INCIDENCE, EPIDEMIOLOGY AND OUTCOMES OF MILD TRAUMATIC BRAIN INJURY IN CLIENTS REFERRED TO THE MASSEY UNIVERSITY CONCUSSION CLINIC

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ABSTRACT

The primary objectives of the present study were: (a) to gain a comprehensive understanding of the epidemiological and demographic variables associated with Mild Traumatic Brain Injury in New Zealand, (b) to investigate the relationship between history of head injury and risk and recovery from future head injuries, (c) to investigate the outcomes of assessment and treatment after Concussion Clinic attendance, and (d) to evaluate the quality of service provided by the Massey University Concussion Clinic.

Data was gained in two stages which involved firstly a review of the cover sheets of clients referred to the Concussion Clinic and secondly, the circulation of a questionnaire and a standardised measure of client satisfaction with services (the Service Satisfaction Survey – 30).

Results indicated that the epidemiological and demographic variables associated with concussion found in our New Zealand sample mirror those trends identified in the international literature. With regards to evaluation of the Concussion Clinic, clients were generally satisfied with the services they received. However, clients did identify some aspects of the service which could be improved.

This study demonstrated the need for an increase in the amount of available literature concerning the incidence and outcomes of Mild Traumatic Brain Injury in New Zealand. It also reinforced the need for ongoing evaluation as means of monitoring service delivery and client satisfaction in health care settings.

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CHAPTER 1:

INTRODUCTION

Traumatic Brain Injury (TBI) is a disorder of major public health significance, affecting some 30,000 New Zealanders each year. Approximately 170 individuals are hospitilised with head injuries every week and many more are concussed or have mild head injuries (Head Injury Society of New Zealand, 2004). The worldwide economic and societal burden caused by brain injuries each year is alarming. In the United States alone, the direct and indirect economic impact of brain disorders has been estimated to be over 400 billion dollars (Murdoch & Thoedoros, 2001).

Outcomes of TBI are variable depending on numerous pre-existing factors, etiological aspects of the injury and rehabilitation. Clearly though, the consequences of TBI can be lifelong and devastating for their victims and their victims' family and friends, especially if the injuries go untreated. For individuals with persisting problems after even mild brain injury, the effects of the injury can result in a permanent, if mild, reduction of an individual's preinjury potential (Raymond & Bennett, 1999)

The majority of TBI is classified as 'mild' in nature with concussion, although commonly under-diagnosed, being one of the most common forms of neurological injury (Maroon, 1999; McCrory, 2001). The neuropsychological consequences of concussion can cause major upheavals to one's daily functioning. Several predisposing risk factors for concussion have been identified but most of the literature on this and the prevalence and outcome of concussion comes from American studies. Little is known about the extent to which there are differences in epidemiological data between New Zealand and overseas research. The current study sought to examine the epidemiology of concussion in a sample of New Zealand victims of Mild Traumatic Brain Injury (MTBI). The study further aimed to examine the relationship between these factors and the outcome of these injuries.

The role of education and rehabilitation are important to the outcome of MTBI. In 2000, the Accident and Compensation Corporation (ACC) became aware of the need for rehabilitation services for those who had suffered varying degrees of MTBI. Subsequent to this realization, ACC instigated their Mild Traumatic Brain Injury Services (Concussion Clinic) plan. This

resulted in the opening of nine nation-wide ACC funded Concussion Clinics which provide neurological/neuropsychological assessments and interventions for clients who are suffering from or, who are likely to suffer from, the effects of MTBI. One such clinic is the Massey University Concussion Clinic in Palmerston North

Client satisfaction at the Massey University Concussion Clinic has previously been examined in a study conducted by Roxanne Leach in 2002. Her results indicated that the majority (70%) of participants were satisfied with the services they received at the clinic (Leach, 2002). However, ongoing evaluation is important to service delivery and consequently, part of the present study is dedicated to investigating client satisfaction with the services provided at the clinic. Such an evaluation would be beneficial to the clinic as a means of monitoring the services they are currently providing and as a tool for guiding change. The need for such an evaluation provided the basis for the second part of the present study which involved the circulation of a client satisfaction questionnaire to all people who had attended the Concussion Clinic between January 2002 and November 2004.

In addition to the client satisfaction questionnaire, a questionnaire about history of head injury, recovery from injury and incidence of persisting symptoms was sent to all clients who were referred to the clinic, regardless of whether or not they actually attended the clinic. This part of the study would enable comparison of recovery between those who attended and those who did not attend the Concussion Clinic.

Given that the Massey University Concussion Clinic services the entire Manawatu region of New Zealand – an area with a population of more than 220,000 - the potential sample was the entire cohort of those sustaining MTBI in that area, thus allowing for a comprehensive view of the topic.

Chapter 2 of this thesis begins by providing the reader with a definition of TBI and the epidemiological factors associated with it. This is followed by a discussion about the classification and neuropsychological sequelae of TBI and aspects of rehabilitation. Chapter 3 goes on to discuss in more detail the prevalence, epidemiology, neuropathophysiology, neuropsychological sequelae and outcome of MTBI. This chapter also includes a discussion about assessment and management of MTBI. Chapter 4 begins by explaining how ACC came to fund the concussion clinics and then goes on to provide more detail about the Massey

University Concussion Clinic. Chapter 5 outlines the objectives of the present study and the hypotheses which were formulated from these. This leads on to chapter 6 which focuses on methodological issues of the present study including: ethical issues, research setting, participants, measures and procedures used. The results in Chapter 7 are presented according to the objectives and hypotheses outlined in Chapter 5. Chapter 8 provides a discussion of the results, how these relate to the objectives of the study and some recommendations for future research.

CHAPTER 2:

TRAUMATIC BRAIN INJURY

"No head injury is too trivial to ignore" (Hippocrates, 460-377 BC)

The material on Traumatic Brain Injury (TBI) will be presented in two chapters.

The current chapter provides an overview of TBI in general (i.e., covering all degrees of severity). This overview begins with a definition of TBI and is followed by a detailed discussion of: relevant epidemiological factors, issues surrounding classification of TBI, identified neuropsychological sequelae and rehabilitation issues.

This will lead into a more comprehensive discussion of mild traumatic brain injury, concussion and related complications in Chapter 3.

Definition:

TBI may be broadly defined as an insult to the brain, not of a degenerative or congenital nature, but rather, a brain injury which is due to an externally inflicted trauma which may produce a diminished or altered state of consciousness and which may result in significant impairment of an individual's physical, cognitive, and psychosocial functioning (The National Head Injury Foundation 1985, cited in Rose & Johnson, 1996; National Institutes of Health Consensus [NIHC] Statement, 1998). According to this definition, TBI does not encompass those injuries which are caused by non-external forces, for example other neurological conditions such as: tumors, cerebro-vascular accidents, demyelinating conditions (e.g., multiple sclerosis), degenerative brain diseases (e.g., Parkinson's disease) and infectious disorders (e.g., encephalitis).

TBI is a disorder of major public health significance and the consequences of TBI can be devastating and lifelong (NIHC Conference Statement, 1998).

Epidemiology:

According to the majority of reports found in the literature, the annual incidence of TBI in Western countries is estimated to be around 200/100,000 (Murdoch & Thoedoros, 2001). In New Zealand, TBI is reported by 9,000 people each year (225/100,000) (ACC, 2004). However, as many cases of TBI go untreated or are seen in non-hospital settings (particularly those considered 'mild' in nature), the figures are more likely to be closer to 30,000 (Head Injury Society of New Zealand, 2004).

Males have a much higher incidence of TBI across the age span, with reported male to female ratios of 3:1 (Wong, Dornan, Schentag, Ip & Keating, 1993). The male to female ratio is even greater during childhood and adolescence with rates increasing for males between the ages of 5 and 15 years, but decreasing for females over the same period (Kraus, 1984, cited in Teeter & Semrud-Clikeman, 1997).

TBI affects people of all ages in a trimodal distribution: children: young adults: and the elderly and is the leading cause of long-term disability among children and young adults (NIHC Statement, 1998). ACC injury statistics indicate that the highest incidence of head injury occurs in the 15-19 year old age group, followed by the 20-24 year old age group (for both males and females). Figure 2.1 below illustrates the age spread for both males and females of the 2,476 head claims submitted to ACC in 2004 (ACC, 2004).

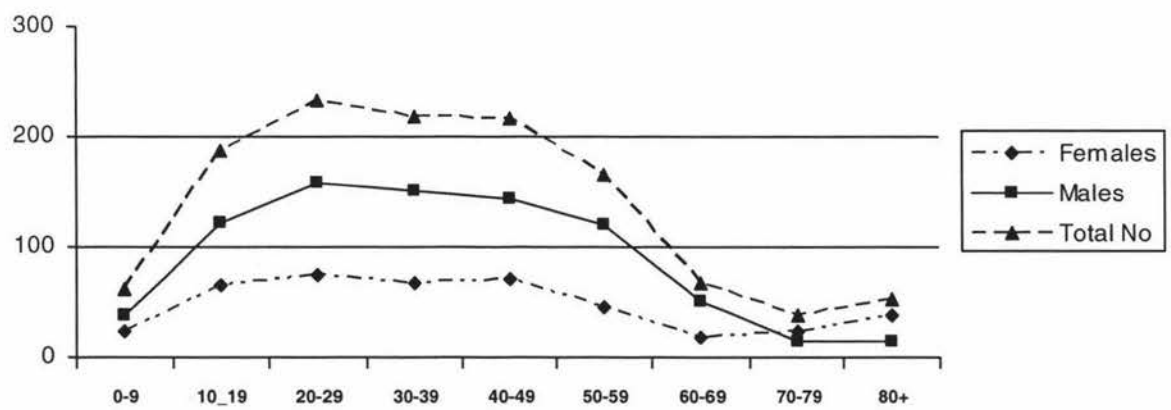

Fig 2.1: Line graph showing incidence of head injury claims to ACC as a function of age in New Zealand in 2004.

In adult populations, motor vehicle accidents (MVA's) i.e., motor vehicle, motorbike and pedestrian-vehicle accidents are the single most common cause of TBI (Naugle, 1990). Other leading causes of TBI include: falls (20-25%), sporting and recreational accidents (10-15%), assault (10-15%) and industrial accidents (Kraus & Nourjah, 1989; Murdoch & Theodoros, 2001). The main causes for TBI in adolescents and older children appears to be motor vehicle accidents, falls for the 6-12 year old age group, home accidents for pre-schoolers and child abuse for infants (Teeter & Semrud-Clikeman, 1997). New Zealand head injury statistics follow this general trend. Table 2.2.below shows 'activity before injury' as percentages of the total 2,476 head claims submitted to ACC last year. Most incidences of TBI are unintentional. In 1994, the New Jersey Department of Health and Senior Services conducted a surveillance study on the incidence of TBI. They found that according to intent, 85.4% of TBIs were classified as unintentional, 11.0% involved homicides/assaults; 1.9% involved suicide/self-inflicted injuries; and 1.8% were of other or unknown intent.

Table 2.1 ACC 2003/2004 'head claims' injury statistics showing percentage of activities that claimants were engaged in immediately prior to injury

Activity before Injury	Number	Percentage
Driving/Riding/ Travelling as a passenger	486	19.63
Fighting	84	3.39
Recreational/Sporting Activities	227	9.17
Walking/Running	269	10.86
Ascending/Descending	34	1.37
Other	1115	45.03
Unknown	263	10.62

There is some controversy surrounding the relationship between ethnicity and risk of TBI. Some studies (e.g., Kraus, et al 1984) have found no correlation between TBI and ethnicity. Others, however (e.g., Barnfield & Leathem, 1998) have found that there is a strong relationship between ethnicity and incidence of TBI. The table below shows the percentage of ACC head claims in New Zealand for the 2003/2004 period as a function of ethnicity.

Table 2.2 ACC 2003/2004 'head claims' injury statistics for ethnicity.

Ethnicity	Percentage of Total Head Claims
NZ Maori	12
Pacific Island	4
Pakeha/European	66
Other	5
Unknown	13
Total	**100**

The ACC data reflect the current population statistics in New Zealand where Pakeha/European represent the majority of the population, followed by Maori who constitute approximately 15% of the total population, people of Asian origin (6.6%) and Pacific Peoples (6.25%) (Statistics New Zealand, 2004).

Past history of head injury is also a major risk factor for TBI. After an initial brain injury, the risk of another injury is increased by about 4-6 times (Kelly & Rosenberg, 1997). Prior history of concussion therefore places an individual at significantly higher risk for sustaining future concussions (Echemendia, Rosenbaum, Bailey, 2003). Similarly, low socio-economic status (SES) has repeatedly been reported in the literature as a risk factor for TBI. Morse & Montgomery (1992) found that 75% of people who suffer a TBI come from low SES groups with an income of less than US$10,000 per annum. In addition, alcohol is reported to be associated with 50% of all TBI, either in the person causing the injury or in the person with the injury (Naugle, 1990). Dikmen, Donovan, Loberg, Machamer & Temkin (1993) went so far as to say that alcohol use was the most commonly cited predisposing factor in head trauma incidence.

Classification:

The type, nature and consequences of TBI vary to a large degree depending on a number of factors such as: the severity and location of the injury, the etiology of the injury, various premorbid factors and the patient's age at injury.

There are a number of ways in which TBI can be classified including: type of injury, severity and neuropathophysiology (Teasdale, 1995).

Type of Injury:

The type of injury may be broadly classified as either open or closed, depending on whether or not the integrity of the skull has been breached (Lucas, 1998). Strictly speaking, a **closed head injury** (or non-penetrating injury) is an injury to the head that does not expose the contents of the skull and there is no penetrating injury to the brain. In a closed head injury (CHI), the primary mechanism of damage is one of blunt impact (Richardson, 2000), compression or acceleration or deceleration forces. These forces cause distortions within the brain and result in the stretching or shearing of nerve fibres which subsequently leads to diffuse axonal injury (Gennarelli, 1986). Closed head injuries tend to be associated with diffuse brain pathology and account for the vast majority of all head injuries sustained (Murdoch & Theodoros, 2001). CHIs are further complicated by the occurrence of '*contrecoup injuries*' where damage to the brain occurs on the side opposite to that of the point of impact (Lucas, 1998) and may lead to acute or chronic haematomas.

Such injuries may be distinguished from **open head injuries** (or penetrating injury) in which the dura mater is torn and the contents of the skull exposed. Examples of penetrating head injuries include missile wounds. Such injuries tend to be more focal in nature than CHIs (Kolb & Whishaw, 1996) and account for the majority of fatalities following head trauma (Lucas, 1998). Although the open versus closed distinction is useful, its value is limited by the fact that the patterns of neurological deficit and associated neuropsychological consequences which they provoke can be relatively similar (Richardson, 2000).

Severity:

Brain injury can be further classified, or rather, quantified according to level of severity. Classification of severity has implications for management (especially in the acute stage), potential for recovery and the relationship between the injury and subsequent sequelae (Teasdale, 1995; Malec, 1999). TBI embraces all degrees of severity which exists along a broad continuum both clinically and pathophysiologically, from an apparently symptom-less blow to the head to irreversible traumatic brain damage (Levin, Eisenberg & Benton 1989;

McAllister, 1995) i.e., from mild, moderate through to severe. Greater severity of injury is associated with greater impairment. Mortality and morbidity rates for victims of moderate-severe TBI are therefore proportionately higher than for those who have suffered more 'mild' injuries (Barnfield & Leathem, 1998).

Commonly used indices of TBI severity including loss of consciousness (LOC), depth of coma and length of post-traumatic amnesia (PTA) are discussed below. Severity of injury typically increases in proportion to the duration of LOC and PTA (Kibby & Long, 1999).

LOC refers to the amount of time it takes for a person to regain consciousness after injury. The most commonly used measure of LOC and depth of coma is the Glasgow Coma Scale (GCS). The GCS, developed by Teasdale and Jennett in 1974, was designed to establish severity of injury and level of consciousness on the basis of eye opening, verbal and motor response (Levin et. al, 1989). A patient's responsiveness in these three areas results in a score out of 15 (Oddy & Alcott, 1996). Any score between 13 and 15 is considered to be mild, scores between 9 and 12 indicate moderate TBI and scores below 9 are classified as severe (Lucas, 1998).

PTA refers to a disturbance of memory for a period of time following the trauma until the return of a continuous memory thread (Gronwall, 1991). The Galveston Orientation and Amnesia Test (GOAT) measures the extent to which a patient is oriented to person, time and place and the extent to which they are amnesic for recent events. It is a measure of PTA which is a widely accepted index of severity in later stages of injury (Teasdale, 1995). PTA is considered mild if the duration is less than one hour, moderate if 1-24 hours, severe if 1-7 days and very severe if 1-4 weeks. The Westmead PTA Scale is another commonly used measure of PTA (Marosszeki, Ryan, Shores, Batchelor & Marosszeki, 1997). Table 2.3 below indicates how LOC, GCS and PTA are used together to indicate severity.

Table 2.3 Classification System for Measuring Severity of Traumatic Brain Injury

Severity	Duration of LOC	GCS	PTA
Mild Injury	1-30 minutes	13-15	<1 hour
Moderate Injury	> 30 minutes < 6 hours	9-12	1-24 hours
Severe Injury	> 6 hours	3-8	>24 hours

Source: Lucas, 1998; McAllister, 1999; Mateer & D'arcy 2000; Newton 2003.

Neuropathophysiology:

Brain injuries can also be described according to the neuropathophysiological effects of the trauma. The principal classification here involves differentiating between focal and diffuse lesions and primary and secondary injuries (Murdoch & Theodoros, 2001).

It is now recognized that for many people, not all of the damage occurs at the time of initial injury (Graham, 1995). Damage may be caused by direct physical injury to the brain as well as from secondary factors. The effects of head injury typically occur as a result of two processes or stages of development – primary and secondary injury. The **primary injury** is the direct result of the penetrating or impact forces which occur at the time of trauma (Smith, 1996). Injuries may be focal e.g., contusions, lacerations, basal ganglia hemorrhage and cranial nerve lesions or diffuse e.g., diffuse axonal injury (DAI) (Murdoch & Theodoros, 2001). Whilst the primary injury is usually focal and time limited in nature, it sets in motion a series of physiological and metabolic processes. These are in turn aggravated by a number of factors and may produce **secondary effects** which are often as damaging to the brain, if not more so, and which further complicate outcome (Lucas, 1998; Smith, 1996).

These secondary effects result from intracranial and extracranial complications initiated at the moment of injury, but they may not be seen clinically for a period of time following the initial injury. Examples of secondary focal effects include hematoma (extradural, subdural and intracranial) and secondary diffuse effects include: cerebral edema, raised intracranial pressure, ischemia, cerebral atrophy and ventricular enlargement (Graham, 1995).

Although some secondary effects invariably occur (such as edema), others may or may not develop. The outcome here depends on the nature, location and extent of the primary injury (Lucas, 1998). "No intervention can attenuate primary brain injury but secondary injury is preventable in many cases" (Smith, 1996, pp. 21). There are a number of so-called 'avoidable factors' which early intervention should be aimed at to avoid the appearance of secondary injuries. These 'avoidable factors' include: lack of oxygen (hypoxia), low blood pressure (hypotension), expanding intracranial blood clots, raised intracranial pressure and infection (Miller et al., 1978, cited in Smith, 1996; King, 1997). TBI, therefore, is a dynamic process, evolving not only in the immediate hours and days following the injury, but continuing over the course of weeks and even months (Lucas, 1998).

Neuropsychological Sequelae:

The neuropsychological sequelae which accompanies TBI depends on the severity and etiology of the injury. The discussion below gives a brief and broad explanation of this sequelae. The sequelae associated with more mild brain injuries will be developed in the following chapter.

The symptoms and consequences of TBI are not usually restricted to one aspect of a person's functioning. Rather, TBI may have a profound impact on all areas of an individual's life form altered physiologic function of cells, through neurological and psychological impairments to medical problems and disabilities, affecting both the individual and their interpersonal relationships. Although TBI may result in physical impairment, the more problematic consequences usually involve the individual's cognition, emotional functioning, and behaviour (Uzzell, 1999).

The most frequently reported cognitive deficits following TBI include: impaired attention and concentration, memory, learning, speed of information processing, communication and other 'executive' functions (Prigatano, 1986; Morse & Montgomery, 1992; Shum, Fleming & Neulinger, 2002). Behavioural disturbances common after TBI can be grouped into two main categories: (a) disinhibition, whereby the patient loses control over action and emotions (examples include: impulsivity, aggression, agitation, inappropriate social, verbal, and/or sexual behaviour and amount of emotional output) and (b) initiation deficits, whereby the patient has difficulty initiating action or emotion (Uomoto, 2000). Shallow self-awareness, mood disorders (such as depression and anxiety) and personality changes are also common after TBI (NIHC Statement 1998). However, it is important to remember that brain injury affects every individual differently. See Table 2.4 for a list of the sequelae which typically accompanies TBI.

The neuropsychological sequelae of brain injury acquired early in life is both quantitatively and qualitatively different from injuries acquired in adulthood. Therefore age at time of injury is another factor to take into account when considering the neuropsychological consequences of TBI. It was previously thought that children's brains were much less susceptible to damage as they possessed a great amount of functional plasticity (Anderson,

Table 2.4 Sequelae of Traumatic Brain Injury

Neurophysical Sequelae:

Aneurysm
Arachnoid/leptomenigeal cysts
Arteriovenous malformations (including carotid/cavernous sinus fistula)
Cerebrospinal fluid leak
Compressive neuropathies
Headache
Motor impairment (spasticity, weakness, ataxia)
Movement disorders
Neuroendocrine dysfunction
Seizures
Sensory dysfunction
Subdural hygroma
Ventricular enlargement (hydrocephalus)

Cognitive Sequelae:

Decreased speed of information processing
Executive dysfunction
Impaired attention and concentration
Impairment of visual-spatial skills
Intellectual decline
Language dysfunction
Memory impairment and amnesia

Neurobehavioural Sequelae:

Aggression	Hysteria
Agitation	Mania
Anxiety	Mood Disorder
Apathy	Psychosis
Depression	Sexual Dysfunction
Disinhibition/poor impulse control	Violence
Emotional lability	Withdrawal
Hostility	

Source: Report to the Consensus Development Panel on the Rehabilitation of Persons with Traumatic Brain Injury (1998)

Northam, Hendy & Wrennall, 2001). Views such as this are reflected by the Kennard Principle which states that 'if you're going to have brain damage, have it early'. Although children may have a certain degree of functional plasticity, extreme claims on the issue are no

longer substantiated in the research. Contemporary models of cognitive development suggest that there are 'critical periods' attached to the development of specific cognitive domains (Anderson et. al, 2001). Kolb and Whishaw (1996) indicate that there are three critical age divisions influencing the loss of function and outcome of the injury. These are: less than 1 year of age; between 1 and 5 years of age; and more than 5 years of age. Injury acquired before the age of 1 usually results in more significant impairment compared to later injuries, injuries sustained between 1 and 5 years often results in reorganization of functions and recovery of language ability and injury after 5 results more significant loss of function. Other pre-injury characteristics which can also heavily influence outcome include: cognitive functioning and personality, alcohol use and neuropsychiatric history (Dikmen et. al, 1993). This is a two-way relationship whereby such characteristics may exacerbate the effects of a TBI and vice versa (Fisher, 2004).

Assessment:

Assessment of TBI comes from both physical and neuropsychological perspectives. A medical diagnostic evaluation of the head-injured patient may involve the use of brain imaging techniques and scans (Graham, 1995). Some of the more frequently used scans include: (a) Electroencephalography (EEG) – which measures the brain's level of electrical activity whilst it is processing information, resulting in a quantifiable measure of gross brain activity and function (Davidson, 1998), (b) Computerized Axial Tomography (CT) – which uses x-rays to provide a structural image of the brain, (c) Positron Emission Tomography (PET) - .a brain imaging technique which provides a measure of brain function by measuring the brain's oxygen consumption, blood flow and glucose metabolism (Martin, 1997), and (d) Functional Magnetic Resonance Imaging (fMRI) – which requires a magnetic field to pass through the patient's head and then measures the changes in the magnetic properties of: atoms, oxygen, blood flow, cerebro-spinal fluid (CSF) or diffusion of water through tissue (Cohen & Bookheimer, 1994) to produce clear, detailed images of brain functioning.
Neuropsychological assessment of TBI includes a comprehensive client interview, the use of psychometric measures to assess functioning across the cognitive domains, self report and observation.

Recovery:

Recovery from TBI is variable and the specific mechanisms underlying recovery of functions are not yet fully understood.

Similarly to the neuropathophysiology of TBI, recovery from these injuries occurs in two stages (Smith, 1996). The **first stage of recovery** is concerned with the acute effects of the injury (i.e., the effects of metabolic and membrane failure, ionic and transmitter imbalance, hemorrhage and edema). During this stage of recovery, medical and pharmacological interventions dominate treatment choices. The **second stage of recovery** takes place months or years after the injury and during this time a significant amount of physiological and functional recovery occurs, probably resulting from intact structures compensating for functional loss caused by the trauma (Kertesz & Gold, 2000).

Furthermore, recovery from TBI is more heterogenous than recovery from vascular insults such as strokes due to the variability of the trauma (Kertesz & Gold, 2000). The type of TBI (i.e., whether it is an open or closed head injury), the site of lesion and the severity of the injury all affect the rate and extent of recovery, whereas vascular insults typically follow a more predictable path of recovery.

Finally, there is evidence that the neurologic picture in children who have suffered TBI is different from that found in adults, especially in terms of initial severity and the possibility of delayed complications such as post-traumatic seizures (Goethe & Levin, 1986).

Rehabilitation:

TBI rehabilitation in general should be understood as "an *approach* to meeting the specific needs of the individual client" (ACC, 1998, pp. 17). It is often a slow and continuous process that adapts to the ever-changing needs of both the individual and their family. Rehabilitation involves preventing/minimising secondary impairments, assessment, planning, implementation and evaluation.

The first step in rehabilitation after TBI is a comprehensive assessment, focusing on the identification of the individual's strengths and weaknesses which paves the way for treatment planning and implementation. Neuropsychological assessment here is invaluable as it is concerned with the evaluation of several major domains of functioning, including: (a) general neuropsychological functioning, (b) sensory motor integrity, (c) attention and concentration, (d) verbal and visual-spatial memory, (e) visual-perceptual abilities, (f) language and communication skills, (g) executive functioning, and (h) general cognitive flexibility and efficiency (Uomoto, 2000).

Rehabilitation planning involves identification of realistic goals and objectives, identified through assessment and collaboration with the individual and their family. Planning includes careful attention to timing of interventions, consideration of how to assess/monitor progress and the prioritization of problems to be addressed and interventions to be used (ACC, 1998).

Implementation of rehabilitation programmes will follow from the assessment and planning phases. Rehabilitation programmes for persons with TBI typically involve professionals from multiple disciplines, using a variety of interventions, e.g., cognitive-behavioural remediation, cognitive rehabilitation, pharmacologic management, assistive technology, environmental manipulation, education, and counseling are among currently used treatments for TBI (Mateer & D'arcy, 2000).

Remediation here focuses on enhancing and improving the person's ability to function and may focus towards 'restorative training' (aimed at improving specific cognitive functions) and/or 'compensatory training' (aimed at teaching people to adapt to cognitive deficits) are techniques common to these treatment programmes. (NIHC Statement, 1998). Cicerone & Fraser (2000) note that among cognitive behavioural interventions for TBI, some of the most common focuses include: (a) learning and acquisition of new job skills, (b) error recognition and correction, (c) sustained attention and resistance to distraction, (d) problem solving and organization, and (e) social judgment and communication. Regardless of the intervention used, the primary focus should be on functional outcome.

Programme evaluation is also an important facet of TBI rehabilitation which ensures that the interventions are successful at both the individual and the programme level (ACC, 1998).

In New Zealand there are a number of residential and out-patient rehabilitation facilities for sufferers of TBI with varying degrees of disability. Ranworth Health Care and Cavit ABI for example provide such services for victims of moderate to severe brain injury where multi-disciplinary teams of specialists (including: neuropsychologists, clinical psychologists, occupational therapists, psychiatrists, physiotherapists and speech and language therapists) work together to provide individualized treatment packages for people with moderate to severe brain injury.

Rehabilitation from more mild head injuries is generally of shorter duration and more symptom-focused. This will be discussed in more detail in the following chapter.

Summary:

Epidemiological data demonstrate that the direct and indirect economic impact of brain injury is a major concern of public health, possibly affecting up to 30,000 New Zealanders each year. More importantly, but not so clearly quantifiable, is the toll that brain injuries extract in terms of human suffering from victims and the impact on their families (Murdoch & Thoedoros, 2001).

This chapter has reviewed the epidemiology, classification, neuropsychological sequelae, assessment, recovery and the rehabilitation process for people who have suffered TBI of all degrees of severity. The following chapter will focus on the incidence, outcome and rehabilitation of Mild Traumatic Brain Injury (MTBI).

CHAPTER 3:

MILD TRAUMATIC BRAIN INJURY, CONCUSSION & POST CONCUSSIVE SYNDROME

"Quite clearly, mild head injury is not always a mild experience" (King, 2003, pp. 276).

The present chapter focuses on Mild Traumatic Brain Injury, (MTBI) a specific component of TBI. Any discussion about brain injury opens up a minefield of confusion surrounding definitions, classification and clinical profiles. This is particularly true in the case of MTBI which is often used interchangeably with 'mild head injury', and 'concussion'. Although these disorders do overlap to an extent in terms of symptomology and outcome, they will be treated separately in the present chapter which begins with an overview and respective definitions of MTBI, Concussion and Post Concussive Syndrome. This is followed by a discussion of the epidemiology, neuropathophysiology, neuropsychological sequelae, assessment and management and outcome issues of the three conditions.

Definitions:

Mild Traumatic Brain Injury:

Mild Traumatic Brain Injury (MTBI) is one of the most common neurologic disorders (National Center for Injury Prevention and Control [NCIPC], 2003). There are obstacles however to the gathering of data and research on the incidence and outcome of MTBI. One is the lack of a uniformly recognized definition (Ruff & Jurica, 1999; NCIP, 2003) and the other is the lack of an internationally accepted classification of its consequences (Greenwood, 1999).

MTBI has been defined by the Mild Traumatic Brain Injury Committee as:

> ...a traumatically induced physiological disruption of brain functions as manifested by *at least* one of the following: (1) any period of loss of consciousness (LOC) of 30 minutes or less; (2) any loss of memory (no longer than 24 hours) for events immediately before or after the accident; (3) any alterations in mental state at the time of the accident (i.e. feeling dazed, disoriented or confused); or (4) focal neurological deficits that may or may not be transient (Kay et al., 1993; p. 86)

In addition, a GCS at the time of initial assessment must be no less than 13 and presenting problems must not be attributable to any pre-existing medical condition or psychological disorder or due to alcohol intoxication (Alexander, 1995).

The term *'mild'* itself is misleading as the symptomology of such injuries can be severe and ongoing (Bigler & Clement, 1997; Gronwall & Wrightson, 1999). Symptoms typically develop in the 24 hour period following the injury and whilst many people who sustain a MTBI will only manifest transient symptoms (Raymond & Bennett, 1999), there is a possibility that they may experience persistent and disabling problems (Kushner, 1998). Malec (1999) estimates that between 20 and 25% of individuals who sustain a MTBI will have residual symptoms or disability. Further, Carr (1993) notes that between 5 and 10% of people who suffer MTBI are unable to maintain their pre-injury performance level.

Concussion:

The term 'concussion' is derived from the Latin *'concussis'* which means to shake violently (Cantu, 2001). "Concussion is probably the most familiar and least feared of all types of head injury" (Gronwall & Sampson, 1974, pp. 13).

Unfortunately, concussion also lacks a specific, universally accepted definition (Bowen, 2003). However, it is generally appreciated as representing the transient symptoms of MTBI with its clinical features reflecting a functional neuronal disturbance (McCrory & Berkovic, 2001). Put more simply, concussion may be defined as a traumatically induced alteration in mental status with or without loss of consciousness (Bailes, 1999; Kelly & Rosenberg, 1997). Concussion has traditionally been identified as a transient loss of consciousness (LOC) or experience of post-traumatic amnesia (PTA) following trauma which does not result in permanent damage to the brain (Gronwall, 1989; Richardson, 2000). Therefore, experience of LOC and length of PTA have dominated the grading schemes of concussion whilst the presence of other signs and symptoms of concussion have traditionally been downplayed (Cantu, 2001). However, clinical research and experience indicates that concussion may be experienced without LOC. (Fisher 1996, cited in McCrea et. al, 2002) noted that confusion and amnesia were in fact the hallmarks of concussion.

Due to the similar clinical profiles of MTBI and concussion, these two terms have historically been used interchangeably. The primary distinguishing factor is that the effects of concussion occur immediately after injury and are transient whereas the damage incurred after a MTBI may develop later and last longer (Esselman & Uomoto, 1995).

Whilst concussion is often regarded as the 'most mild' form of head injury, and is therefore frequently disregarded as not posing any real threat , it is important to remember that in any head trauma sufficient to cause alterations in consciousness, neurological impairment, or cognitive deficits, an injury to the brain should be assumed (Lucas, 1998).

Post Concussion Syndrome:

Generally speaking, the symptomology associated with concussion dissipates over a period of hours, days or weeks. However, in a significant number of cases, complaints will persist for longer periods of time (Dikmen, Temkin & Armsden, 1989). These symptoms can be grouped into three categories: cognitive complaints, somatic complaints and affective complaints (McAllister, 1995).

The term used to describe this persistence of post-injury symptoms (seen subsequent to brain injury of all levels of severity) is **'post-concussion syndrome'** (PCS) (McAllister, 1995). Although the term 'syndrome' is used, which implies a consistent constellation of symptoms, the persistence of any single self-reported symptom is generally regarded as sufficient to warrant a diagnosis of PCS (Gasquoine, 1997). Consequently, some clinicians treat PCS as a syndrome, whereas others treat each symptom as an individual entity (King, 1999).

No single 'cause' of PCS has been established, although a number of theories have been put forward. Van Zomeren & Van den Burg (1985) posited that the development of PCS is due to the chronic effort required by patients to cope with persisting information processing deficits.

Prevalence and Epidemiology:

Mild Traumatic Brain Injury:

Most brain injury falls into the mild category, with up to 80% of all reported adult TBI cases and 90% of all child TBI cases being classified as 'mild' (NCIPC, 2003; Gomez, Lobato, Ortega & De La Cruz, 1996; Snoek, 1989; Raymond & Bennett, 1999). Data indicate that MTBI is a major concern to public health both in New Zealand and worldwide. However, prevalence rates of MTBI are impossible to calculate accurately, primarily due to the fact that treatment is often in non-hospital medical settings and therefore not included in official figures or not reported at all as the potential for harm caused by MTBI is under-recognised (Alexander, 1995). Sosin, Sniezek and Thurman (1996) found that in one year, 25% of the 1.5 million TBI's sustained did not receive medical care. Furthermore, detection of MTBI may be obscured by other injuries (Newton, 2003). The size of the problem is underscored by the fact that it is estimated that 1.3 million MTBIs occur each year in the United States (Kay, 1993).

The prevalence of MTBI mirrors that of TBI in general. The peak incidence is among 15-24 year olds (Raymond & Bennett, 1999), especially males. MVAs account for the vast majority (up to 42%) of all MTBIs (Kraus & Nourjah, 1989), followed by falls, especially in children under 10 years of age and people over 65 (Luersen, 1988, cited in McAllister, 1995).

Concussion:

In 2001, there were 14,255 thousand concussions reported in New Zealand (Ranworth Health Care Statistics, 2001). Such figures however must be treated with caution due to possible inconsistencies in the distinction and classification of these types of injuries. MTBI, concussion and PCS often share similar clinical profiles, thus resulting in a possible overlap in statistical figures of the three conditions.

Risk factors and trends for concussion mirror those for MTBI. History of concussion in particular is a high risk factor for future injury. Zemper (2003) conducted a two-year prospective study on 15,304 football players, measuring the relative risk of cerebral concussion among those with a history of concussion (n=975) compared to those with no previous history (n= 14329). His results showed that 16.5% of the 572 concussions recorded

during the study were sustained by those with a history, compared to 2.9 %of those with no history, indicating that the relative risk of concussion for those with a previous history is 5.8 times greater than that for people with no history.

Post-Concussive Syndrome:

For many patients, the symptoms associated with concussion will resolve over the 3 months following injury (King, 2003), however, a significant number of people continue to report symptoms at 3, 6 or 12 months post-injury and beyond (Raymond & Bennett 1999). PCS has been estimated to affect 50-8-% of individuals with MTBI at 3 months post-injury (Ferguson, Mittenberg, Barone & Schneider, 1999) and Binder (1997) estimates that approximately 8% of MTBI patients will still have significant PCS symptoms at 1 year post-injury.

A number of factors are associated with the presence of 'late symptoms'. These include: sex, age, length of post-traumatic amnesia and history of previous head injury. There is a statistically significant positive correlation with being female and the presence of late onset (PCS) symptoms (Rutherford, 1989). The occurrence of late onset symptoms is also more common in people aged 40 years and over. It is reasonable to assume that older people will be more affected by head injury than younger people due to the natural progressive loss of brain tissue that occurs with advancing age (Gronwall, 1989). Higher symptom rates are also associated with longer periods of PTA (Rutherford, 1989).

Finally, Gronwall (1989) notes that when neuropsychological scores on tests of cognitive functioning (such as the Paced Auditory Serial Addition Task [PASAT]) are used as a point of comparison between groups of patients with no previous head injury and those who have experienced TBI, the latter are shown to be more severely affected and take longer to recover.

Neuropathophysiology:

Mild Traumatic Brain Injury:

Magnetic Resonance Imaging (MRI) indicates that the majority of MTBI lesions are localized to the frontal and temporal regions (Levin et. al, 1987, cited in Mateer & D'arcy, 2000).

In addition to such focal changes, there is also evidence to suggest diffuse axonal injury (DAI) throughout the brain following TBI of all severities (Oppenheimer, 1968). DAI is due to gradients of stress within the brain after experience of acceleration/deceleration forces. The poor anchoring of the brain in the skull and its soft consistency renders it liable to move in response to rapid acceleration or deceleration and has even been shown to result from injuries with LOC of <5 minutes (Adams, Graham & Murray, 1982). In such injuries, distortion of the brain, caused by internal shearing forces, leads to the stretching and tearing of axonal tracts within the white matter. This damage is widespread in severe injuries, causing approximately 35% of all deaths after brain injury (Graham, 1995). Traumatic axonal injury and dysfunction are determined by the amount of axonal stretch and can be categorized into four distinct stages (Gennarelli, 1986), including (1) nodal membrane injury, (2) reversible cytoskeletal damage, (3) secondary axotomy, and (4) primary axotomy. In cases of MTBI, mild stretch injury is responsible for the transient disturbances of consciousness so commonly found in concussion (Smith, 1996).

Neurochemical changes in the brain can also result in DAI (Newton, 2003). Immediately after injury, there is a depolarization, resulting in an influx of sodium and calcium ions, extracellular potassium ions and various neurotransmitters (including glutamate, acetylcholine, serotonin and dopamine) which can lead to cell death, especially in sensitive areas of the brain - for example, the hippocampi (Wrightson & Gronwall, 1999). These ionic fluxes may subsequently lead to an increase in glucose metabolism (Hovda, Prins, Becker, Lee, Bergsneider & Martin, 1999).

TBI also affects cerebral blood flow. The literature on experimental brain injury (which derives much of its findings from studies on animals, in particular, rats) consistently shows that cerebral blood flow is significantly reduced immediately after injury (Hovda et. al, 1999).

Furthermore, there is a small possibility that the effects of even mild head injuries will be further exacerbated by neurological complications that may require neurosurgical intervention. These can be divided into three broad categories based on their time of onset (Benes, 2001). **Immediate complications** (which usually dominate over the actual concussion, such as: injury to the integrity of the skull, arteries or cranial nerves), **early complications** (in which symptomology will develop in the hours or days following injury such as haematomas) and

late complications (where symptomology develops over weeks or months following the initial injury such as: chronic subdural haematoma and delayed symptoms of a skull base fracture [e.g., pneumocephalus]). Gomez et al., (1996) note that older patients are at significantly higher risk of neurological and medical complications post-injury. Although these complications are rare, they are dangerous and should always be considered when assessing a patient who has suffered a cerebral concussion (Benes, 2001; Dacey, 1989).

Concussion:

Most commonly, concussion is due to a functional rather than structural lesion (McCrory (b), 2001). It has, therefore, traditionally been assumed that the disturbance of brain function caused by concussion was only temporary and completely reversible (Bernstein, 1999). However, it is now widely accepted that structural damage associated with the loss of brain cells does occur with some concussions and that in the minutes and days immediately following a concussive injury, brain cells that are not irreversibly damaged remain in a vulnerable state produced by metabolic dysfunction and are highly susceptible to minor changes in intracranial pressure and cerebral blood flow (Cantu, 2001; Bowen, 2003).

The pathophysiology of concussion remains a contentious issue (McCrory, 2001) but it is now clear that concussive injuries can cause considerable, persisting problems.

Neuropsychological Sequelae:

Mild Traumatic Brain Injury:

There are a variety of functional, cognitive and behavioural deficits which commonly follow MTBI. Whilst there may be some physical evidence of injury (such as fractures, cuts and scars), it is often the cognitive and behavioural changes which are more troublesome to the victim of MTBI than any physical manifestations (Uzzell, 1999). There also a group of somatic complaints which typically follow MTBI. A full list of sequelae is shown in Table 3.1 below.

Table 3.1: Common Symptoms of Mild Traumatic Brain Injury

Physical	Cognitive	Emotional
-Headache	-Disoreintation	-Depression
-Vertigo	-Memory Problems	-Anxiety
-Diplopia	-Fluctuating Attention/Concentration	-Irritability
-Blurred Vision	-Reduced Insight/Judgment	-Phobic Reaction
-Photophobia	-Poor Abstract Reasoning	-Disinhibition
-Sonophobia	-Slowed Information Processing	-Reduced self-esteem
-Fatigue	-Reduced Reaction Time	-Somatic preoccupation
-Nausea/Vomiting	-Language Difficulties	
	-Impaired Sequential thought processing	

Source: Bennett & Raymond, 1999, pp. 220

Cognitive Deficits. Bigler and Clement (1997) note that even a very mild injury to the head may result in significant damage.

Gronwall and Wrightson (1999) posit that the cognitive deficits seen after MTBI may be due to decreased attentional capacity. In contrast, Baddeley (1998) has speculated that individuals with MTBI have normal processing capacity but have difficulty allocating resources (cited in Berstein, 2002).Either way, attentional and concentration problems and reduced information-processing speed are among the most commonly reported cognitive deficits subsequent to MTBI (Levin, Eisenberg & Benton 1989; Lezak, 1995).

Memory deficits are also common after brain injuries of all levels of severity. In a three-centre study conjointly conducted by the University of California Medical Center, John Sealy Hospital at the University of Texas and the Jacoby Hospital of the Albert Einstein College of Medicine, memory was found to be among the most common deficits associated with MTBI. The study showed that patients tend to demonstrate compromised memory function within one week of injury (cited in Ruff, Levin, Mattis, High, Marshall, Eisenberg & Tabaddor, 1989).

Lucas (1998) cautions that those with MTBI are usually extremely aware of these attention problems and reduced information-processing capacity and as a result may develop emotional and personality changes.

Emotional and Personality Changes. These changes following MTBI have also been well documented in the literature and can be broadly classified as (a) organic personality

changes, and (b) reactive personality changes. **Organic personality changes** result from the brain injury itself and are more common in moderate to severe cases (Bennett & Raymond, 1999). In the majority of instances of CHI, the temporal and frontal lobes are affected (Bennett & Raymond, 1999) and the resulting neurobehavioural patterns reflect the underlying pathology. Personality changes due to damage of the temporal lobe limbic structures include: hyperirritability, angry/aggressive outbursts and sudden onset of dysphoric mood states. Frontal lobe personality changes may take the form of excitability (i.e., impulsivity, emotional lability and mood swings, socially inappropriate behaviour and childishness) or reduced activation (i.e., apathy, lack of interest and emotional blunting) (Lucas, 1998). **Reactive personality changes** (e.g., depression, guilt, anxiety and feelings of helplessness) are also common after brain injury, particularly in cases of mild to moderate severity (Bennett & Raymond, 1999) and it is likely that these reactions are due to the recognition of reduced competencies the patient may be experiencing (Lucas, 1998). Cicerone & Fraser (2000) note that unlike organic personality changes, reactive changes bear no relationship to the severity of injury and that degree of emotional distress and difficulty re-adjusting after injury often increases over time.

Concussion:

Symonds (1962) speculates that it is questionable whether the effects of concussions, however slight, are ever completely reversible.

The classic symptoms of concussion do not usually appear simultaneously, but rather, they develop in stages (Rutherford, 1989). The symptoms associated with concussion can be divided into 2 broad categories: **early symptoms** (which develop immediately after the injury and, with the exception of headache and dizziness, are usually short-lived) and **late symptoms** (which are reported weeks after the injury itself). Figure 3.2 illustrates these symptoms.

Cognitive Deficits. Cognitive impairments are a reliable consequence of mild head injury and concussion (Collie, Maruff, McCrory, Makdissi & Darby, 2001). These authors found that based on results of the CogState (a measure of cognitive function in mildly impaired individuals), the most common cognitive deficit was an increase in reaction time and psycho-motor speed at 2 days post-injury. Similarly, Gronwall & Sampson (1974), based on a series of experiments, came to the same conclusion and went on to hypothesize that this

reduced processing capacity evident immediately after concussion was a result of lowered arousal level. Many people who have suffered a concussion also report memory difficulties, in particular with short term memory capacity (Shum et. al, 2002). The table below shows some well known studies which have focusing on the neuropsychological domains of functioning which may be affected by concussion.

Table 3.2: Early and late symptoms of concussion

Early Symptoms	Late Symptoms
Headache	Headache
Dizziness	Dizziness
Vomiting	Irritability
Nausea	Anxiety
Drowsiness	Depression
Blurred Vision	Poor memory
	Poor concentration
	Sleep disturbance
	Fatigue
	Poor hearing
	Poor vision

Source: Rutherford, 1989; Maroon, 1999.

Emotional Disturbances. Negative mood disturbances such as depression, anxiety and confusion resulting from concussion have been well documented (Bennett & Raymond, 1999; Cicerone, 1999). Researchers at the Centre for Neuro Skills compared pre- and post-concussion emotional profiles of athletes reported a causal link between concussion and subsequent emotional distress and that these observed mood disturbances disappear within weeks following the initial injury. Cicerone (1999) notes that emotional symptoms are thought to influence cognitive functioning and that many patients displaying moderate to severe cognitive complaints will also exhibit emotional complaints.

Table 3.3 Findings of some studies on the neuropsychological effects of concussion.

Function	Author	N	Population	Measures	Results
Information Processing	Bernstein, 2002	23	13 undergraduates with self-reported MHI at least 1 year post-injury and 10 matched controls.	-Cognitive Failures Questionnaire -Post Concussive Symptoms Checklist -Short Neuro-psychological battery (WAIS 3) -4 ERP Oddball tasks -2 CNV tasks	Findings indicate longterm deficits in resource allocation and information processing capacity following MTBI.
Psychomotor Speed	Collie, Maruff, McCrory, Makdissi & Darby, 2001	30	15 footballers who received a concussive injury during one season and 15 matched controls. All had taken a CogState pre-season to be used as a baseline measure	-Digit Symbol Substitution Test (DSST) -Trail Making Test (TMT) -CogState computerized test of cognitive function	-Significant impairments were evident on tests of psychomotor speed at 2 days post-concussion (characterized by increased reaction time). -All impairment had resolved at 14 days post-injury
Attention	Gronwall & Sampson, 1974	40	2 experimental groups of 10 concussed patients (<48 hours of admission) & 2 control groups of 10	-PASAT	-The concussed group performed significantly worse (68% compared to 98% right) than controls.

Post Concussive Syndrome:

Alvers (1993, cited in Gasquoine, 1997) has noted that headache and/or memory loss are generally the most frequently reported post-concussion symptoms. Other classic symptoms include: dizziness, fatigue, irritability, reduced concentration, sleep disturbance, anxiety, blurred or double vision, photosensitivity, hypersensitivity to sound and depression (King, 1999; Rutherford, 1989; Wrightson & Gronwall, 1999; Cullum & Thompson, 1999; Kibby & Long, 1999). Table 3.4 summarises the neuropsychological components of PCS.

MTBI, concussion and PCS share a very similar clinical profile with regards to symptomology and consequently there may be a high degree of overlap in the clinical and research data concerning the three conditions. The primary distinguishing feature is time of onset and duration of symptoms. The neuropsychological consequences of MTBI and concussion may

Table 3.4 Components of the postconcussive syndrome

	% of patients with persistent complaints at:	
Symptom	**1 month**	**3 months**
Cognitive		
Impaired attention or concentration	40-45	NK
Impaired memory	50-55	59
Somatic		
Fatigue or decreased energy	65	20-25
Headache	55	45-78
Dizziness	40	20-25
Sensitivity to noise	50	NK
Insomnia	40	NK
Behavioural		
Irritability or loss of temper	65	NK
Anxiety	55	NK

Note: NK = not known
Source: McAllister, 1995.

occur immediately after injury. However, the effects of concussion have traditionally been regarded as transient. Furthermore, the symptomolgy typically associated with concussion develops in stages (Rutherford, 1989). A diagnosis of PCS on the other hand requires that symptoms have been present for at least three months post injury (Diagnostic and Statistical Manual of Mental Disorders 4th edition [DSM-IV], 2000).

Assessment and Severity:

Formal assessment of functioning post MTBI should be conducted to assist with diagnosis/formulation, monitoring, prediction and planning, programme or service evaluation and epidemiology. (Oddy & Alcott, 1996). The type of assessment will vary depending on place, need and nature of injury. Lezak (1995) for example notes that it is important to distinguish early on whether symptoms are representative of a diffuse concussive injury or a focal lesion.

Early assessment may be via screening measures such as: GCS, and/or GOAT described in the previous chapter. In the case of suspected MTBI in sports other sideline assessments may be employed such as that used by Maddocks (McCrory, 2002). Assessment in this situation will

take place alongside any basic first aid that may be required and involve serial measures to deal with varying levels of consciousness (McCrory, 200). These measures will be discussed in more detail in the following chapter.

More comprehensive neuropsychological evaluation would take place after the acute needs of the patient have been met. This will include a review of records, a clinical interview, administration of neuropsychological tests and the formulation of a report.

Mild Traumatic Brain Injury:

Presence of LOC can be established first by asking the person about what happened. If they can remember the event (e.g., the blow) that caused the injury, it is unlikely that they lost consciousness (Wills, 2002). Firstly, it is important to establish whether the typical symptoms such as nausea, headache and blurred vision are present, whether there is any amnesia (retro and/or anterograde) and its duration and whether they have sustained any past brain injuries.

GCS and PTA scores here are extremely useful for establishing initial severity, giving a guide to prognosis and monitoring progress. However, neuropsychological evaluation gives a much clearer picture of the integrity of brain function and level of impairment following injury and may be used for diagnostic, treatment planning and monitoring, discharge planning, community functioning, and vocational planning purposes (Uomoto, 2000).

Concussion:

Assessment of concussion and measures of severity used will again depend on time and place. Quick, screening tests of mental status can be administered immediately following injury, followed by more comprehensive neurological examination in the early stages after injury (i.e., in the emergencydepartment) and later, neuropsychological assessments may be used to investigate the more subtle effects of the trauma.

No single grading system of concussion has been endorsed (Richter, 2001), however, two commonly used tests of mental status used to assess severity of concussion and return-to-play decisions immediately after injury are:

Standardized Assessment of Concussion (SAC): This test was developed in 1997 as a brief screening instrument for the assessment of concussion (McCrea, Kelly, Randolph, Cisler & Berger, 2002). It requires 5-10 minutes to administer and includes measures of orientation, immediate memory, concentration, delayed recall and exertional manoeuvers (such as sit-ups). It also comprises a brief neurological screen including questions about LOC and PTA and some co-ordination, sensation, strength and movement tests. It is a valid and reliable measure of mental status and highlights neurological abnormalities within minutes of sustaining an MTBI (McCrea et. al , 2002; Richter, 2001). In addition, it has also been shown to be effective in tracking recovery from concussion (McCrea, Kelly, Randolph, Kluge, Bartolic, Finn & Baxter, 1998).

Maddocks Questions: These were developed primarily for the rapid preliminary assessment of MTBI in athletes on the sports field. They are more valuable than the general questions traditionally used to determine whether a player has sustained a concussion (such as: "how many fingers am I holding up?") and they focus on recent memory. Any incorrect response indicates concussion and the player should be removed from the field for further medical evaluation. Examples of Maddocks Questions include:

-Which field are we at?
-Which team are we playing today?
-Who is your opponent at present?
-Which half/period is it?
-How far into the half is it?
-Which side scored the last touchdown/goal/point?
-Which team did we play last week?
-Did we win last week?

Concussion may also be classified according to severity.

Table 3.5 Grading scale of concussion.

-Grade 1-	mild concussion	-	No LOC, confusion without amnesia.
-Grade 2-	slightly more severe	-	No LOC, confusion with amnesia.
-Grade 3-	classic concussion	-	LOC is experienced & inability to recall the event.

Management / Rehabilitation:

Mild Traumatic Brain Injury / Concussion:

Most cases of MTBI do not require extensive emergency care as is often the case with moderate to severe TBI where detailed evaluation (including neuroimaging and hospital observation) and neurosurgical intervention is commonplace (Kelly & Rosenberg, 1997). However, diagnosis of MTBI is important to identify risk of further problems, e.g., secondary brain injury, post-concussive symptomology, risk of second impact and premature return to work (Malec, 1999), as is the provision of education (Barth et. al, 1999; Dacey, 1989; Mittenberg, Digiulio, Perrin & Babs, 1992). Treatment of MTBI must consider physical, neurological, cognitive and psychosocial environmental factors (Barth et. al, 1999; Gronwall, 1989).

The practical management of MTBI/concussion falls into 3 stages (McCrory, 2002). During **the acute stage**, management is primarily concerned with first aid requirements and relief from early symptoms. Emergency room physicians are generally concerned with the "here and now" (i.e., the immediate condition and necessary treatment for it) and consideration is not often given to future needs/rehabilitation (Uzzell, 1999).

The middle (or early) stage is more in depth and will take place after the patient has been seen for any immediate complications of the injury. This stage of management may involve neurological examination, neuropsychological assessment, observation, education and counseling. Naturally, these 'middle stage' interventions may not be employed until the acute symptoms have dissipated (Wrightson, 1989). Mittenberg, Tremont, Zielinski, Fichera & Rayls (1996) note that providing patient early on with information about MTBI significantly reduces symptoms.

Finally, **later stages** of management involve more longer term interventions –for example, attendance at a concussion clinic (McCrory, 2002). Management at this stage must address problems which may arise later and hinder re-adjustment. Wrightson (1989) has named this stage of management *'the patient and the community'*.

Post Concussive Syndrome:

PCS may cause significant psychosocial problems regarding return to work/school, re-adjustment and personal relationships. It is therefore critical to identify early any patients at high risk of experiencing persisting PCS so that appropriate intervention can be implemented. Intervention is generally psychological in nature with a strong emphasis on the provision of relevant information, reassurance, monitoring of symptoms, neuropsychological assessment and psychotherapy (King, 1999).

Although numerous effective treatments for PCS have been described in the literature, few well-controlled, cost-effective studies have been reported (Malec, 1999). Kay (1993) has developed a neuropsychological treatment model for patients with MTBI which appears to be effective on a clinical basis. This model includes guidelines for prevention and early intervention of PCS. Kay notes that the primary objectives of early intervention should be to prevent the development of dysfunctional adjustment through: (1) evaluation and education, (2) behavioural symptom management, (3) gradual reintegration into activities, and (4) potential referral for more intensive treatment. Kay goes on to recommend a more comprehensive rehabilitation programme for the patient who displays chronic PCS. This includes: (1) problem identification and validation, (2) systematic support, (3) neurobehavioural rehabilitation, and (4) redefinition of self and goals.

Predictors of Outcome:

Mild Traumatic Brain Injury:

Generally speaking, the outlook for somebody who has sustained a single minor or mild head injury is good (Larrabee, 1999). It is however important to remember that one of the most critical variables for outcome after any incidence of TBI, is individual vulnerability to trauma (Barth, Macciocchi & Diamond, 1999). Although severity and location of injury are of great importance, additional intra-individual factors such as age, personality, general health, premorbid intellectual ability, previous neurological, psychiatric and substance abuse histories, the availability of family, psychosocial, vocational and economic support systems and the possibility of pending litigation are all critically important to individual vulnerability

to and outcome after MTBI (Barth et. al, 1999; Kibby & Long, 1999; Reitan & Wolfson, 1999).

Concussion:

The extent of impairment of consciousness is an important factor in evaluating the severity of a CHI and in predicting the eventual outcome (Richardson, 2000).

McCrea et. al (2002) looked at the immediate effects of concussion by creating profiles of 91 athletes who sustained a MTBI during a sports season. They then classified the injuries into one of three groups: no LOC/ no PTA ; PTA/ no LOC and LOC/PTA. Based on SAC scores immediately after concussion, they found that a number of variables influenced rate of recovery with the most important being the presence or absence of LOC. The LOC group was the most severely impaired and the no LOC / no PTA group the least impaired.

In contrast, when Lovell, Iverson, Collins, McKeag and Maroon (1999) investigated the importance of the role of LOC in predicting neuropsychological test performance, they performed a retrospective comparison between 383 patients and found that there was no significant difference in test performance between those who had and those who had not experienced LOC. This in turn led them to question the emphasis based on LOC in existing measures of concussion.

History of concussion is also an important factor to take into account. Gronwall and Wrightson (1983) have noted that repeated concussions have a cumulative effect whereby the long-term effects of concussion become more and more evident with repeat incidences.

Post Concussive Syndrome:

In addition to such intra-individual variables mentioned above, recovery from PCS may be further complicated by secondary gain issues (Youngjohn, Burrows, & Erdal, 1995, cited in Cullum & Thompson, 1999). Malingering has often been associated with persistence of symptoms following MTBI. This has caused many people to become skeptical about the real extent of problems following and even the existence of PCS (Uzzell, 1999). Mittenberg,

Wittner & Miller (1997), however, note that children, who are generally not seeking any secondary gain, display postconcussive symptoms very similar to the clinical picture seen in adults, thus dispelling the possibility that PCS does not exist.

Second Impact Syndrome:

During the minutes and days following a concussion, the brain has an increased vulnerability to severe, sometimes permanent injury (Hovda, et. al, 1999). In clinical settings, the term Second Impact Syndrome (SIS) is used to describe a catastrophic condition which occurs when somebody who has sustained a concussion or cerebral contusion sustains a second head injury prior to recovery from the initial injury (Cullum & Thompson, 1999; Bowen, 2003). SIS has a mortality rate close to 50% and a morbidity rate of nearl 100% and is thought to result from abnormal cerebral vascular sensitivity from the first injury (Bailes, 1999). The second injury then sets in motion cerebral autoregulatory dysfunction, vascular congestion and intracranial hypertension, causing substantial damage or even death to the patient.

Even if the second injury is only minor, the effects can be devastating. Typically, the injured person will remain standing for a number of seconds-minutes before collapsing, semicomatose, with respiratory failure, lack of eye movement and rapid pupil dilation. There is a rapid change from time between second impact and brain stem failure – an estimated 2 to 5 minutes (Bowen, 2003). Treatment for SIS requires rapid diagnosis and medical intervention for neurological symptoms (such as intracranial hypertension).

Summary:

Although an injury to the brain may be classified as 'mild' in terms of severity, there is still a large potential for harm. Any MTBI may result in physical, neurological and neuropsychological impairment.

Whilst many deficits associated with injury will dissipate in the days and weeks following the trauma, there are a significant number of people who continue to experience symptoms at 3 months and longer post-injury. The most commonly reported neuropsychological impairments

following MTBI are in the domains of cognitive functioning (in particular, information processing and memory functioning) although physical symptomology (e.g., headaches and fatigue) and behavioural changes (e.g, increased irritability, depression and anxiety) are also commonly reported.

It is important to remember that any brain injury occurs along a continuum and that due to the similarities in the clinical pictures of MTBI and concussion, it is often difficult to differentiate between the two. As such, there is a degree of overlap in the literature, especially where epidemiological data and classification are concerned.

Specifics of client inclusion criteria and assessment and treatment programmes available at the Concussion Clinic are detailed in the following chapter.

CHAPTER 4:

ACC AND THE CONCUSSION CLINICS

"Injury arising from accident demands an attack on three fronts. The most important is obviously prevention. Next in importance is the obligation to rehabilitate the injured. Thirdly, there is the duty to compensate them for their losses" (Thee Woodhouse Report, 1967).

The Accident Compensation Corporation:

The original vision of Accident Compensation Commission (ACC) was born out of a recommendation made in the Woodhouse Commission in 1967 which aimed to provide New Zealanders with a 'no-fault' accident insurance scheme as a replacement for the right to sue for personal injury. The Woodhouse Report recommended that such a scheme be based on five basic principles: (1) Community Responsibility, (2) Comprehensive Entitlement, (3) Complete Rehabilitation, (4) Real Compensation, and (5) Administrative Efficiency. In exchange for paying levies, employers and motor vehicle owners became protected from being sued for damages. The original Accident Compensation Bill was passed into law by parliament in 1972, amended in 1973 to cover a wider range of people (such as students and non-earners) and was finally put into effect on the 1st of April, 1974. New Zealand was the first country in the world to adopt such a scheme.

Over the last 30 years, ACC has undergone much legislative change. The legislation of most relevance to the present topic - rehabilitation of claimants - is outlined in Table 4.1 on the following page.

In addition to legislative changes within the institution itself, ACC has been transformed and modified by the policies of the ruling political party. For example, when the Accident Compensation Bill came into effect in 1974, a Labour Government was in power and ACC was a government department. When National returned to power in 1990, the scheme was altered again with tighter regulations being placed on claimant entitlements and re-compensation. In 1998, legislation changed again and National privatized some of the services previously provided by ACC. Private insurers were now permitted to provide work-

related accident insurance, thus creating a competitive market for insurance against workplace injuries. However, under the Accident Insurance Amendment Act, passed in April 2000, ACC once more became the sole provider of insurance for all work and non-work injuries for all New Zealanders (ACC, 2005).

Table 4.1 ACC legislation relevant to rehabilitation of claimants

Year	Scheme	Outcome
1974	The Accident Compensation Bill (1972) is put in to effect	Three schemes are established: 1.) The Earners' Scheme - funded from levies paid by employers and self-employed people. 2.) The Motor Vehicle Accident Scheme – funded by levies paid by the owners of motor vehicles. 3.) The Supplementary Scheme – funded by the government. This scheme covers everyone else.
1994	Case Management is introduced	Rehabilitation of injured persons is now based more on an assessment of individual needs.
1996	An accredited employer framework is established	ACC can now purchase health and rehabilitation services from the private and public sectors. Wait lists for treatment are consequently reduced.
1998	Commercial subsidiaries are developed to cover case & claims management, injury prevention, health services contracting and independent dispute resolution	The 4 resulting subsidiaries are: 1.) ACC Healthwise 2.) Catalyst 3.) Prism 4.) Dispute Resolution Services Ltd.
2001	The Injury Prevention Rehabilitation and Compensation Act introduced	This resulted in: 1.) A strong emphasis on injury prevention and rehabilitation 2.) The Code of ACC Claimants Rights 3.) The re-introduction of lump sum entitlements for claimants with permanent impairment. 4.) Changes to weekly compensation.

Rehabilitation & Recovery:

One of ACC's primary goals is to return claimants to their maximum degree of independence in everyday activity and return to work/school. Consequently, ACC has

developed a comprehensive rehabilitation and recovery strategy. Each year, ACC funds approximately one billion $NZ in rehabilitation services and treatments (ACC, 1998).

ACC can help injured people in a variety of ways including: assistance with treatment costs for the injury, compensation for loss of earnings, the cost of non-urgent surgery, rehabilitation toward return to work and regaining independence in daily life.

ACC's rehabilitation and recovery strategy came about when case management was introduced in 1994, enabling individualized rehabilitation plans to be developed for claimants. Each client was then assigned to a case manager who developed and oversaw the implementation of individual rehabilitation plans. These detailed the expected outcomes of rehabilitation and the claimant's rehabilitation entitlements (ACC, 2004). This system continues today although it has evolved somewhat over the last decade.

Lifetime rehabilitation planning was introduced in 2003. This involves a comprehensive assessment of the medical and support needs an injured claimant may require throughout their lifetime. An individualized lifetime rehabilitation plan, based on the specific injury and the claimant's circumstances, is subsequently developed. This plan provides a framework for the claimant's ongoing care and rehabilitation.

Relationships & Partnerships:

In 1996, ACC established 'Healthwise', a division which was set up to engage health and rehabilitation services from the private and public sectors. This division was designed to facilitate and publish best practice guidelines, develop competency standards and service specifications and monitor the performance of providers to ensure quality, affordable healthcare.
The ACC partnership programme was launched in 2000 which saw ACC working in close partnership with a wide range of treatment providers, industry representatives, government bodies and businesses, enabling it to deliver a comprehensive, effective service.

With regards to treatment providers, any provider that is involved in a partnership with ACC must meet certain requirements (concerning qualifications, certification, registration etc), thus creating a certain standard of service delivery. This standard is maintained via ACC's

provider relationship managers who communicate the provider's issues and interests back to the organization, help providers work effectively with claimants and ensure that administrative processes between ACC and providers work well.

ACC and Mild Traumatic Brain Injury:

Management of severe TBI is largely dealt with by residential services, however, the results of a 2000/2001 review undertaken by ACC identified a large number of people who had suffered MTBI and who did not have their injury-related needs fully met. This in turn led to the development of a new contracting initiative for MTBI with a specific focus on early intervention and preventing long-term problems. ACC thus sent out a number of invitations to tender to potential partners and invited each of these providers to respond to their invitation. This resulted in ACC contracting nine nation-wide Mild Traumatic Brain Injury Service Providers (Concussion Clinics). These were:

Table 4.2 ACC Concussion Clinics in New Zealand

-Rehab & ADHB	(Auckland)
-Health Partners (Burtons)	(Auckland)
-Head Start DHB	(Hawkes Bay)
-Mid Central / Massey	(Palmerston North)
-Capital & Coast DHB	(Wellington)
-Nelson Nursing Service	(Nelson)
-Burwood Hospital	(Christchurch)
-Children's Specialist Centre	(Christchurch)
-ISIS Otago DHB	(Otago)

The underlying philosophy of the service is that it is a comprehensive needs based approach (including: assessment, treatment, rehabilitation, maintaining or regaining independence, employer liaison and work planning and education and injury prevention), with continuity of care and multidisciplinary management (requiring a qualified multi-disciplinary team of healthcare providers including a medical specialist and neuropsychologist who together work towards providing an optimal treatment and rehabilitation plan for the individual). All providers must work in accordance with philosophies expressed in the "Traumatic Brain Injury Guidelines" (ACC/NHC, 1998) and within the clinical protocols and policies outlined by ACC.

As per the ACC specifications outlined in the contract, the providers must deliver 3 main types of service:

Table 4.3 Types of Services Provided by the Concussion Clinics.

Type of Service	**Service Specifications**
Assessment	-For people with TBI related symptoms. This includes a full medical examination and neuro-psychological testing appropriate to the injury.
Treatment / Rehabilitation	-Treatment programmes are structured, systematic, goal-directed and individualized to the client's needs. There is an emphasis on cognitive-behavioural (CBT) techniques. Interventions may consist of individual or group therapy.
Telephone Contact	- Telephone support must be provided for up to 6 months after the claimant has terminated treatment / rehabilitation.

ACC requires that claimants using these services meet certain criteria, falling into one of the following three categories: (1) Those claimants whom it is unclear whether they have suffered MTBI (as defined in table 4.2 on the following page), (2) Those claimants deemed to be at high risk of chronicity, or (3) Those claimants with established symptoms of more than 3 months duration post- injury i.e., with PCS (as defined in table 4.5).

Furthermore, ACC requires that referrals to the Concussion Clinics come only from district health boards (DHBs), accident and emergency providers, a GP or an ACC case manager.

Under the contract, ACC purchases various packages of service from each of the providers. Service packages purchased by ACC include:

1.) Initial Assessment & Provision of Clinical Assessment and Rehabilitation Report (CARR).

2.) Provision of Progress and Discharge Reports.

3.) Pre-approved Single Treatment Session & follow-up (usually 3-6 sessions).

4.) Family / Whanau Meeting with claimant, GP & Case Manager (maximum of 2 per claimant).

5.) Non-attendance Fee (payable once per claimant).

6.) Travel Costs for uninterrupted journeys of over 20km.

Table 4.4 Criteria for MTBI as defined by ACC (2000).

MTBI occurs when a person has had a traumatically induced disruption of brain function manifested by:

A. At least *two* of the following:
-A period of loss of consciousness from a few seconds up to 30 minutes, verified by an external observer wherever possible.
-Disturbance of memory for events immediately before and/or after the accident. Memory disturbance should last at least 1 minute but no longer than 24 hours, verified by an external observer wherever possible.
-Focal neurological deficit(s) that may or may not be transient, including evidence of altered mental state such as confusion or disorientation.

AND

B. A Glasgow Coma Score (GCS) of 13 or higher at the time of initial medical examination, preferably at one hour after injury.

AND

C. Presenting symptoms are not attributable to pre-existing medical condition or pre-existing psychological disorder, or primarily due to drug or alcohol intoxication. The presence of any of these may still mean an injury has occurred.

AND

D. EITHER of the following:
-Evidence that medical care has been sought within 7 days of injury (unless it is unavailable e.g., the person was on a fishing boat, in the mountains or similar).
-There is documentation from a Registered Health Professional consistent with external force to the head having occurred, such as:
    -Contusion, abrasion, bruising or other injury to the skin or scalp
    -Skull fracture, with radiological evidence
    -Injury to the scalp, skull, meninges or brain including intracranial haematoma
    -Acceleration-deceleration injury
-In the absence of either of the above, review by a Registered Specialist* that indicates, on the balance of probabilities, an external force to the head has occurred.

Table 4.5 Criteria for Post-Concussional Syndrome (PCS) as defined by ACC (2000).

A. The claimant *must* have a documented history of head trauma that has caused mild (or more severe) TBI (as defined in table 4.1). Note that PCS may also arise following a more severe TBI.

AND

B. This classification may be made for a claimant who has been symptomatic *for at least 6 weeks,* but not continuously asymptomatic for the first 4 weeks.

AND

C. The claimant has at *least three* of the following symptoms *for at least 6 weeks,* and onset of these occurred shortly after the head trauma.

(1) Difficulties with concentration, attention, and/or memory
(2) Becoming fatigued easily
(3) Disordered sleep
(4) Headache
(5) Vertigo or dizziness
(6) Irritability or aggression on little or no provocation
(7) Anxiety, depression, or affective lability
(8) Changes in personality (e.g, social or sexual inappropriateness)
(9) Apathy or lack of spontaneity
(10) Distractibility due to light and/or noise

AND

D. There is evidence from neuropsychological testing or quantified cognitive assessment of difficulty in attention (concentrating, shifting focus of attention, performing simultaneous cognitive tasks) or memory (learning or recalling information).

AND

E. The symptoms in C and D had their onset following head trauma or else represent a substantial worsening of pre-existing symptoms.

AND

F. The disturbance causes significant impairment in social or occupational functioning and represents a significant decline from a previous level of functioning.

AND

G. The symptoms are not better accounted for by a psychological disorder.

A number of steps are taken to ensure monitoring of patient progress and consistency of administration and services across the Concussion Clinics e.g., CARR (which is given to the case manager within 5 days of assessment and if accepted is then implemented by the provider within 10 days), progress reports (outlining claimant details, progress towards rehabilitation and reasons for any amendments to the CARR), discharge reports, quarterly service reports and summary statements. Furthermore, ACC reserves the right to carry out audits of these providers.

The Massey University Concussion Clinic:

Midcentral Health and the Massey University Psychology Clinic jointly tendered for, and were granted a contract in 2001. The Midcentral Health/Massey Concussion Clinic was opened as an outpatient service on the Palmerston North Hospital campus in September 2001.

In December 2003 Midcentral Health withdrew from the partnership due to needing to place resources in services at the more severe end of the health spectrum. The Concussion Clinic contract was then taken over solely by Massey University. Consequently, the clinic was relocated to the Massey University Psychology Clinic at the Palmerston North campus. As at November 2004, the Concussion Clinic had received 225 referrals.

The Massey Concussion Clinic consists of a multidisciplinary team who together manage claimant referrals. The initial appointment is assessment oriented and comprises a medical and neuropsychological assessment with the possible inclusion of functional assessment also. The medical component targets clinical history and examination, identification or confirm-ation of MTBI or PCS, relevant investigations and a review of pre-morbid psychological and psychiatric factors and substance abuse disorders. The neuropsychological facet of assessment includes a clinical and structured assessment of cognitive functioning (including: executive function, memory, concentration and attention, visuo-spatial ability, comprehension and verbal ability), assessment of pre-morbid personality, psychiatric morbidity and alcohol and drug addiction issues as well as assessment of relationships, family/whanau, workplace, study and recreational issues both before and after injury. The initial appointment takes 2 hours.

The initial appointment results in the formulation of a Clinical Assessment and Rehabilitation Report (CARR), summarizing the client's status and giving recommendations for further testing/rehabilitation/ referrals. The CARR is then forwarded to the claimant's ACC case manager within 5 days of the assessment. The case manager then takes responsibility of the CARR and reserves the right to either accept or decline the recommendations within it.

The Concussion Clinic employs an individualized, structured, goal-directed approach to intervention. One of the most important facets of this is ensuring that clients have adequate information about the nature and consequences of MTBI and PCS and in some cases, this information alone will be sufficient intervention for the claimant (ACC, 2001). If further intervention is required, the case manager will approve funding for a block of rehabilitation sessions (with a minimum of 3 and a maximum of 6 sessions unless in exceptional circumstances where a further 6 sessions may be approved). Intervention here may involve individual and/or group sessions which are largely cognitive-behavioural in nature. It is the responsibility of the clinic to report to the case manager at the end of each block of rehabilitation therapy, using a Progress Report Form. Once rehabilitation has been terminated and a Discharge Report has been submitted to the case manager, telephone support is provided to the client for up to 6 months from the start of rehabilitation.

Previous Studies:

In 2002, Roxanne Leach conducted an evaluation of the then Midcentral/Massey Concussion Clinic. The primary objectives of her study were to provide feedback to the Concussion Clinic about their service based on an evaluation of quality and outcome and to evaluate the use of client satisfaction measures in such services. Ms. Leach employed the Service Satisfaction Scale (SSS-30) (Greenfield & Attkisson, 1989) as a measure of client satisfaction with services received at the Concussion Clinic. This multi-dimensional measure will be used again in the present study and is described in more detail in Chapter 6.

Leach's sample consisted of 20 participants, the majority of whom (70%) were satisfied with the services they received from the Concussion Clinic. 95% of participants indicated general service satisfaction and 90% of participants' composite satisfaction scores demonstrated "satisfied" and "delighted" responses. Furthermore, although dissatisfaction was reported on

18 of the items included in the SSS-30, the level of dissatisfaction with services was low, ranging from 5% to 18.2% (Leach, 2003).

Of the five dimensions measured by the SSS-30, *'practitioner manner and skill'* ranked the highest with items in this category earning a mean score of 4.27 / 5. The lowest ranking dimension was *'perceived outcome'* where the mean score for items in this category totaled 3.95 / 5.

Whilst Leach's results portrayed a high level of client satisfaction with services received at the Concussion Clinic, evaluation is an ongoing process and services should therefore be continually evaluated to ensure that quality is maintained.

CHAPTER 5:

THE PRESENT STUDY

The previous chapters have established that MTBI, affects thousands of individuals and their families each year in New Zealand. A number of epidemiological risk factors associated with MTBI have been identified. Most of the research in this area, however, comes from overseas data. It is likely that data will vary somewhat depending on the milieu in which such epidemiological studies take place. The current study aims to provide a comprehensive investigation of the incidence and epidemiological factors associated with MTBI in a sample of clients referred to a concussion clinic in the Manawatu, New Zealand. Since the clinic services the whole of the Manawatu region, which has a population base of over 220,000 people, the potential sample was the entire cohort of those sustaining concussion in that area, thus allowing for a very comprehensive view of the topic.

The current study also aims to add to existing research on recovery from MTBI. In particular, the role of early intervention on recovery through comparison of recovery information between those who attended the clinic and those who were referred but did not actually attend, thus illustrating the role that intervention for MTBI had on our participants.

Evaluation of human services is an important step towards improving the impact of ongoing programmes. Service evaluation, therefore, is a means of monitoring services to ensure that clients receive the best possible service. Attkisson and Broskowski (1978) note that from the perspective of the client, a good service is one which does more than simply reduce a single problem or increase some previously restricted level of functioning. With regards to monitoring existing programmes, client satisfaction ratings are invaluable as they tap different conceptual domains to other outcome measures and they involve clients directly in evaluating the programme (Hargreaves & Attkisson, 1978). The current study also aims to evaluate the Massey University Concussion Clinic, an outpatient service which caters for people who have sustained a MTBI / concussion, from the clients' perspective and according to the ACC specifications under which it must operate.

Objectives:

This study has three main objectives. The first objective was to gather demographic data about the clients such as: age, gender ethnicity and socio-economic status as well as information about the actual injury for which they were referred to the clinic (i.e., mechanism of injury, experience of LOC and/or PTA, GCS scores where recorded and symptoms experienced) and recovery (e.g., persistence of any symptoms and whether or not they were still receiving or would like to receive any further form of treatment). This information would be compared to prior studies.

A second objective was to gather information about each participant's history of head/ brain injury and compare the data between those who attended the clinic and those who were referred but did not attend their scheduled appointment at the Concussion Clinic.

A third objective of the study was to evaluate the Concussion Clinic itself. Firstly, to ensure that the clinic is running in accordance with the ACC specifications outlined in the initial contract. Secondly, to evaluate services provided by the Concussion Clinic from the client's perspective, information regarding Perceived Outcome, Practitioner Manner and Skill, Office Procedures, Accessibility and Waiting were obtained using the Service Satisfaction Survey (SSS-30).

Objective 1: Epidemiology and Demographic Data:

Hypothesis One: Gender Ratios

Numerous studies indicate that males have a much higher incidence of TBI across the age span than do females, with reported male to female ratios of 3:1 (Wong, Dornan, Schentag, Ip & Keating, 1993). It was therefore expected that similar ratios would be found in referrals to the Concussion Clinic.

Hypothesis 1: That the ratio of males to females referred to the clinic will be in the region of 3:1.

Hypothesis Two: Age Trends

Age is an important factor to take into account when examining prevalence rates of TBI. ACC statistics indicate that of the 2,476 head claims submitted in 2004, most came from the

15-19 year old bracket (11.23%), followed closely by the 20-24 year old (10.95%), the 45-49 year old (9.23%) and the 35-39 year old brackets (9.13%) for both males and females. These statistics only account for 27.5% of the approximate annual incidence of TBI in New Zealand (which is 9,000) although they do follow the same general trend as international data on the incidence of TBI. Concussion Clinic data was examined to determine the extent to which they reflect these trends.

Hypothesis 2: The age trend of clients referred will reflect the ACC 2004 statistics with higher numbers of referrals coming from the: 15-19, 20-24, 45-49 and 35-39 age groups for both males and females.

Hypothesis Three: Ethnicity

Many studies have examined the similarities and differences across a wide range of factors between Maori and Pakeha cultures in particular. The literature on TBI in New Zealand is relatively scant. However, in an investigation of the prevalence of TBI among New Zealand prison inmates, Barnfield and Leathem (1998) investigated the prevalence of TBI among New Zealand prison inmates. They found that Maori were disproportion-ately over-represented with regards to incidence of TBI, possibly owing to the fact that Maori are generally over-represented in high risk of TBI populations (including: low SES, higher alcohol and drug use and high incidence of MVA). Their results showed that 91.4% of their Maori sample compared to 79.4% of their non-Maori sample reported sustaining a TBI at some stage in their lives. In contrast, however, ACC (2004) statistics indicate that only 12% of head claims come from people of Maori ethnicity, compared to 66% of Pakeha/European ethnicity. As the population at the clinic comes largely from ACC referrals, it seems probable that referral rates in terms of ethnicity will be similar to the ACC rate, rather than the rate reported in the Barnfield and Leathem study which surveyed a sample in which there was likely to have been a large number of people who never sought assistance either medically or through ACC.

Hypothesis 3: Maori clients will constitute approximately 12% of the total clients referred to the Concussion Clinic.

Hypothesis Four: Socio-economic Status:

Socio-economic status (SES) has repeatedly been implicated in the TBI literature. Morse and Montgomery (1992) found that as many as 75% of all TBI victims in America belong to

low SES groups with incomes of under US$10,000 per annum. A section concerned with employment and income has been included in the questionnaire.

Hypothesis 4: The majority of respondents come from households in lower (under NZD $20,000 per annum) SES brackets.

Hypothesis Five: Mechanism of Injury:

Studies on the cause of TBI have repeatedly reported that MVAs are the leading cause of TBI, followed by falls, sporting and industrial injuries and assaults (Murdoch & Theodoros, 2001). It was hypothesised that the Concussion Clinic sample would reflect this trend. However, it is also assumed that sporting accidents, in particular those occurring whilst playing rugby, would represent a higher number of injuries than would normally be expected due to the popularity of the sport in New Zealand.

Marion (1999) reports that of all the reported TBIs in the United States, sports-related injuries account for less than 5% of these. Others, however, have estimated that sport-related brain injury may account for as many as 20% of all reported TBI sustained each year in the US (Maroon, 1999; Powell, 1999). In an investigation of the prevalence of MTBI in club-grade rugby in the Manawatu, New Zealand (the same area served by the Concussion Clinic), Wills (2002) reported a rate of 20-48.6% with higher rates for younger players. ACC (2004) statistics also indicate that sporting injuries constitute a large number of "head" claims per annum with figures steadily increasing from 159 claims in 1994 to 227 in 2004 (9.42% of total head claims).

Hypothesis 5: MVAs will be the highest cause of reported concussion in our sample. Sports related head injury will account for close to 10% of total referrals to the Clinic.

Objective 2: Recovery, History and Response:

Hypothesis Six: History of TBI:

People who have experienced a TBI or MTBI at some stage in their lives have a considerably higher chance of sustaining subsequent injuries. With regards to concussion, Zemper (2003) conducted a two-year prospective study, measuring the relative risk of cerebral concussion among those with a history of concussion, compared to subjects with no previous concussion history. His subject base consisted of 15,304 football players, 975 of whom had a history of concussion within the last 5 years. His data revealed that the relative

risk of sustaining a concussion for those with a previous history is 5.8 times greater than that for people with no history. It is therefore reasonable to assume that many Concussion Clinic clients will have had a prior history of TBI.

In addition, research suggests that the neuropsychological effects of recurrent TBI are cumulative, making it probable that those who have prior history of TBI will report longer-lasting, more pervasive symptomology.

Hypothesis 6: That a higher proportion of people seen at the Concussion Clinic will have sustained at least one other TBI at some stage in their lives than the proportion within the community at large and that clients with prior history will report a higher frequency of persisting, more problematic symptomology.

Hypothesis Seven: Differences in recovery ratings between those who attended and those who did not attend the Concussion Clinic.

A number of studies have shown that early intervention is beneficial to longterm recovery from MTBI. Ponsford, Willmott, Rothwell, Cameron, Kell, Nelms & Curran (2002) for example investigated the impact of early intervention for MTBI and found that patients in the intervention group reported fewer symptoms on the post-concussion syndrome checklist at 3 months post-injury and were significantly less distressed overall compared to those who did not partake in the intervention programme.

In the current study, it was planned to obtain information regarding recovery outcomes (using recovery ratings lists of persisting symptoms included in the questionnaire) for the group who attended the Concussion Clinic compared to those who either cancelled or did not attend their scheduled appointment at all.

Hypothesis 7: Those who reply to the questionnaire but who did not come to the clinic for their scheduled appointment will demonstrate longer lasting symptomology of concussion and will report lower recovery ratings.

Hypothesis Eight: Recruitment Bias:

In order to examine the validity of the results of Hypothesis 8, it was important to rule out the possibility of recruitment bias. Such bias has been previously reported by McCullagh & Feinstein (2003) who found that the presence of identifiable, selective factors influencing

subject recruitment produced a substantial source of systematic bias. Of their sample of 626 patients with MTBI who were invited to take part in the outcome research, those who agreed to participate (n=272) were compared to those who declined (n=354) on injury-related, demographic and past-health related variables. The authors found that there were no premorbid differences between the groups but that early indices of TBI severity were significantly worse for the participant group, indicating that the participant group was biased towards more significant injuries. This study has important implications for subject recruitment in longitudinal studies of MTBI.

Hypothesis 8: Those with higher early indices of severity (GCS, LOC and PTA) will have a higher response rate and will report a high number of long-lasting complaints.

Objective 3: The Concussion Clinic:

Hypothesis Nine: Client Satisfaction with the Concussion Clinic:

In her 2002 investigation of client satisfaction at the Massey University Concussion Clinic using the SSS-30, Roxanne Leach found that of the 20 participants in her study, clients were very satisfied with the manner and skill of the practitioners seen and quite satisfied with the other 4 dimensions of the survey. She reported that 70% of participants were satisfied with the services they received at the Concussion Clinic and that the level of dissatisfaction where reported was low, ranging from 5-18.2%.

With regard to the dimensions measured by the SSS-30, *'practitioner manner and skill'* ranked the highest, followed by *'accessibility'*, *'office procedures'* and *'waiting'*. The lowest ranking dimension was *'perceived outcome'* where the mean score for items in this category totaled 3.95 / 5.

Hypothesis 9: That client evaluation of services received at the Concussion Clinic will be similar to those obtained by Leach (2002).

Hypothesis Ten: The Concussion Clinic & ACC:

The Concussion Clinic contractual agreement with ACC is that it will provide services according to the specifications laid out by ACC. Quarterly service reports are to be made to

ACC (detailing how the clinic is operating, numbers of new cases etc.) and the clinic is subject to audits by ACC.

Hypothesis 10: That the Concussion Clinic is operating in accordance with the ACC specifications outlined in the initial contract.

CHAPTER 6:

METHOD

The present chapter provides an overview of the present study, relevant ethical considerations, the research setting, participants and measures used. This is followed by a more detailed description of the methodology employed in the present study. To facilitate reading, the two stages of data collection are presented separately.

Overview of the Present Study:

Information pertaining to the three objectives and related hypotheses was gathered in two stages.

First Stage:

This involved a review of the cover sheets from client files attending the clinic from January 2002 to November 2004. Information gathered included: name and address, age and gender. This information would later be used for comparison with overseas figures and prior local figures (Leach, 2002). During this stage, data was also gathered to allow for comparison of services provided by the Concussion Clinic (service delivery) with the service specifications as set out by ACC (service requirements). This data included source and date of referral and date seen.

Second stage:

This involved circulation of a questionnaire to all clients referred to the Concussion Clinic from January 2002 to November 2004. The questionnaire sought client's views of their recovery from and history of concussion and satisfaction with services provided by the Concussion Clinic. The questionnaire also covered remaining demographic information such as ethnicity and socio-economic status.

Ethical Considerations:

Permission to conduct the present study was sought and obtained from the Massey University Human Ethics Committee (MUHEC), WGTN Protocol 04/34 and from the clinic manager of the Concussion Clinic at Massey University, Palmerston North campus.

The principal issue in seeking ethics approval was one of informed consent and anonymity/confidentiality. All clients were therefore assigned a reference number which was used instead of their names when data was being collected and recorded.

To ensure that all prospective participants were aware of their rights and the purpose of the study, an information sheet (*Appendix 1*) was sent out with the questionnaire. The information sheet provided (a) a brief description of the study and its objectives, (b) an invitation to participate in the study, (c) an explanation that participation was voluntary, (d) a reminder that consent to participate was assumed if the questionnaire was returned, (e) an explanation that all information received was confidential and that only grouped data would be used so individuals would never be identified, and (f) contact details of the researcher, supervisor and the MUHEC committee.

Research Setting:

Stage one of the research was conducted at the Massey University Concussion Clinic located at and operated from the Massey University Psychology Clinic at the Palmerston North campus. The Concussion Clinic itself operates one day a week (Tuesday) although the Psychology clinic is open during the rest of the week. No data or information by which participants could be personally identified was removed from the Concussion Clinic.

In stage two, correspondence from participants was sent to the Massey University Albany Campus where it was collected and analysed by the researcher.

Participants:

Prospective participants included all 209 clients who were referred to the Concussion Clinic from January 2002 to November 2004.

During this period, 161 people attended the clinic and 48 people either cancelled or did not come to their scheduled appointment, giving a potential sample of 209 participants, consisting of 132 males (mean age 31.67 years) and 77 females (mean age 35.96 years).

Measures:

Service Satisfaction Scale-30 (SSS-30):

This self-administered measure of client satisfaction with services received was developed by Greenfield and Attkisson in 1989. It is intended for use in the evaluation of primary and mental health services.

The SSS-30 is a multidimensional measure, consisting of 30 close-ended questions designed to assess empirical facets of satisfaction with services (Greenfield & Attkisson, 1999). Service-related factors assessed by the SSS-30 include: Perceived Outcome, Manner and Skill of Practitioners, Office Procedures and Accessibility. The SSS-30 employs a Likert-type scale form, using a 5-point scale ranging from 'delighted' to 'terrible', which renders it a quick, efficient measure of service evaluation. Further, there is a section on demographic information and 3 open-ended comments requesting additional comments. See table 6.1 for the items and dimensions measured by the SSS-30.

The SSS-30 is a well established measure of client satisfaction and has sound psychometric properties (Brink, 2004). High internal consistency has been demonstrated with Cronbachs α values ranging from .93 to .96 (Attkisson & Greenfield, 1994). It also possesses strong validity for global measurement (Brink, 2004).

The questionnaire used in the current study was an adapted version of the SSS-30. Some questions were changed slightly to be more relevant to the Concussion Clinic and a New

Table 6.1 Dimensions of the SSS-30 and the items included within them

MANNER & SKILL:

1. Kind of services offered
2. Opportunity to choose practitioner
6. Professional knowledge and competence of main practitioner(s)
9. Ability of your practitioner to listen and understand your problems
10. Personal manner of the practitioner(s) seen
15. Confidentiality and respect of your rights as an individual
19. Explanations of specific procedures and approaches used
29. Overall general satisfaction with services received

PERCEIVED OUTCOME:

3. Effects of services in helping you deal with your problems
14. Effect of services in maintaining well-being and preventing relapse
16. Amount of help you received
17. Availability of information on how to get the most out of services
18. Prescription (or non-prescription) medications
20. Effects of services in helping relieve symptoms or reduce problems
23. Thoroughness of the main practitioner you have seen
24. Appropriate use of referrals to other practitioners/services when needed
28. Contribution of services to achievement of your life goals

ACCESSIBILITY:

7. Location and accessibility of the Concussion Clinic (distance, parking etc)
12. Availability of appointment times that fit your schedule
21. Response to crises or urgent needs during office hours
22. Arrangements made for after hours emergencies or urgent help

OFFICE PROCEDURES:

4. Office personnel (receptionist) on the telephone or in person
5. Office procedures (scheduling, forms, tests, etc)
24. Appropriate use of referrals to other practitioners/services when needed
25. Collaboration between service providers (if more than one)
27. Handling and accuracy of your records (as best you can tell)

WAITING:

11. Waiting time between referral to the Concussion Clinic and the appointment time

MISCELLANEOUS & ADDED ITEMS:

8. Appearance and physical layout of the Concussion Clinic (eg waiting area)
13. Cost of services to me
26. Publicity or information about programs and services offered
30. Information you were given about concussion

*Two further questions relating to concussion were added onto the questionnaire

31. The amount of information I was given about Concussion
32. How well did the information given to you help you understand concussion

Zealand sample. For example, the question about ethnic background in the original version is geared towards an American population and requires the participant to select from a list of ethnicities including: Caucasian/White, Native American/Indian, African American/Black,

Asian/Pacific American and Hispanic/Latino. Given that the current research is being conducted on a New Zealand sample, these options were altered to include: NZ European, Maori, Pacific Islander and Other. Some questions were removed altogether (such as question 12 from the original version which was concerned with waiting time between referral and appointment as this information was readily available from the client cover sheets examined in Stage One of the study) and others were replaced (e.g., question 31 *[If Applicable] Support of the group as a whole, helpfulness and caring of its members* from the original was replaced with *Information you were given about concussion.* Finally, one further option was added at the end of the questionnaire whereby participants could select to receive a summary of the results of the study. According to the manual which accompanies the survey, the psychometric properties of the SSS-30 are not altered by the addition or subtraction of such items.

Recovery Rating Scale:

This was a single item using an eleven-point scale included in the questionnaire to indicate how clients felt about their recovery. The anchors were 0 (very unhappy) and 10 (very happy).

Procedure:

First Stage:

In Stage 1, data was taken from the cover sheets of all client files dating from January 2002 to November 2004 were examined. Data gathered included name and address of client, date and source of referral and length of time between referral to the clinic and date of scheduled appointment. Most other information, e.g., mechanism of injury, ethnicity and socio-economic status were gathered through the questionnaire – see Stage 2.

During this phase of the study, a coding system was employed whereby each person referred to the clinic was assigned a reference number to be used from this point onwards as a means of protecting the anonymity and confidentiality of the participants and for the facilitation of data collection and analysis. Clients were coded firstly according to whether they actually attended assessment/rehabilitation at the clinic (ARR) or whether they cancelled or did not attend their scheduled appointment (DNA), then according to the year in which they were referred and finally by their client number for that year. For example, the

first person to attend the clinic in 2002 was coded as ARR 02 01 and the first person to referred to the clinic in 2002 but cancel the appointment was DNA 02 01.

Second Stage:

To gather information about the clients themselves, their concussion and recovery and their experience at the clinic, questionnaires were sent out to all people who had been referred to the Concussion Clinic from January 2002 to November 2004. The questionnaire sought (a) demographic information (i.e., age, ethnicity, employment and income bracket), (b) general information about the concussion (i.e., mechanism of injury and details of symptoms experienced), (c) information about participants' recovery from concussion, including a rating scale and (d) information about participants' history and past experience of head injury.

There were 2 versions of the questionnaire. *Version 1* (8 pages long – see Appendix 2) was sent to clients who attended the clinic from January 2003 to November 2004. *Version 2* (4 pages long – see Appendix 3) was sent to all clients who attended the clinic from January 2002 to December 2002 and all clients who either cancelled or did not attend their scheduled appointment at the clinic. The reason for this was because a similar study had been undertaken with the same population by another Massey University student, Roxanne Leach, in 2002. Leach sent copies of the SSS-30 to all people who had attended the clinic from September 2001 to December 2002 (a total of 79 people). In an effort to avoid doubling up by asking people who had already completed the SSS-30 to do so again, they received the shortened version which was solely concerned with questions about the concussion itself and their recovery rather than an evaluation of services. Those who did not attend the clinic also received this version as they would not have been able to answer the questions relevant to the clinic.

In addition, a self-addressed, postage paid envelope was included with the information sheet and questionnaire to assist participants and promote a higher rate of return.

A return rate of close to 24% was achieved. Figure 6.1, on the following page sets out how the participants were derived.

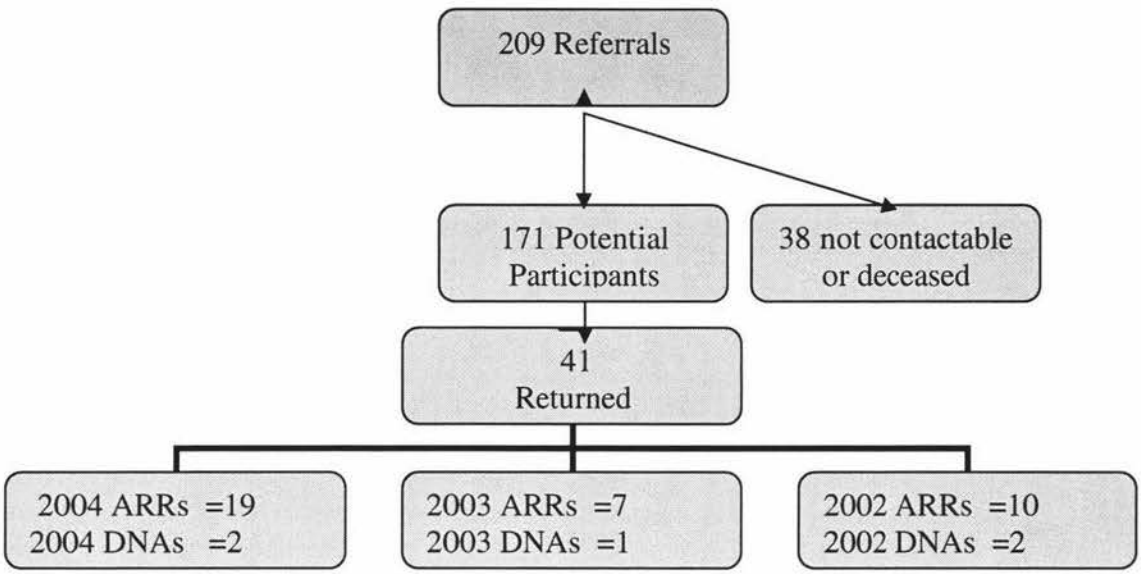

Figure 6.1 Flowchart illustrating the potential and actual participant sample.

Questionnaires were sent out in sets to make preparation and postage more manageable for the researcher. A timeline of when the questionnaires were sent is shown below.

Figure 6.2 Timeline showing when the questionnaires were sent out to participants.

Due to the relatively low rate of return, a reminder letter (see Appendix 4) was sent to the remaining 2004 referrals (both ARRs and DNAs) in the first week of January 2005. However, the rest of the reminder letters (for the 2002 & 2003 referrals) were not sent due to an oversight whereby a large number of the researcher's client sample inadvertently received a second questionnaire as part of another study being undertaken at Massey University also targeting victims of TBI in the Manawatu region (Judkins, 2005). It was decided that due to the large amount of paper work that these clients were receiving, it would be best not to send out any more correspondence than was absolutely necessary.

Data Analysis:

Basic demographic and epidemiological data was recorded straight from the questionnaires. Data from the questionnaires was processed using SPSS (Version 12) statistical analysis software.

CHAPTER 7:

RESULTS

Results of the study will be presented according the aims and hypotheses as they were set out in chapter 5. Part one (epidemiology and demographic data) will cover hypotheses 1 to 5, Part two (recovery, history and response) will cover hypotheses 6 to 8 and Part three (the Concussion Clinic) will cover hypotheses 9 and 10.

Objective 1: Epidemiology and Demographic Data:

Hypothesis One: Gender Ratios

The ratio of males to females referred to the clinic will be in the region of 3:1.

Of the 209 referrals, 131 (63%) were male and 78 (37%) female, equating to a ratio of 1:1.68

Hypothesis Two: Age Trends

The age trend of clients referred will reflect the ACC 2004 statistics with higher numbers of referrals coming from the: 15-19, 20-24, 45-49 and 35-39 age groups for both males and females.

As predicted and as shown on Figure 7.1, most referrals came from the 15-19, 20-24, 45-49 and 35-39 age groups.

The combined average age of clients referred to the Concussion Clinic from January 2002 to November 2004 was 33.82 years. There was a tendency for males to be younger (mean age 31.67 years) than females (mean age 35.96 years).

Figure 7.1, also shows that the peak age groups of males referred to the Concussion Clinic were the 20-24 year (20.61%) and 15-19 year age groups (19.85%) followed by the 25-29 year (11.45%), the 30-34 year (9.16%) and the 45-49 year age groups (8.40%). The peak age groups of females referred to the Concussion Clinic were the 15-19, the 20-24 and the 35-39

year age groups (all with 11.54%), followed by the 30-34 year (10.26%) and the 55-59 year age group (8.97%).

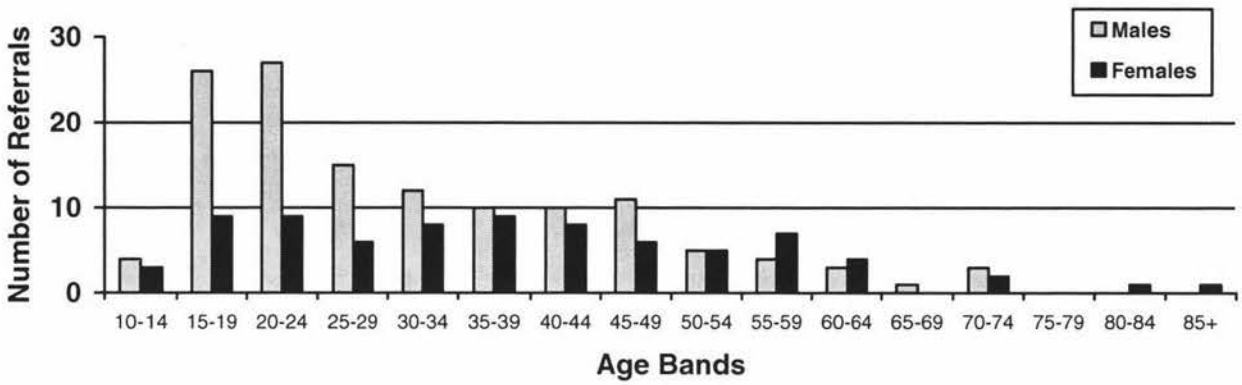

Figure 7.1 Number of male and females referred to the Concussion Clinic across age groups.

If the ACC statistics and the data from the Concussion Clinic are converted into percentages, as shown in Figure 7.2 on the following page, it is clear that the age trend of clients referred to the Concussion Clinic follows a similar pattern to the 2003/2004 ACC data. The primary differences are that the Concussion Clinic did not receive any referrals for children under the age of 10, whereas these claims accounted for 5.1% of ACC's total head claims and that 3 of the 4 high frequency age groups (15-19, 20-24 and 35-39 year olds) accounted for considerably more Concussion Clinic referrals than they did for ACC claims.

Hypothesis Three: Ethnicity

Maori clients will constitute approximately 12% of the total clients referred to the Concussion Clinic.

As referral information did not list ethnicity, the only information available was from returned questionnaires where ethnicity had been listed as specific question. On the 41 questionnaires, 4 (9.8%) identified as Maori, 35 (85.4%) New Zealand European, and 2 as 'other' than those options listed on the questionnaire. No respondents identified as Pacific Islanders.

Numbers were too small to comment on differences between attenders and non-attenders in terms of ethnicity. Of the 5 participants who did not attend the clinic one was Maori (20%) and 4 (80%) New Zealand European.

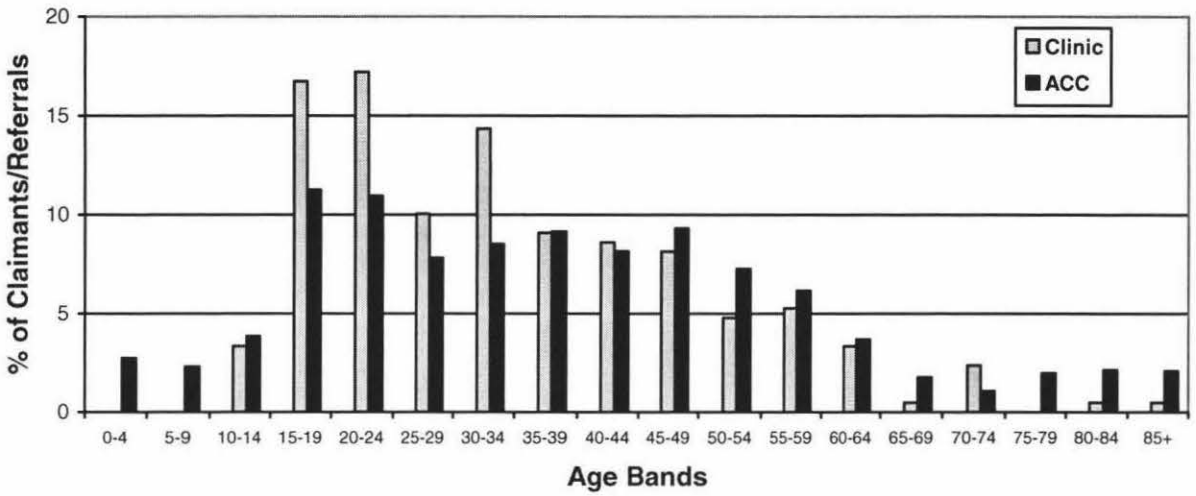

Figure 7.2 Comparison of the age distribution of ACC head claims claimants in 2003/2004 and Concussion Clinic referrals from January 2002 to November 2004.

Hypothesis Four: Socio-economic status

The majority of respondents come from households in lower (under NZD $20,000 per annum) SES brackets.

Only 29 of the 41 respondents completed this section. The hypothesis that the majority of respondents would come from lower (Under $20,000per annum) SES brackets was not supported by the data. This group accounted for only 37.93% of respondents. Instead, the majority of respondents came from SES brackets of under $40,000 (65.52% of respondents).

As shown on Figure 7.3, 4 (13.79%) had a yearly family income of less than $10,000 prior to their injury, 7 (24.14%) between $10-20,000, 8 (27.59%) $20-40,000, 4 (13.79%) in each of the $40-60,000 and the $60-80,000 brackets and 2 (6.90%) earned over $80,000. Thus the majority of respondents earned more than NZD $20,000. Post-injury data was similar to pre-injury data.

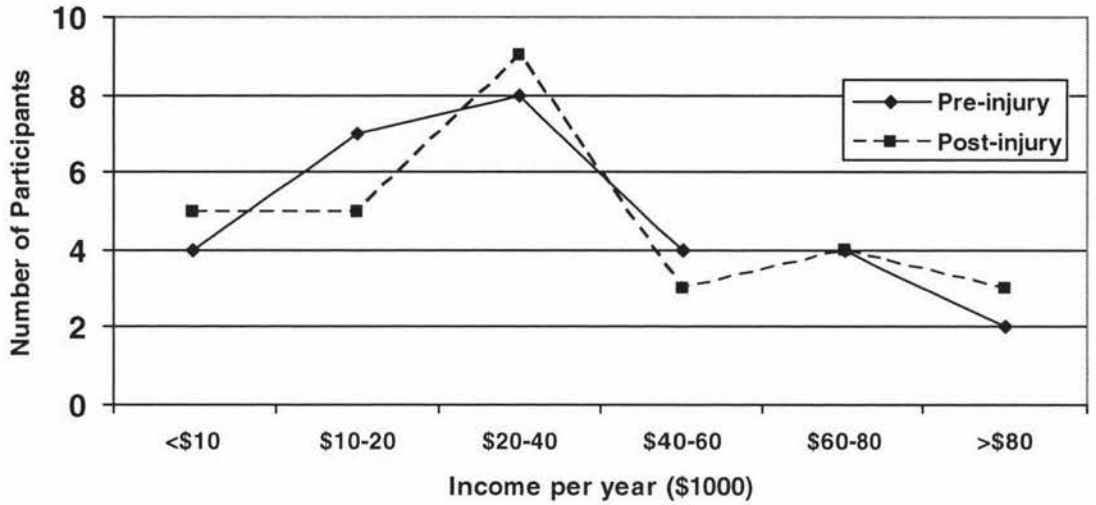

Figure 7.3: Annual family income before and after injury of the 29 participants who responded to the questionnaire.

The questionnaire also asked participants about the amount of study or work (i.e., full time or part time) they were doing pre- and post-injury. The results of the 39 people who responded to this section are shown in Table 7.1. This data indicates that the amount of study/work undertaken by attenders is considerably reduced post injury. In contrast, there was little change in the amount of study/work undertaken by the non-attenders.

Table 7.1 Number of respondents who engaged in study/work pre- and post-injury.

	Pre-injury			Post-injury		
	ATT [a]	DNA [b]	Total	ATT [a]	DNA [b]	Total
Full-time study/work	24	4	**28**	17	5	**22**
Part-time study/work	5	1	**6**	6	0	**6**
Unemployed/benefit	2	0	**2**	8	0	**8**
Retired	3	0	**3**	3	0	**3**

a. Attended Concussion Clinic

b. Did not attend Concussion Clinic

Hypothesis Five: Mechanism of Injury

MVAs will be the highest cause of reported concussion in the Concussion Clinic sample. Sports related head injury will account for close to 10% of total referrals to the Concussion Clinic.

As hypothesized (and shown on Table 7.2) motor vehicle accidents (MVAs) were the most frequently cited cause of injury, accounting for 70 (33.5%) of the total 209 injuries. Sporting injuries accounted for slightly more (12.9%) injuries than the hypothesized rate of 10%.

Table 7.2 Cited mechanism of injury for the 209 referrals to the Concussion Clinic.

Mechanism of Injury	Number	Percent
Motor Vehicle Accident	70	33.5
Fall	47	22.5
Blow	15	7.2
Assault / Fight	31	14.8
Sport	27	12.9
Other / Unknown	19	9.1

Objective 2: Recovery, History and Response:

Hypothesis Six: History of TBI

A higher proportion of people seen at the Concussion Clinic will have sustained at least one other TBI at some stage in their lives than within the community at large and that clients with prior history will report a higher frequency of persisting, more problematic symptomology.

From information in the client files and participant responses to the questionnaire, a brief history of past TBI (including all degrees of severity) was gained for 98 participants. Of these, 57 (58%) reported at least one previous TBI at some stage in their lives, compared to approximately 1.2% in the general population.

Recovery data was gained for 41 of the 209 Concussion Clinic referrals. As shown on Table 7.3 of these, 23 had no past history of TBI, 9 reported one previous TBI, 5 had sustained 2 TBIs, 1 client reported 3 another 4 past TBI and 3 had sustained 5 or more TBI's. The mean number of persisting symptoms for those without previous history of TBI was 1.57, compared to a mean of 1.90 for those with previous injuries. The mean recovery rating for those without previous TBI was 7.39 compared to 6.74 for those with previous injuries. Although figures are small there was a trend for persisting symptoms to be higher and the mean recovery rating (out of ten) to be lower as a function of higher number of previous TBI.

Table 7.3 Previous history of and present recovery from TBI.

History of Previous TBI	N	Mean No of Persisting Symptoms	Mean Recovery Rating (/10)
Nil	23	1.57	7.39
1	9	1.67	7.25
2	5	2.00	5.80
3	1	4.00	6.00
4	1	0.00	9.00
5+	3	2.33	5.67

Hypothesis Seven: Differences in recovery ratings between those who attended and those who did not attend the Concussion Clinic

Those who reply to the questionnaire but who did not come to the clinic for their scheduled appointment will demonstrate longer lasting symptomology of concussion and will report lower recovery ratings.

As noted earlier, only 5 of the 41 returned questionnaires, were from non-attendees. The results from this group should therefore be interpreted with caution. The mean number of persisting problems for the 36 respondents who attended the Concussion Clinic was 0.57 compared to 1.4 for non-attendees and the mean recovery rating for attendees 6.9, compared to 7.8 for non-attendees. Therefore, despite reporting a higher frequency of persisting symptomology, the non-attenders reported greater overall recovery ratings than did the attendees.

Hypothesis Eight: Recruitment Bias

Those with higher early indices of severity (GCS, LOC and PTA) will have a higher response rate and will report a high number of long-lasting complaints.

Information about the severity of clients' injuries at the time of admission to hospitals and emergency departments was recorded where possible. However, for a large proportion of the sample, this information was either not recorded, not available or was unknown. As stated earlier, of the 171 possible participants 41 (23.9%) people responded to the questionnaire that was sent out, leaving 130 (76.0%) non-respondents. Table 7.4 below shows the data gained about early indices severity for the 2 groups.

Table 7.4 Ratings of Severity for Respondents and Non Respondents.

Group	GCS	PTA	LOC
Non Respondents (n = 130)	N recorded = 70 Mean GCS = 14.07	N recorded = 65 N with PTA = 62 (95%)	N recorded = 83 N with LOC = 64 (77%)
Respondents (n = 41)	N recorded = 18 Mean GCS = 14.28	N recorded = 20 N with PTA = 16 (80%)	N recorded = 15 N with LOC = 13 (87%)

The two groups were relatively evenly matched based on early indices of severity with respondents displaying slightly higher GCS scores and a lower incidence of PTA than the 'non respondents'. However the frequency of LOC was slightly higher in the respondent group. Taken together, these results do not support the hypothesis that participant recruitment in the present study would be biased towards those who had sustained more severe injuries as measured by GCS, PTA and LOC at the time of injury.

It was not possible to draw correlations between severity of injury (as measured by GCS, PTA and LOC) and symptom persistence as there were very few instances where all three indices were recorded for any one client, therefore making it impossible to compare and contrast data.

Objective 3: The Concussion Clinic:

Hypothesis Nine: Client Satisfaction with the Concussion Clinic

That client evaluation of services received at the Concussion Clinic will be similar to those obtained by Leach (2002).

Data was analyzed using SPSS statistical analysis software, Version 12. Each item in the SSS-30 was considered first separately and then grouped with related items to give information about the dimensions measured by the SSS-30 as outlined in Chapter five.

Of the 171 people invited to take part, 25 participants completed the SSS-30. Part of the reason for this low figure is that all clients seen prior to December 2002 were not sent the SSS-30 as they had previously been asked to complete a copy for Leach's (2002) study.

The results for each item in the questionnaire are summarized in Table 7.5 which outlines the mean and standard deviations for each item as well as the proportion of participants who were "delighted with", "mostly satisfied" with, had "mixed feelings" about, were "mostly dissatisfied" with or who considered particular items as "terrible". The highest mean satisfaction ratings were for: item 9 – "ability of practitioner to listen and understand your problems" (mean = 4.40), item 6 – "professional knowledge and competence (mean = 3.40), item 26 – "information given about services offered" (mean = 3.43) and item 2 – "opportunity to choose your practitioner" (mean = 3.50). When compared to Leach's (2002) results, overall client satisfaction in this study seems to be slightly lower. If the mean scores for each variable are examined together, the mean score for the SSS-30 variables in this study is 3.84, compared to 4.07, core obtained by Leach.

Results from table 7.5 were collapsed to examine client satisfaction with the dimensions measured by the SSS-30: Professional Manner and Skill, Perceived Outcome, Accessibility, Office Procedures and Waiting. Table 7.6 shows the mean, standard deviation and the proportion of delighted, mostly satisfied, mixed, mostly dissatisfied and terrible responses for each dimension.

Table 7.5 Results of the SSS-30 for each item included in the questionnaire (n = 25)

VARIABLE / ITEM	*M*	*SD*	PERCENTAGE				
			Delighted	Mostly Satisfied	Mixed	Mostly Dissatisfied	Terrible
MANNER & SKILL:							
1. Kind of services offered	3.92	.78	20.8	54.2	20.8	4.2	-
2.Opportunity to choose practitioner	3.50	.89	10.0	40.0	45.0	-	5.0
6. Professional knowledge and competence	4.38	.65	45.8	45.8	8.3	-	-
9. Ability to listen & understand	4.40	.71	52.0	36.0	12.0	-	-
10. Personal manner	4.36	.76	52.0	32.0	16.0	-	-
15. Confidentiality and respect	4.28	.94	52.0	32.0	8.0	8.0	-
19. Explanations of procedures	3.87	1.01	26.1	47.8	17.4	4.3	4.3
29. Overall general satisfaction	3.63	1.28	29.2	33.3	16.7	12.5	8.3
PERCEIVED OUTCOME:							
3. Helpfulness with problems	3.57	.65	17.4	39.1	30.4	8.7	4.3
14. Well-being and prevention	3.77	1.11	27.3	40.9	18.2	9.1	4.5
16 .Amount of help received	3.58	1.41	33.3	29.2	12.5	12.5	12.5
17. Info on how to get the most out of services	3.52	1.23	20.0	40.0	24.0	4.0	12.0
18. Prescription of medication	3.94	.94	33.3	33.3	27.8	5.6	-
20. Symptom relief	3.38	1.06	12.5	37.5	29.2	16.7	4.2
23. Thoroughness of practitioner	3.96	1.14	44.0	24.0	16.0	16.0	-
24. Use of referrals	3.61	1.29	27.8	33.3	22.2	5.6	11.1
28. Contribution to life goals	3.43	1.24	17.4	39.1	26.1	4.3	13.0
ACCESSIBILITY:							
7. Location and accessibility	4.00	.95	28.0	44.0	16.0	-	4.0
12. Appointment times that fit	3.88	1.01	28.0	48.0	8.0	16.0	-
21. Urgent care during hours	3.75	1.07	28.0	12.0	32.0	8.0	-
22. Urgent care after hours	3.63	.81	12.0	16.0	36.0	-	-
OFFICE PROCEDURES:							
4. Office personnel	4.32	.90	54.5	27.3	13.6	4.5	-
5. Office procedures	3.86	.99	22.7	54.5	13.6	4.5	4.5
24. Use of referrals	3.61	1.29	27.8	33.3	22.2	5.6	11.1
25. Collaboration between services	4.06	1.25	27.8	22.2	27.8	16.7	5.6
27. Handling of records	3.74	1.18	34.8	21.7	30.4	8.7	4.3
WAITING:							
11. Wait time between referral and appointment	3.40	1.53	28.0	28.0	4.0	16.0	16.0
MISCELLANEOUS & ADDED ITEMS:							
8. Appearance of Clinic	3.83	1.01	29.2	37.5	20.8	12.5	-
13. Cost of services to me	4.26	.81	47.8	30.4	20.0	-	-
26. Info about services offered	3.43	.99	13.0	34.8	39.1	8.7	4.3
30. Information about concussion	4.16	.69	32.0	52.0	16.0	-	-

Table 7.6 Results of the SSS-30 for each dimension measured

DIMENSION	*M*	*SD*	PERCENTAGE				
			Delighted	Mostly Satisfied	Mixed	Mostly Dissatisfied	Terrible
MANNER & SKILL	4.04	.88	36.0	40.1	18.0	3.6	2.2
PERCEIVED OUTCOME	3.64	1.11	17.4	23.0	17.4	9.2	6.8
ACCESSIBILITY	3.82	.96	24.0	30.0	23.0	6.0	1.0
OFFICE PROCEDURES	3.92	1.12	33.5	31.8	21.5	8.0	5.1
WAITING	3.40	1.53	28.0	28.0	4.0	4.0	

Two further questions were added into the questionnaire but were not included in the statistical analysis above due to the different format in which they were asked. In response to question 31, "The amount of information I was given about concussion", 21 (84%) respondents replied that the amount of information received was about right, 3 people (12%) said that too little information was given and 1 person (4%) said that far too much information was received. In response to question 32 "How well did the information given help you to understand concussion?", 8 people (32%) said that the information given was somewhat helpful, 7 people (28%) thought the information given helped them quite a bit, 6 respondents (24%) believed that the information helped them a little, 3 people (12%) thought the information helped them a great deal and 1 person (4%) did not believe that the information helped them understand concussion at all.

Results from the present study show lower rates of client satisfaction with services received at the Concussion Clinic than those reported by Leach in 2002. There are a number of possible reasons for this – such as lower 'accessibility' ratings due to the relocation of the clinic from MidCentral hospital to the Massey University Campus – these will be discussed in the following chapter.

Hypothesis Ten: The Concussion Clinic & ACC

That the Concussion Clinic is operating in accordance with the ACC specifications outlined in the initial contract.

The Concussion Clinic contract states that the clinic may only accept referrals from: District Health Boards (DHBs), Accident and Emergency (A&E) providers, General Practitioners (GPs) or ACC Case Managers. Source of referral data was gathered for 120 of the 209 referrals to the Concussion Clinic. All of these referrals (100%) came from one of the sources specified above.

The contract further specifies that clients must be provided with an initial assessment within 5 days of receipt of their referral. The overall mean time taken between date of referral and date of initial assessment for all clients was 21.53 days. The mean time taken between referral date and date of appointment for those who attended the clinic was 21.09 days, compared to 21.96 days for those who either cancelled or did not come to their scheduled appointment. Figure 7.6 below shows the mean time between referral and appointment date for clients who came to the clinic and for those who did not attend in 2002, 2003 and 2004.

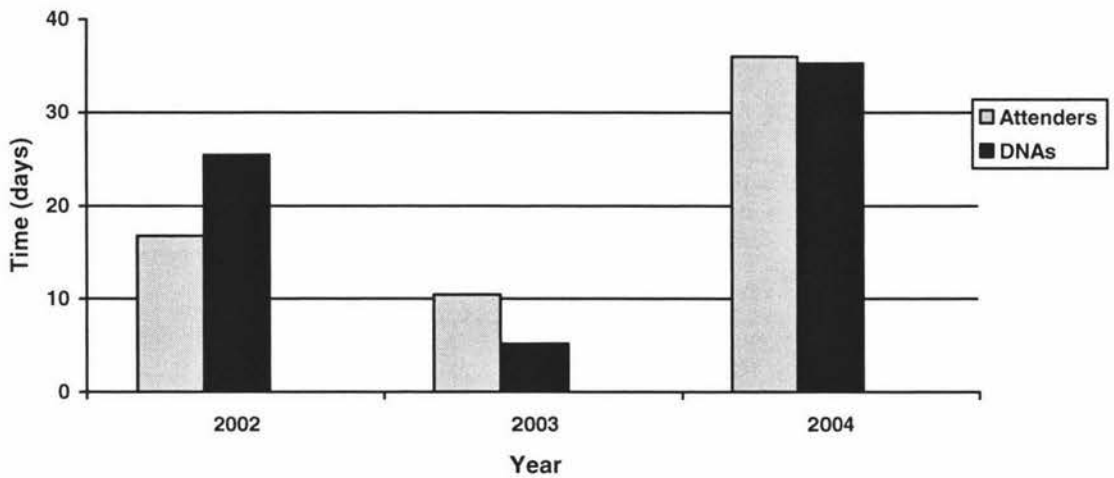

Figure 7.6 Time between date of referral and date of initial assessment for attendees and non-attendees (DNAs).

An independent samples t-test was used to determine whether the difference between the means for the attendees and the DNAs was significant. Results indicated that for 2002 and 2004, the difference between the means was not significant at the .05 level ($\alpha = .05$) of significance. However, there was a significant difference between the groups for the 2003 period. These results suggest that time taken between referral and date of initial appointment is

probably not related to the attendance or, non-attendance, of people referred to the Concussion Clinic.

CHAPTER 8:

DISCUSSION

This chapter presents the findings of the present study and recommendations for future research. Section 1 considers the findings associated with the first objective: *epidemiology and demographic data,* Section 2 the second objective: *recovery, history and response* and Section 3. *the Concussion Clinic.*

Objective 1: Epidemiology and Demographic Data:

Epidemiological and demographic data about concussion was gathered both to contribute to a developing picture of the correlations between epidemiological and demographic variables and the incidence and outcome of MTBI as well as to determine the extent to which a New Zealand sample follows overseas trends.

As outlined below, the data, which was collected partially from the client files held at the Concussion Clinic but primarily from the questionnaires distributed, were similar to epidemiological and demographic trends found in both the American literature and other New Zealand data sources, specifically data from ACC (2004).

Gender Ratios:

Results from the present study show that the ratio of male to female clients referred to the Concussion Clinic was approximately 2:1, which is close to both overseas figures of 2:1 (Kraus, 1987) and 3:1 (Wong, Dornan, Schentag, Ip & Keating, 1993) and New Zealand ACC (2004) statistics 2.5:1.

A number of interesting differences between the genders were identified in the present study. Females reported a higher number of persisting symptoms post injury (mean = 2.62) compared to males (mean = 1.45). Males reported higher overall recovery ratings (mean = 7.29) than did their female counterparts (mean = 6.71). An independent samples t-test showed that the difference between the means of recovery rating scales between males and females was significant at the .05 level of significance where '$t_{obtained}$ (16.06) was significantly larger than

't' $_{critical}$ (2.021). Finally, males had a higher rate of non-attendance (70%) compared to females (30%).

Age Trends:

Most referrals fell in the 15-19, 20-24 and 30-34 year age groups which again are close to overseas and ACC figures. The primary point of difference between the ACC statistics and the Concussion Clinic data was in the young children (0-9 years) and the older adult (75 years plus) age groups. ACC head claims claimants between the ages of 0-9 and 75+ years made up 5% and 3.9% respectively of their total sample for the 2003/2004 period. The Concussion Clinic has not had any referrals from clients under the age of 10 and fewer than 1% of their referrals came from over 75 year olds.

According to NHIC's (1998) statement, incidence of TBI should show three 'peaks' across the age span: *children, young adults* and *the elderly.* Neither the ACC nor the Concussion Clinic data demonstrated age peaks for the 'children' and 'elderly' groups. The most likely reason for this is that across all claims categories (not just those restricted to 'head claims'), only 1.5% of ACC claimants during the 2003/2004 period were submitted for people under ten years of age and only 6% were submitted by over 75 year olds. ACC referrals make up 20% of all client referrals to the Concussion Clinic which could offer one explanation for this. Another explanation is that the elderly may be more inclined to visit their local GPs rather than being seen in hospital settings or actively seeking out ACC rehabilitation and re-compensation. GP referrals made up 37% of the total referrals to the clinic.

Ethnicity:

Ten percent of clients referred to the Concussion Clinic identified as Maori which was slightly lower than but still close to the hypothesized figure of 12%. Since this figure was taken from returned questionnaires only (i.e., only 20% of those referred), the figure may not be a true representation of ethnicity of referrals.

In addition, national statistics indicate that the proportion of Pakeha/European people living in the Manawatu is significantly higher (at 85.1%) than the proportion found for all of New Zealand (80.1%) (Statistics New Zealand, 2005). This could account for the higher number of

Pakeha/ European referrals and the lower number of Maori referrals found in the present study as the ACC data (from which this hypothesis was drawn) reflects nation-wide statistics.

Socio-economic status (SES):

The hypothesis that the majority of participants would come from the lower (under NZD $20,000 per annum) income brackets was not supported by the data. The majority of respondents (65.5%) earned less than NZD $40,000 per annum. There were no significant differences between pre- and post-injury income for participants as a whole.

When considered individually, only 7 of the 29 respondents who answered this section had changed income brackets post injury, with 3 people decreasing and 4 increasing their earnings These changes may however have been unrelated to the concussion. For example, reported decreases in earnings may have been due to the age of the participants (two were aged between 55 and 64 and the other, aged between 35 and 44 had reduced his work from full to part time). One respondent reported a decrease in earnings from $40-60,000 to $10-20,000 and two respondents went from earning $20-40,000 to under $10,000 per annum. Of those whose income increased, 2 were aged between 15 and 24, (both gaining full-time employment after being a student and on a benefit respectively).

Although there were no significance differences in earnings pre- and post-injury, there were differences in the amount of work undertaken by respondents. Those who attended the Concussion Clinic worked significantly fewer hours post injury than prior to injury. Full time work undertaken by attendees went from 70.5% to 50% post-injury, part-time work went from 14.7% to 17.6% and the rate of unemployment jumped from 5.9% to 23.5% post-injury. No such differences were found for the group who did not attend. Given the neuropsychological sequelae which accompanies MTBI, specifically reduced concentration, memory and attention, (all of which are important to maintaining a job or study), it is not surprising that participants, as a whole, engaged in fewer hours of study/work post-injury. What is surprising is that on the surface, it seems that the Concussion Clinic attendees did considerably worse in terms of return to study/work than the non-attendees. One possible explanation for this is that those with persisting problems after head injury are more likely to seek help and attend rehabilitation programmes (such as those provided by the Concussion Clinic) where it is highly likely that they would have been advised to 'take it easy' and not place unreasonable

demands upon themselves. A reduction in the amount of time spent at study/work cannot therefore be assumed to be a necessarily bad thing. Furthermore, whilst the non-attendees may engage in more study/work post-injury, they did report a higher number of persisting symptoms (mean = 1.4) than the group who attended the Concussion Clinic (mean = 0.57).

Mechanism of Injury:

In keeping with the international data, motor vehicle accidents (MVAs) were the primary cause of injury, accounting for 33.5% of the current injuries in this sample – overseas data suggests that MVAs account for up to 42% of all MTBI (Kraus & Nourjah, 1989).

ACC statistics (2004) indicate that 9.17% of all filed 'head claims' are due to sporting/ recreational activities. In the present study, the incidence of sports-related injuries was slightly higher (at 12.9%) than what would normally have been expected. Of the current sample 48% of the 27 sports-related injuries were incurred whilst playing rugby. This is in line with previous findings that rugby union accounts for the highest rate of injury in sport between 22.4% and 60.5% (Hume & Marshall, 1994), 14.4% of which are MTBIs (Wills, 2002). The current findings could be expected given that rugby is considered by many to be our country's national sport (Bird, Waller, Marshall, Alsop, Chalmers & Gerrard, 1998).

Objective 2: Recovery, History and Response:

Recovery was examined through participant's responses to questions regarding persistence of symptoms or problems experienced as a result of the concussion for which they were referred to the Concussion Clinic. Participants also gave a global recovery rating (ranging from 0 [very unhappy] to 10 [very happy]) as well as information about previous experience(s) of head injury. Responses were compared between those who had attended the clinic (ARRs) and those who were referred to but who did not attend (DNAs). Data were also examined for recruitment bias using early indices of severity as a measure against which to test the hypothesis that those with more severe injuries would be more likely to participate in the study.

Hypothesis Six: History of TBI:

The current results are similar to overseas figures that indicate that previous brain injury increases the risk of incurring further brain injuries (Kelly & Rosenberg, 1997; Echemendia, Rosenbaum, Bailey, 2003). At least one previous incidence of MTBI was reported by 58% of participants which is approximately 3 times more likely than would be expected in the community at large (ACC, 2004).

On closer examination of previous injuries, more than 40% were due to the same cause as the current cause of injury. Mechanism of previous TBI can therefore be considered as a predictive factor for the cause of future injury.

Hypothesis Seven: Differences in recovery ratings between those who attended and those who did not attend the Concussion Clinic:

It is important to note that only 5 of the 41 returned questionnaires (12%) came from the 'Did Not Attend' (DNA) group which means that the results discussed below should be interpreted with caution.

On average, those clients who attended the Concussion Clinic reported a lower incidence of persisting symptoms (mean = 0.57) post assessment/treatment compared to those who did not attend the Concussion Clinic (the mean number of persisting symptoms for this group was 1.4). Conversely, those who did not attend the Concussion Clinic reported higher overall recovery ratings (mean = 7.8/10) than did those who attended the clinic (mean recovery rating = 6.9/10). The hypothesis that those who did not come to the clinic for their scheduled appointment would demonstrate longer lasting symptomology and would report lower recovery ratings was therefore only partially supported by the results.

In addition to the differences in persisting symptomology and recovery ratings between the ARRs and the DNAs, there were some significant differences in the recorded demographic variables between the two groups. The first concerns gender with males having a higher rate of non-attendance (70%) than females (30%). The DNA group was also younger as a whole than the ARR group with a mean age of 31 years compared to 35 years.

There were some important differences between the two groups in terms of mechanism of injury. The leading cause of injury for the ARR group was MVA (37.5%), followed by falls (23.5%), assaults (11%) and sporting accidents (10%). The trend for the DNA group however saw assault as the leading cause on injury (31%), followed by sporting injuries (23%), MVAs (18%) and falls (14%).

Finally, as noted earlier, the DNA group as a whole seemed to be less affected than the ARR group by their injuries. Although they did report a slightly higher number of persisting symptoms than the ARR group, the DNAs all either maintained or increased both their financial earnings and the amount of work/study they were engaged in post-injury.

Hypothesis Eight: Recruitment Bias:

The hypothesis that those with higher early indices of severity (GCS, LOC and PTA) would have a higher response rate and would report a high number of long-lasting complaints was not supported by the data.

Recorded GCS scores for respondents and non-respondents were matched with means of 14.28 and 14.07 respectively. There was a higher incidence of LOC in the respondent group (87%) compared to non-respondents (77%). However, the non-respondents reported a higher incidence of PTA at the time of injury (95% compared to 80% for the respondents). The hypothesis proposed by McCullagh & Feinstein (2003) whereby participant groups tend to be biased towards more significant injuries was not supported by the findings of the present study.

A further limitation to answering this hypothesis was that in most cases, only one or two indices were recorded. As it would be impossible to compare results across varying indices, correlations between outcome and early indices of severity were not able to be made.

Objective 3: The Concussion Clinic:

The evaluation of the Massey University Concussion Clinic involved both an investigation of client satisfaction with services received as well as an evaluation of the degree to which

the clinic was operating under the guidelines identified in the initial contract between ACC and the clinic.

Hypothesis Nine: Client Satisfaction with the Concussion Clinic:

Combined results of the 25 people who completed the service satisfaction survey (SSS-30) indicated that overall client satisfaction in the present study was slightly lower than in Leach's (2002) study. The mean rating of client satisfaction for each item evaluated by the current survey was 3.84, compared to 4.07 in Leach's investigation.

Similar to Leach's (2002) findings, participants in the present study were most satisfied with aspects relating to the manner and skill of practitioners, in particular: The ability of the main practitioner to listen and understand; Professional knowledge and competence; Personal manner and Thoroughness of the main practitioner. Participants were, on the whole, very satisfied with the kind of services offered at the Concussion Clinic, the location and accessibility of the clinic, the cost of services to them and the information they were given about concussion.

Dissatisfaction was reported in 25 of the 30 SSS-30 items, with levels of dissatisfaction (indicated by: (a) 'mixed', (b) 'mostly dissatisfied', and (c) 'terrible' responses to items on the questionnaire) ranging from 4.2% to 32%. The results for the three items with the highest dissatisfaction ratings (21% or higher dissatisfaction) however require closer investigation. These items, *Wait time between referral and appointment* (32% dissatisfaction), *Amount of help received* (25% dissatisfaction) and *Collaboration between services* (22.3% dissatisfaction) raise important issues.

Time between referral and appointment is also difficult to evaluate because clients may not even know when ACC, their GP or another referral source makes the actual referral to the clinic. It is only once the clinic receives an approved referral that they can commence rehabilitation. In addition, it is difficult to pin-point where exactly there is a breakdown in the collaboration between services – the Concussion Clinic has a strict set of guidelines laid out by ACC which it must adhere to and is therefore unlikely that any problems with regards to

collaboration with other services stems from the clinic. Further these are guidelines that determine the amount of help each client is to receive.

When the results of the SSS-30 were collapsed to give figures of overall evaluation for each of the five dimensions measured by the SSS-30, the figures obtained in the present study were again slightly lower than those obtained by Leach in 2002. However, both studies revealed that clients were most satisfied with *'Practitioner Manner and Skill'*.

With regards to the amount of information provided about concussion, 84% of participants believed that the amount of information received was about right, with 72% saying that the information received was at least somewhat helpful.

Finally, the relationship between a number of client variables and ratings of service satisfaction has been identified in the literature. Age has been found to be positively correlated with satisfaction ratings (Carr-Hill, 1992; Sitzia & Wood, 1997). Williams and Wilkinson (1995) posit that the positive correlation between age and satisfaction is due to the more passive role of the elder generations as opposed to the more consumer-oriented stance of the younger generations. To evaluate this phenomenon in the present study, answers from item number 29 on the SSS-30 (*"In an overall general sense, how satisfied are you with the services you have received?"*) were examined according to age. The 24 participants who responded to this item were divided into two groups: (a) those under 40 years of age; and (b) those over 40 years old. The majority of respondents from group 'a' (57%) either had mixed feelings about, were mostly dissatisfied with or felt terrible about the services they received. Conversely, the vast majority of group 'b' (90%) were either delighted or mostly satisfied with services received at the Concussion Clinic with only one member from this group reporting any degree of dissatisfaction. A positive correlation between age and client satisfaction was therefore evident in the present study.

Gender may also play a role in client satisfaction ratings. A positive correlation has been identified between satisfaction and being female (Aharoney & Strasser, 1993). Item number 29 was again used as a point of comparison to test this hypothesis. This trend was not found in the present study where males reported higher levels of satisfaction (69%) than did females (50%).

Hypothesis Ten: The Concussion Clinic & ACC:

The overall mean waiting time between referral and initial appointment was much longer (at 21.35 days) than the maximum waiting time specified by ACC (5 days). On closer examination, there appeared to be valid reasons for this. Some of the referrals were dated at the time of injury but were not forwarded to the Concussion Clinic until they had been processed and approved (a process which in some instances took more than 2 weeks). This is more a problem of collaboration between services which the Concussion Clinic cannot take sole responsibility for. Secondly, some clients had changed, cancelled or not attended appointments scheduled for earlier dates, thus further increasing the period of waiting time between referral and appointment found in this study.

With regards to the specifications outlined in their contract with ACC, the Concussion Clinic meets all requirements concerning: core skills and professional competencies of their staff, reporting requirements and interventions used. They also showed a 100% adherence to the referral requirements set out by ACC.

Limitations of the Present Study:

One of the major limitations of the present study is that although a substantial amount of information was gained regarding recovery from concussion, it is difficult to classify this data. All participants had sustained their injuries since 2001 (when the Concussion Clinic was opened). Some respondents had only recently sustained their injuries (i.e., only a couple of months before the recovery data was collected). This means that the recovery data (i.e., persistence and severity of symptomology) found in this study should not be generalized as a true representation of 'long-term' recovery from concussion.

Recommendations for Future Research:

A future study of the Massey University Concussion Clinic would be more comprehensive if permission was sought, and granted, to gain full access to the client files. This would enable more data to be gained about the injury itself (for example doctors' notes at the time of injury)

and related variables which may be related to risk and recovery (for example – how the existence of any pre-existing psychological disorders may influence risk of injury and recovery). In the present study, only the cover page of the client files containing only very basic information (such as: name, age, gender, type of injury, date of referral and appointment) was accessed. Due to this, it was not possible to answer some of the hypotheses. For example, one component of hypothesis eight was concerned with the extent to which early indices of severity are correlated with outcome of TBI. Unfortunately, in most cases this information was not readily available on the cover pages of the client files. A more detailed examination of such variables would yield more robust results.

Summary:

The present study began with an overview of the definition, incidence and outcome of TBI. This was followed by a more detailed discussion about MTBI and related epidemiological, neuropsychological and management issues. This led into a brief history of the Accident Compensation Corporation (ACC) and the birth of the 9 nation-wide Concussion Clinics which were founded by ACC in 2001. An overview of the present study followed coherently from this point which in turn led into a more detailed explanation of the methodological process used in this study and the results that it yielded.

This study arose firstly out of the need to understand the epidemiological factors associated with MTBI in New Zealand and secondly from a need for constant evaluation of health services, in this case, the Massey University Concussion Clinic. The epidemiological and demographic data obtained in the present study may be useful to future researchers investigating the incidence and outcomes of MTBI in New Zealand. The information gained concerning client satisfaction at the Concussion Clinic will be useful on a number of levels. In the first instance, the results of this section will provide useful feedback to the clinic about how clients perceive the services they offer. Secondly, because of the nature of the measurement used (the SSS-30), staff at the Concussion Clinic will be able determine which specific areas of service delivery clients are most satisfied with and which areas may need to be altered or improved for better service delivery.

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APPENDICES:

Appendix 1

Information Sheet

Information Sheet:

Client satisfaction and follow-up at the Massey University Concussion Clinic

Hello,

My name is Julia Taylor and I am a graduate student at Massey University. I am currently writing a thesis on the outcomes of assessment and treatment after Concussion Clinic attendance. The aim of the study is to find out more about the causes and risks of and recovery from concussion in New Zealand.

As a previous client of the clinic, you are invited to take part in this research and any information you could provide me with would be greatly appreciated.

The questionnaire should take about 10 minutes to complete and your responses can be sent back in the self-addressed, stamped envelope provided. We will send a reminder about the questionnaire if you have not replied after 2 weeks.

Participation in this research is voluntary and you can choose not to answer any of the questions. If you complete the questionnaire and send it back, it is assumed that you are consenting to take part.

All of the information you give is confidential and used only for this study. There will be no information that could identify individuals – all results will be grouped together. Your answers will not affect any past or future contact you may have with the clinic.

The number at the top of the questionnaire is simply for my reference should you wish to be informed about the results of this study. If you would like to receive a summary of the results, please tick this item at the end of the questionnaire.

The supervisor for this research is Professor Janet Leathem.

If you would like any further information or have any questions about the study, please do not hesitate to contact Julia Taylor or Janet Leathem on: (06) 3505799 extn 6768.

I thank you in advance for your participation in my research.

This project has been reviewed and approved by the Massey University Human Ethics Committee, WGTN Protocol 04/34. If you have any concerns about the conduct of this research, please contact Mr Jeremy Hubbard, Acting Chair, Massey University Campus Human Ethics Committee: Wellington, telephone 04 801 5799 ext 6358, email J.J.Hubbard@massey.ac.nz."

Appendix II

Service Satisfaction Survey SSS -30: Long Version

Concussion Clinic
OUTCOME AND SERVICES EVALUATION
CONFIDENTIAL

Please read the following statements carefully and answer the questions as best you can. Indicate the answer that best describes your feeling about your injury, recovery and services received at the clinic.

*Even if you did not attend the clinic, it would be greatly appreciated if you could fill in the relevant sections in this questionnaire about your injury – Thank you.

I attended: (please tick)

No sessions at the clinic ____
1 session at the clinic ____
2-4 sessions at the clinic ____
4-6 sessions at the clinic ____
More than 6 sessions ____

The Concussion:

1. What was the cause of the concussion?
   Motor Vehicle Accident ____
   Fall ____
   Sports Injury ____ (Please Specify Sport)_____
   Assault ____
   Other (Please Specify) _____

2. What symptoms did the concussion have on you in the weeks/months following your injury and what were the main problems that you experienced? (please rank in order of most to least troublesome and give examples where possible):

   1.) _____
   2.) _____
   3.) _____
   4.) _____
   5.) _____

3. Who referred you to the clinic for assessment/treatment?

   Hospital _____
   GP _____
   ACC Case Manager _____
   Don't know _____ Other (please specify) _____

How would you describe your recovery from this concussion?

1. In general I am…

BACK TO NORMAL	*MOSTLY BACK TO NORMAL*	*STILL HAVE MAJOR PROBLEMS*

2. If you were working or at school prior to injury, are you now…

BACK TO THE SAME LEVEL AS BEFORE	*MOSTLY BACK TO THE SAME LEVEL AS BEFORE*	*STILL HAVING PROBLEMS WHICH ARE AFFECTING YOUR RETURN*

3. Are you still receiving any treatment or support that is related to your injury? Y / N

If yes, please specify: _____

4. Do you think further treatment/support would be beneficial to your recovery? Y / N

If yes, please specify what type of support you think may be beneficial to you:

5. On a scale of 1-10, how happy are you with your recovery from concussion?

0	1	2	3	4	5	6	7	8	9	10
Very unhappy										Very happy

6. Please list in order of severity (most to least troublesome) any problems related to the concussion that you are still experiencing:

1.) _____

2.) _____

3.) _____

4.) _____

5.) _____

7. What do you think was most helpful to your recovery? (this is not limited to treatment)

It is important to know something about you so we request this extra information. Since only group data will be used, you will never be identified.

1. Age (years) now:

0 – 14	15 – 24
25 – 34	35 – 44
45 – 54	55 – 64
65 – 74	75 & over

2. What age were you when you were seen at the clinic?

3. What is your ethnicity?

NZ European ____
Maori ____
Pacific Island ____
Other (Please Specify) _____

4. Occupation (Please specify):

_____ (At the time of your injury)

_____ (At Present)

5. Employment:

At the time of your injury:		At Present:	
Employed full time	Employed part-time	Employed full time	Employed part-time
Unemployed	Full-time student	Unemployed	Full-time student
Part-time student	Retired	Part-time student	Retired
Other (Please specifiy)_____		Other (Please specifiy)_____	

6. Yearly Family Income:

At the time of your injury:		At Present:	
Under $10,000	$10,000 - $20,000	Under $10,000	$10,000 - $20,000
$20,001 - $40,000	$40,001 - $60,000	$20,001 - $40,000	$40,001 - $60,000
$60,001 - $80,000	Over $80,000	$60,001 - $80,000	Over $80,000

7. Have you ever had a concussion / head injury before or since the concussion for which you were seen at the clinic?

Yes ____ No ____

If the answer to this question was yes;

*How many other concussions / head injuries have you had? ____

*How old were you when this / these happened and what was the cause of injury?

1.)_____(age)_____(cause)

2.)_____(age)_____(cause)

3.)_____(age)_____(cause)

4.)_____(age)_____(cause)

5.)_____(age)_____(cause)

*Did you receive any medical attention / treatment for this / them? Y / N

If yes, where were you seen and on which occasions were you seen there? (use numbers as above to indicate)

Hospital _____
GP _____
Concussion Clinic _____
Other (Please Specify) _____

The following questions are to do with the clinic.
What is your overall feeling about the...

1. Kinds of services offered

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

2. Opportunity to choose which practitioner you see

TERRIBLE *MOSTLY DISSATISFIED* *MIXED* *MOSTLY SATISFIED* *DELIGHTED*

3. Effect of services in helping you deal with your problems

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

4. Office personnel (receptionist) on the telephone or in person

TERRIBLE *MOSTLY DISSATISFIED* *MIXED* *MOSTLY SATISFIED* *DELIGHTED*

5. Office procedures (scheduling, forms, tests, etc.)

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

What is your overall feeling about the...

6. Professional knowledge and competence of the main practitioner(s)

TERRIBLE *MOSTLY DISSATISFIED* *MIXED* *MOSTLY SATISFIED* *DELIGHTED*

7. Location and accessibility of the Concussion Clinic (distance, parking, etc.)

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

8. Appearance and physical layout of the Concussion Clinic (e.g. waiting area)

TERRIBLE *MOSTLY DISSATISFIED* *MIXED* *MOSTLY SATISFIED* *DELIGHTED*

9. Ability of your practitioner(s) to listen to and understand your problems

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

10. Personal manner of the main practitioner(s) seen

TERRIBLE *MOSTLY DISSATISFIED* *MIXED* *MOSTLY SATISFIED* *DELIGHTED*

11. Waiting time between referral to the Concussion Clinic and the appointment (date and time) given

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

What is your overall feeling about the...

12. Availability of appointment times that fit your schedule

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

13. Cost of services to me

TERRIBLE *MOSTLY DISSATISFIED* *MIXED* *MOSTLY SATISFIED* *DELIGHTED*

14. Effect of services in maintaining well-being and preventing relapse

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

15. Confidentiality and respect for your rights as an individual

TERRIBLE *MOSTLY DISSATISFIED* *MIXED* *MOSTLY SATISFIED* *DELIGHTED*

16. Amount of help you have received

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

17. Availability of information on how to get the most out of services

TERRIBLE *MOSTLY DISSATISFIED* *MIXED* *MOSTLY SATISFIED* *DELIGHTED*

18. Prescription (or non-prescription) of medications

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

19. Explanations of specific procedures and approaches used

TERRIBLE *MOSTLY DISSATISFIED* *MIXED* *MOSTLY SATISFIED* *DELIGHTED*

What is your overall feeling about the...

20. Effect of services in helping relieve symptoms or reduce problems

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

21. Response to crises or urgent needs during office hours

TERRIBLE *MOSTLY DISSATISFIED* *MIXED* *MOSTLY SATISFIED* *DELIGHTED*

22. Arrangements made for after hours emergencies or urgent help

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

23. Thoroughness of the main practitioner(s) you have seen

TERRIBLE *MOSTLY DISSATISFIED* *MIXED* *MOSTLY SATISFIED* *DELIGHTED*

24. Appropriate use of referrals to other practitioners or services when needed

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

25. Collaboration between service providers (if more than one)

TERRIBLE *MOSTLY DISSATISFIED* *MIXED* *MOSTLY SATISFIED* *DELIGHTED*

What is your overall feeling about the...

26. Publicity or information about programs and services offered

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

27. Handling and accuracy of your records (as best as you can tell)

TERRIBLE *MOSTLY DISSATISFIED* *MIXED* *MOSTLY SATISFIED* *DELIGHTED*

28. Contribution of services to achievement of your life goals

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

29. In an overall general sense, how satisfied are you with the services you have received

TERRIBLE *MOSTLY DISSATISFIED* *MIXED* *MOSTLY SATISFIED* *DELIGHTED*

30. Information you were given about concussion

DELIGHTED *MOSTLY SATISFIED* *MIXED* *MOSTLY DISSATISFIED* *TERRIBLE*

The next questions are also about information you were given on concussion...

31. The *amount* of information I was given about concussion was

FAR TOO MUCH *TOO MUCH* *ABOUT RIGHT* *TOO LITTLE* *FAR TOO LITTLE*

32. How well did the information given to you help you to understand concussion and its effects

NOT AT ALL *A LITTLE* *SOMEWHAT* *QUITE A BIT* *A GREAT DEAL*

THANK YOU VERY MUCH FOR YOUR HELP WITH THIS SURVEY, WE WOULD APPRECIATE ANY ADDITIONAL COMMENTS ABOUT THIS SERVICE YOU WOULD CARE TO ADD. YOU MAY WRITE THEM BELOW.

Would like the Concussion Clinic to send you a summary of the results of this evaluation?

Yes ____ No ____

Concussion Clinic

OUTCOME AND SERVICES EVALUATION
CONFIDENTIAL

Please read the following statements carefully and answer the questions as best you can.

*Even if you did not attend the clinic, it would be greatly appreciated if you could fill in the relevant sections in this questionnaire about your injury – Thank you.

I attended: (please tick)

No sessions at the clinic	____
1 session at the clinic	____
2-4 sessions at the clinic	____
4-6 sessions at the clinic	____
More than 6 sessions	____

If you did not attend the clinic after being referred, what was the primary reason for this?

The Concussion:

1. What was the cause of the concussion?

Motor Vehicle Accident	____	
Fall	____	
Sports Injury	____	(Please Specify Sport)_____
Assault	____	
Other (Please Specify)	_____	

2. What symptoms did the concussion cause in the weeks/months following the injury and what were the main problems that you experienced? (please rank in order of most to least troublesome and give examples where possible):

2.) _____

2.) _____

3.) _____

4.) _____

5.) _____

3. Who referred you to the clinic for assessment/treatment?

Hospital	_____	
GP	_____	
ACC Case Manager	_____	
Don't know	_____	Other (please specify) _____

How would you describe your recovery from this concussion?

1. In general I am...

BACK TO NORMAL	*MOSTLY BACK TO NORMAL*	*STILL HAVE MAJOR PROBLEMS*

2. If you were working or at school <u>prior</u> to injury, are you now...

BACK TO THE SAME LEVEL AS BEFORE	*MOSTLY BACK TO THE SAME LEVEL AS BEFORE*	*STILL HAVING PROBLEMS WHICH ARE AFFECTING YOUR RETURN*

3. Are you still receiving any treatment or support that is related to your injury? Y / N

If yes, please specify: _____

4. Do you think further treatment/support would be beneficial to your recovery? Y / N

If yes, please specify what type of support you think may be beneficial to you:

5. On a scale of 1-10, how happy are you with your recovery from concussion?

0	1	2	3	4	5	6	7	8	9	10
Very unhappy										Very happy

6. Please list in order of severity (most to least troublesome) any problems related to the concussion that you are still experiencing:

2.) _____

2.) _____

3.) _____

4.) _____

5.) _____

7. What do you think was most helpful to your recovery? (this is not limited to treatment)

It is important to know something about you so we request this extra information. Since only group data will be used, you will never be identified.

1. Age (years) now:

0 – 14	15 – 24
25 – 34	35 – 44
45 – 54	55 – 64
65 – 74	75 & over

2. What age were you when you were seen at the clinic?

3. What is your ethnicity?

NZ European ____
Maori ____
Pacific Island ____
Other (Please Specify) _____

4. Occupation (Please specify):

_____

_____

(At the time of your injury) (At Present)

5. Employment:

At the time of your injury:		At Present:	
Employed full time	Employed part-time	Employed full time	Employed part-time
Unemployed	Full-time student	Unemployed	Full-time student
Part-time student	Retired	Part-time student	Retired
Other (Please specifiy)_____		Other (Please specifiy)_____	

6. Yearly Family Income:

At the time of your injury:		At Present:	
Under $10,000	$10,000 - $20,000	Under $10,000	$10,000 - $20,000
$20,001 - $40,000	$40,001 - $60,000	$20,001 - $40,000	$40,001 - $60,000
$60,001 - $80,000	Over $80,000	$60,001 - $80,000	Over $80,000

7. Have you ever had a concussion / head injury before or since the concussion for which you were seen at the clinic?

Yes ____ No ____

If the answer to this question was yes;

*How many other concussions / head injuries have you had? ____

*How old were you when this / these happened and what was the cause of injury?

1.)_____(age)_____(cause)

2.)_____(age)_____(cause)

3.)_____(age)_____(cause)

4.)_____(age)_____(cause)

5.)_____(age)_____(cause)

*Did you receive any medical attention / treatment for this / them? Y / N

If yes, where were you seen and on which occasions were you seen there? (use numbers as above to indicate)

Hospital _____
GP _____
Concussion Clinic _____
Other (Please Specify) _____

THANK YOU VERY MUCH FOR YOUR HELP WITH THIS SURVEY, WE WOULD APPRECIATE ANY ADDITIONAL COMMENTS ABOUT THIS SERVICE YOU WOULD CARE TO ADD. YOU MAY WRITE THEM BELOW.

Would like the Concussion Clinic to send you a summary of the results of this evaluation?
Yes ____ No ____