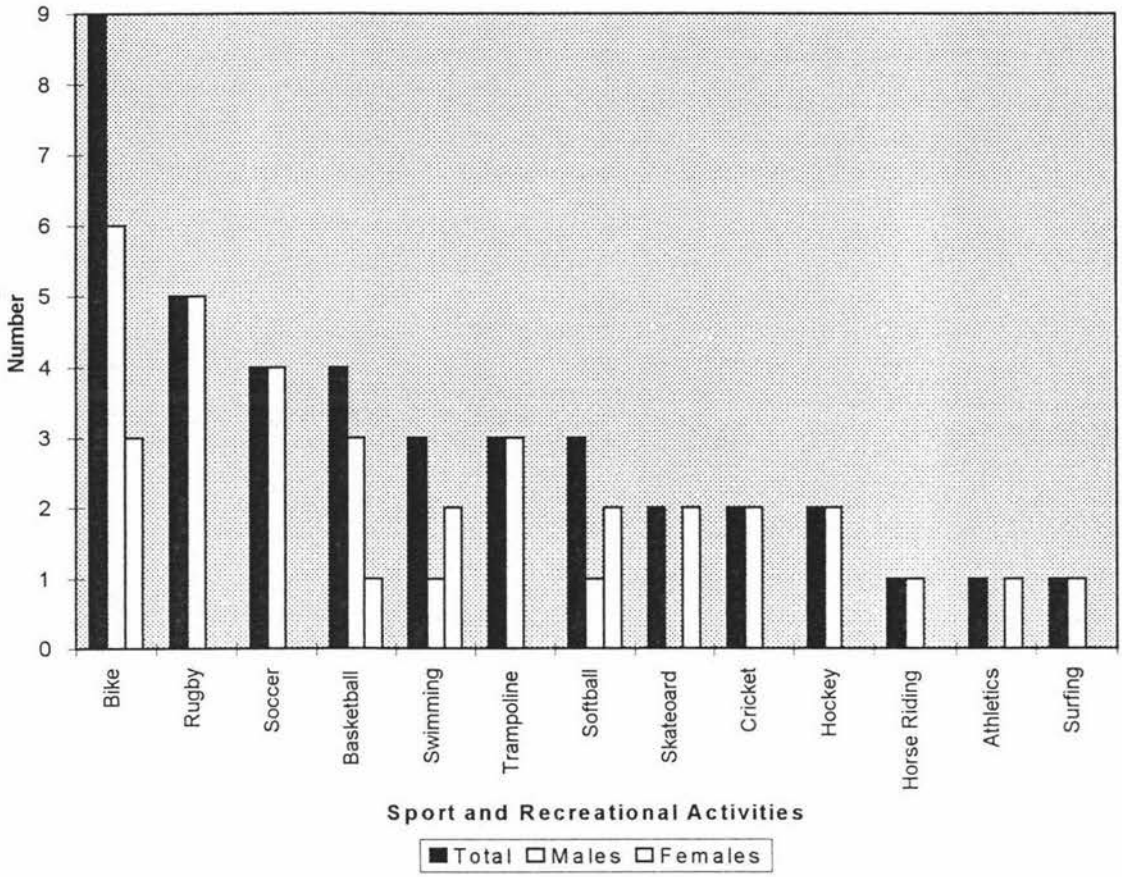
0 = Not True (as far as you know) 1 = Somewhat or Sometimes True 2 = Very True or Often True

0 1 2 57. Physically attacks people
0 1 2 58. Picks nose, skin, or other parts of body (describe): _____
_____
0 1 2 59. Sleeps in class
0 1 2 60. Apathetic or unmotivated
0 1 2 61. Poor school work
0 1 2 62. Poorly coordinated or clumsy
0 1 2 63. Prefers being with older children
0 1 2 64. Prefers being with younger children
0 1 2 65. Refuses to talk
0 1 2 66. Repeats certain acts over and over; compulsions (describe): _____
_____
0 1 2 67. Disrupts class discipline
0 1 2 68. Screams a lot
0 1 2 69. Secretive, keeps things to self
0 1 2 70. Sees things that aren't there (describe):
_____
_____
0 1 2 71. Self-conscious or easily embarrassed
0 1 2 72. Messy work
0 1 2 73. Behaves irresponsibly (describe): _____
_____
0 1 2 74. Showing off or clowning
0 1 2 75. Shy or timid
0 1 2 76. Explosive and unpredictable behavior
0 1 2 77. Demands must be met immediately, easily frustrated
0 1 2 78. Inattentive, easily distracted
0 1 2 79. Speech problem (describe): _____
_____
0 1 2 80. Stares blankly
0 1 2 81. Feels hurt when criticized
0 1 2 82. Steals
0 1 2 83. Stores up things he/she doesn't need (describe):
_____
_____
0 1 2 84. Strange behavior (describe): _____
_____
0 1 2 85. Strange ideas (describe): _____
_____
0 1 2 86. Stubborn, sullen, or irritable
0 1 2 87. Sudden changes in mood or feelings
0 1 2 88. Sulks a lot
0 1 2 89. Suspicious
0 1 2 90. Swearing or obscene language
0 1 2 91. Talks about killing self
0 1 2 92. Underachieving, not working up to potential
0 1 2 93. Talks too much
0 1 2 94. Teases a lot
0 1 2 95. Temper tantrums or hot temper
0 1 2 96. Seems preoccupied with sex
0 1 2 97. Threatens people
0 1 2 98. Tardy to school or class
0 1 2 99. Too concerned with neatness or cleanliness
0 1 2 100. Fails to carry out assigned tasks
0 1 2 101. Truancy or unexplained absence
0 1 2 102. Underactive, slow moving, or lacks energy
0 1 2 103. Unhappy, sad, or depressed
0 1 2 104. Unusually loud
0 1 2 105. Uses alcohol or drugs for nonmedical purposes (describe): _____
0 1 2 106. Overly anxious to please
0 1 2 107. Dislikes school
0 1 2 108. Is afraid of making mistakes
0 1 2 109. Whining
0 1 2 110. Unclean personal appearance
0 1 2 111. Withdrawn, doesn't get involved with others
0 1 2 112. Worrying
113. Please write in any problems the pupil has that were not listed above:
0 1 2 _____
0 1 2 _____
0 1 2 _____

PLEASE BE SURE YOU HAVE ANSWERED ALL ITEMS

Appendix XVII

Number of Head Injuries sustained by Male and Female Participants through Specific Sporting and Recreational Activities



Total Number of Males (N=22) and Females (N=8) Sustaining Head Injuries through Various Sporting Activities

Appendix XVIII

(a) Number and Severity of Head Injuries Sustained by the Head Injury Group (N=24) in Part Two

Number and Severity of Head Injuries Sustained by the Head Injury Group (=24) in Part Two

Number of Head Injury	Light	Mild	Moderate	Severe
1	8	9	3	1
2	5	2	--	--
3	1	2	--	--
4	--	--	--	--
5	1	1	--	--
Total [1]	15	14	3	1

[1] Total is more that 24 due to multiple head injuries

Appendix XVIII

(b) Number and Percentage of Participants, in Part Two of the Study (N=24) in each Severity Group Before and After Reclassification

Number and Percentage of Different Severity of Head Injury Sustained by the Head Injury Group (N=24) Before and After Reclassification

	Light	Mild	Moderate	Severe
Before [1]	15 (63%)	14 (58%)	3 (12%)	1 (4%)
Reclassification	6 (25%)	12 (50%)	5 (21%)	1 (4%)

[1] Does not equal 100% due to multiple head injuries