Exploring Psychological Outcomes of Sport Concussion in Elite Athletes and their Parents

by

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Abstract

At present, there is a paucity of research evaluating the long-term effects of concussion in children and adolescents. The purpose of this study was to examine psychosocial functioning of elite youth ice hockey players with a history of concussion. Further, this study investigated parent report and explored the level of agreement between parent and player report on a measure of psychosocial functioning. Participants included 492 elite youth male and female ice hockey players between the ages of 13 and 17 years from Calgary and Edmonton, Alberta. Control participants included players with a history of muscular skeletal (MSK) injuries and players with a history of no injuries. Players completed the Behavior Assessment Scale for Children, Self Report Questionnaire (BASC-2, Adolescent Form) and parents completed the BASC-2 Parent Report Scale at baseline. Results from the first analysis, which examined differences between players with a history of concussion, a history of MSK injuries and a history of no injuries using a MANOVA, indicated that players with a history of concussion reported a greater level of difficulty on the attention subscale in comparison to MSK controls [$F(3, 487) = 3.26$, $p = .022$, partial $\eta^2 = .020$]. The next analysis examined individuals with a history of concussion closer and indicated that players with a history of two or more concussions were experiencing greater difficulties on the depression [$F(2, 488) = 4.10$, $p = .017$, partial $\eta^2 = .017$] , attention [$F(2, 488) = 4.00$, $p = .019$, partial $\eta^2 = .016$] and hyperactivity [$F(5, 484) = 1.67$, $p = .014$, partial $\eta^2 = .017$] subscales in comparison to players with a history of no concussions. Parent report indicated no differences in reporting regardless of concussion or injury history [$F(15, 1328) = .692$, $p = .789$, partial $\eta^2 = .007$]. The last analysis evaluated the level of agreement between player and parent report using paired samples t tests and correlations. Results indicated agreement on parent

and player report of attention [$t(127) = -0.068$, $p = .946$] for those players with a history of concussion. Further, there was agreement on the depression [$t(32) = -.645$, $p = 0.524$] subscale if the player had experienced a history of two or more concussions. However, within the overall sample there was a low level of agreement between player and parent report. Overall, the results of the study suggest that players with a history of multiple concussions may experience subtle psychosocial difficulties that are recognizable by parents under some circumstances.

Dedications

This thesis is first dedicated to my family. Without their unconditional support and encouragement every step of the way my journey through school thus far would not have been possible. I am forever grateful to have parents who always wanted the best for me no matter the circumstances. To Daniel for his patience, kind words and love throughout grad school; he keeps me grounded, calm and instills confidence in my abilities and myself. To our kitten Hobbes, who has brought so much joy into our lives and much needed pet therapy during stressful times.

To my dearest friends, who are my biggest cheerleaders in life, for decades they have stood by me and have always believed in me. I am so blessed to have understanding, compassionate and supportive friends. To my cohort, who have been unwavering sources of support and guidance throughout grad school. I feel very privileged to have learnt from and collaborated with this group of individuals.

Additionally, this research is dedicated to those who have been concussed or injured during sport or other circumstances. While writing this thesis I broke my arm and underwent two emergency surgeries. Through this challenging time I have come to truly appreciate the physical and psychological challenges of daily life with an injury. I will continue to contribute to the ever changing and growing fields of youth concussion, sport injury and clinical child psychology.

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Chapter One: Introduction

There are many factors that can influence a child's mental health status (Sattler, 2014). As children grow and develop into their early adolescent years there are a host of factors that contribute to their overall mental well-being. A child/adolescent's mental health status may contribute to performance at school, family relationships, social-emotional development, participation in recreational activities etc. (Sattler, 2014). Recently there has been interest in the effects of sport concussion on the developing youth brain and its short-term and long-term impact on psychosocial functioning. Currently, there is a paucity of research investigating the psychosocial impact of concussion in youth athletes. Therefore, it is of interest to investigate the possibility of concussion as a factor that impacts an adolescent's psychosocial adaptation.

For youth athletes participating in high impact sports, injury is a likely reality. Ice Hockey is among these high impact sports and with its high popularity in North America participation rates are high. In youth ice hockey, concussion accounts for more than 15% of all injuries and has been found to be the most common specific injury type (Emery & Meeuwisse, 2006; Emery, Meeuwisse & McAllister, 2006; K.J. Schneider, Meeuwisse, Kang, G.M. Schneider & Emery, 2013). Recently, there has been an elevated concern with youth hockey players and the incidence of concussion. Adolescent (age 12 to 19 years) sport concussion has become a great public concern with approximately 29,000 sports related concussions occurring annually in Canada (Statistics Canada, 2010).

Humans are social beings and psychosocial functioning is imperative to mental health as well as social success (Ensign, Maricle, Brown & Mayfield, 2012). The term "psychosocial" in this context refers to the psychological, behavioral, emotional and social aspects of overall mental health functioning (Ensign, Maricle, Brown & Mayfield, 2012; Sattler, 2014). Given that

a large portion of the brain is used for social interaction, an insult to the brain may cause disruptions in psychosocial functioning. Further, the frontal lobe, which is involved in higher order cognitions associated with psychosocial functioning, is very vulnerable after the acceleration deceleration that occurs during a concussive impact (Barkley, 1997).

The relationship between concussion and psychosocial difficulties is better described in adults than in youth populations. Researchers have shown that recurrent high impact sport concussions may lead to adverse psychosocial outcomes such as depression in adult populations (Chen et al., 2008; Guskiewicz et al., 2007; Kerr et al., 2012). Adult athletes have also reported lifestyle changes and psychosocial problems such as turbulent social relationships, marital and family distress, academic failure and substance abuse (Chen et al., 2008; Guskiewicz et al., 2007; Kerr et al., 2012).

In pediatric populations, psychosocial dysfunction is common following moderate to severe traumatic brain injury (Ensign et al., 2012; Luis & Mittenberg, 2002). Research has shown that disruptions in psychosocial functioning caused by a brain injury at a young age can place the child at a greater risk for deficits in social information processing. In turn, this can lead to a range of maladaptive behaviors and adverse psychological outcomes that may impact an individual throughout the life span (Yeates et al., 2007).

However, the psychosocial outcomes of mild brain trauma in youth are not as well understood (McCory et al., 2013; McKinlay, Grace, Horwood, Fergusson & MacFarlance, 2009; McKinlay, 2010). Recently, researchers have indicated that adolescent athletes with a history of two or more concussions reported significantly higher symptoms at baseline as well as elevated ratings on a measure of psychosocial functioning (Brooks et al., 2013; Kirkwood, Yeates & Wilson, 2006; Mrazik, Brooks, Jubinville, Meeuwisse & Emery, 2016). This highlights the

concern that children are at risk for sustaining multiple concussions during their early developmental years which could lead to significant effects on brain functioning in later life (Chen, Johnston, Petrides & Ptito, 2008; Guskiewicz et al., 2007; Guskiewicz et al., 2003; Iverson, Brooks, Lovell & Collins, 2006; Iverson et al., 2012; Kerr et al., 2012).

Young athletes present a unique set of challenges from both a clinical and research perspective. Specifically, accuracy of reporting due to age and number of possible informants can be very challenging. It is crucial that youth and their primary caregivers are able to accurately identify psychosocial functioning difficulties post concussion in order to seek help, support and/or treatment (Emery et al., 2016). Informant discrepancies between parent and player can have an impact on assessment, classification, and treatment of concussion. In fact, research has shown that oftentimes there is low to moderate agreement on symptom and overall quality of life reporting between parents and players post concussion (Ayr et al., 2009; Hajek et al., 2011). Some research has investigated parent's ability to identify symptoms (Coghlin & Howitt, 2009), evaluate executive function (Rieger et al., 2013), and examine overall quality of life post concussion (Ayr et al., 2009; Hajek et al., 2011; Piper & Garvan, 2014). However, no studies to date have investigated the agreement between parent and adolescent report of psychosocial functioning post concussion. It is important to explore whether multiple reporters enhance diagnostic sensitivity, a particularly important issue in the reliable assessment of post concussion functioning in pediatric populations. Further, understanding the typical degree of agreement between youth and their parents is important information necessary to facilitate appropriate integration of data required for sound clinical decision making.

Research Purpose

The purpose of this study was to explore the psychosocial functioning of elite youth ice hockey players' ages 13 to 17 years old at baseline (Prior to the start of the season) using the Behavioral Assessment Scale for Children-Second Edition (BASC-2 SRP). Additionally, it was of interest to explore parent perception of their adolescent's psychosocial functioning using the Behavioral Assessment Scale for Parents-Second Edition (BASC-2 PRS). Finally, the level of agreement between parent and player report was explored based on history of injury, history of concussion and severity of parent and player report. This research hopes to contribute to the pediatric sport concussion literature by providing a better understanding of psychosocial outcomes related to sport concussion and the agreement between informants on such measures.

Chapter Two: Literature Review

The purpose of this chapter is to review the literature related to psychosocial outcomes of Mild Traumatic Brain Injury (mTBI) and concussion in the youth population. Further, this chapter will discuss the agreement between parent and child/adolescent report of psychosocial functioning in healthy and concussed populations. The chapter will conclude with the statement of hypothesis supported by the reviewed literature.

Youth and Mental Health

Mental health is an integral part of a developing child and adolescent's overall health (Sattler, 2014). A child and/or adolescent's mental health status has a complex interactive relationship with their physical health, school performance and ability to be successful in society (American Psychiatric Association, 2013). Mental health status can also affect the child/adolescent's cognitive functioning, affective reactions, personality and temperament (Sattler, 2014). There are many risk factors, both biological and environmental, that influence the status of one's mental health. Participation in high contact sports leading to concussion may be an environmental risk factor for developing mental health difficulties. Specifically, researchers are beginning to examine the potential psychosocial impact of sport concussion in youth athletes.

History of Concussion

A Persian Physicist, Rhazes, first coined the term "concussion" in the 10th century (McCory & Brekovic, 2001). Rhazes was the first to distinguish the difference between a concussion and a more severe brain injury (McCory & Brekovic, 2001). Since then medicine, psychology, neuropsychology, physiotherapy, neuro-ophthalmology and other health related professions began to develop an understanding of head injuries and that each injury produced a different clinical presentation (McCory et al., 2013; Williams & Danan, 2016). Concussion in

sport did not become a prominent injury concern until the early 1900's when 21 documented American football related deaths were reported due to intracerebral hemorrhage, spinal cord injury, internal bleeding and cardiac arrest (Stone, Patel & Julian, 2014). Consequently, in 1910, the formation of the National Collegiate Athletic Association (NCAA) occurred in hopes to limit the number and severity of injuries by rule implementation (Williams & Danan, 2016). However, there was not a decrease in injuries, including concussion, until the late 1960's. The decrease in serious injuries, including concussion, was primarily attributed to changes in helmet design and more stringent rules during game play (Bailes & Cantu, 2001). In 2001, the Concussion in Sport Group published the first consensus statement outlining the most up to date research and best practices when managing concussions (Aubry et al., 2002). Since then, three more consensus statements have been produced, with the most recent being in 2013 (McCory et al., 2013). Throughout the years concussion research and awareness has grown; however, it has increased rapidly over the past 10 years beginning to uncover the true complexities of this injury (McCory et al., 2013). Despite the awareness of sport concussion for over a century this field is still in its infancy and requires much more research, knowledge translation and implementation into clinical practice (Williams & Danan, 2016).

Defining Concussion

The vast increase in concussion research has brought substantive changes in our understanding of what a concussion is. As a result, there have been changes in the definition and key terms used to clinically describe a concussion (McCory et al., 2013; McKinlay, 2010). Terms including minor closed-headed injury (Yeates et al., 2010), mild traumatic brain injury (Aubry et al., 2002) and concussion (McCory et al., 2009) have all been used to describe this injury. However, the use of multiple terms is problematic as it creates inconsistency in the field,

and suggests different meanings with respect to mechanism of injury, severity and effects on the brain (Williams & Danan, 2016). Further, multiple definitions of concussion have been generated in the literature with differing criteria, mechanism and symptoms (McCory et al., 2013).

The most current definition for concussion was created by the Concussion in Sport Group at the consensus meeting in 2012:

> "Concussion is a brain injury and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces. Several common features that incorporate clinical, pathologic and biomechanical injury constructs that may be utilized in defining the nature of concussive head injury include: 1) concussion may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an "impulsive" force transmitted to the head; 2) concussion typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously. However, in some cases, symptoms, and signs may evolve over a number of minutes to hours; 3) concussion may result in neuropathological changes, but the acute clinical symptoms largely reflect a functional disturbance rather than a structural injury, and as such, no abnormality is seen on standard structural neuroimaging studies; 4) concussion results in a graded set of clinical symptoms that may or may not involve loss of consciousness. Resolution of clinical and cognitive symptoms typically follows a sequential course. However, it is important to note that in a small percentage of cases, post-concussive symptoms may be prolonged" (McCrory et al., 2013, p. 179).

For the purposes of this thesis the term concussion will follow the definition laid out by McCory et al. (2013) as stated above. However, due to the fact that concussion was previously

regarded as a mild subset of mTBI, and these terms have been used inconsistently and interchangeably, literature examining both mTBI and concussion will be reviewed and discussed. Although the terms mTBI and concussion differ according to current guidelines, the accepted terminology used at the time of each study will be kept consistent in this review.

Concussion in Youth and Adolescent Populations

As mentioned above, research over the last decade has improved our understanding of the effects on the brain following concussive injuries. However, the majority of research has been conducted within the adult population (Emery et al., 2016; Gioia, Schneider, Vaughan & Isquith, 2009; McCory et al., 2013; McKinlay, 2010). Specifically, Gioia and colleagues (2009) reviewed the literature and determined that there were no data available for performing an age appropriate symptom assessment in children under the age of 8; however, there were many suitable assessments for young adults. Thus, the most comprehensive and well-researched guidelines have been created for adults. Children and adolescents brains are developing and maturing, making them anatomically, physiologically, and behaviorally different from adults and therefore should be managed differently (McCrory, Collie, Anderson, & Davis, 2004; McCrory et al., 2013; Purcell, 2009).

The most recent consensus statement included a section on managing child and adolescent (13 to 19 years of age) concussions (McCory et al., 2013). It has been well established that children and adolescent concussions need to be managed more conservatively than do adult concussions. Specifically, children and adolescents require more time to recover and have more specific risks including diffuse cerebral swelling. When working with this special population is it important to consider multiple informants including parents and possibly teachers along with the child/adolescent's input (McCory et al., 2013). Researchers have placed an

emphasis on returning to learn before returning to play (Gioia et al., 2009; McCory et al., 2013). Furthermore, careful consideration of concussion modifiers is critical in this population, as they influence prognosis of the injury. Concussion modifiers include: type of symptoms, loss of consciousness, time from previous concussion, number of previous concussions, age, co and pre morbidities, medication, behavior and sport type. Co and pre morbidities include migraines, depression or other mental health disorders, attention deficit hyperactivity disorder (ADHD), learning disability (LD), and/or sleep disorders (McCory et al., 2013). ADHD is present in approximately 5% of children and LD's are present in approximately 5% to 15% of children, therefore close and careful consideration is necessary when managing a pediatric concussion as these disorders are quite prevalent and need to be taken seriously (American Psychiatric Association, 2013).

Incidence. Concussions are one of the most common specific injuries among children and adolescents (Emery et al., 2016). Concussions occur more frequently in high impact sports, including hockey (Emery et al., 2010; Browne & Lam, 2006). In 2015, there were more than 650,000 youth registered for hockey in Canada (Emery et al., 2010). Furthermore, in Canada, 10 to 20 percent of hockey players aged 9 to 17 years report at least 1 head injury annually (Emery et al., 2010). However, it is difficult to determine the true incidence due to players under reporting to parents, coaches and medical professionals. Oftentimes incidence data collected via emergency department visits and not all individuals that sustain a concussion seek emergency medical attention (Williamson & Goodman, 2006). For example, when surveyed retrospectively, 50% of sampled junior hockey players did not report a concussion that was earlier recognized as a concussion by volunteer scouts (Goodman, Gaetz & Meichenbaum, 2001). However, data from

8 Canadian pediatric emergency departments indicated that 1 out of every 20 to 70 visits are for concussion (Zemek, Duval & Dematteo, 2014).

In terms of mTBI, in the United States, approximately 600,000 youth ages 0 to 19 years seek hospital medical care for mTBI's (Faul, Wald, Coronado & Dellinger, 2010). There are no current comparable data that exist for youth affected my mTBI in Canada. Pfister and colleagues (2016) performed a systematic meta-analysis to determine the incidence of concussion in children and adolescents (under the age of 18 years) in North America. The meta-analysis included 23 empirical articles to estimate the overall risk of concussion across 12 different sports. The results indicated that the pooled incidence rates of concussion were 0.23/1000 Athlete Exposures (AE). Further, they determined that hockey had the second highest incidence rate of concussion at 1.20/1000 AE (Pfister et al., 2016).

In terms of sport concussion in Canada, in 1998 to 2000 in the British Colombia Junior Hockey League, it was determined that higher rates of concussion occur in games versus practice and the average age for a first hockey related concussion was 15 year old (Goodman et al., 2001). Further, in the British Colombia, the incidence rate appears to be approximately 5.29 concussions per 1000 player/game hours for peewee to midget players (Goodman at al., 2001). An epidemiological review study summarizing US and Canadian incidence rates from multiple peer reviewed articles in children and adolescents across baseball, basketball, cross-country running, football, gymnastics, ice hockey, rugby, soccer and wrestling found that the incidence rate was highest for male ice hockey players ranging from 5 to 33.4 concussions per 1000 hours of exposure (Caine.D., Maffulli & Caine.C., 2008). The researchers attributed the large range in incidence rates due to different methods, sample size and length of data collection (Caine et al.,

2008). This highlights the need for more systematic large-scale incidence studies in Canada to help better determine the true sport concussion incidence rate in children and adolescents.

Common Symptoms. No two concussions are alike and they are often compared to the uniqueness of a snowflake. Therefore, symptoms can look quite different depending on the individual (McCory et al., 2013). However, the recent consensus statement outlined the most common and most clinically useful symptoms to look for. These symptoms fall under the following domains; somatic (e.g. headache), cognitive (e.g. feeling in a mental fog), emotional (e.g. lability), physical (e.g. loss of consciousness), behavioral changes (e.g. irritability) and sleep disturbance (e.g. insomnia) (McCory et al., 2013). The best practices states that if a player is experiencing any of these features that they be evaluated by a physician or licensed healthcare professional immediately including the administration of the Standard Concussion Assessment tool- Third Edition (available in child and adolescent/adult versions) (McCory et al., 2013b). Research has shown that the onset of these symptoms is typically immediately after the impact. However, it may take several minutes or even hours for signs and symptoms to fully emerge. Further, 80 to 90 percent of the time these signs and symptoms resolve within 7 to 10 days (McCory et al., 2013).

However, there is a small subset of individuals who do not get better within the expected 7 to 10 day period and continue to have persistent symptoms (Cantu, 1996; Yeates, 2010). This is often described as persistent post-concussion symptoms (PPCS) and refers to a variety of somatic, cognitive, emotional and behavioral symptoms, which persist past the typical recovery period (Cantu, 1996). In two large cohort studies in Alberta, 12 to 14 percent of children who sustained a concussion were still experiencing symptoms 3 months post concussion (Barlow, Crawford, Stevenson, Sandhu, Belanger & Dewey, 2010; Barlow, Crawford, Brooks, Turley &

Mikrogianakis, 2015). Further, in a sample of 130 children with mTBI's 17% showed significant ongoing problems 3 months post injury (Ponsford et al., 1999). However, the majority of those individuals that were experiencing persisting symptoms had a history of previous head injury, learning difficulties, neurological impairments, psychiatric problems and/or family stress; which are all recognized concussion modifiers known to complicate the recovery process (McCory et al., 2013; Ponsford et al., 1999). In the sport concussion population, Brooks, McKay, Mrazik, Barlow, Meeuwisse and Emery (2013) found that adolescent athletes that sustained two or more concussions (greater than 6 months ago, prior to testing) did not differ significantly on a measure of neurocognitive functioning but reported greater symptoms at baseline in comparison to those who did not have a history of multiple concussions, suggesting the potential for PPCS.

Persistent post concussion symptoms are less clear in child and adolescent populations; however researchers are beginning to develop effective management strategies for children and adolescents who do not recover within normal time limits (DeMatteo et al., 2015). For children and adolescents, these lingering symptoms may impact return to school, activity and sport and often require an increased level of health care services (Emery et al., 2016). Therefore, it is important to consider cognitive, somatic and psychosocial functioning in the overall recovery process. For the purposes of this thesis the prolonged disturbances in psychosocial functioning (psychological, social, emotional and behavioral symptoms) associated with PPCS will be the focus.

Psychosocial Outcomes following Concussion. As mentioned earlier, adults who have sustained multiple concussions are at risk for psychosocial dysfunction (Chen et al., 2008; Guskiewicz et al., 2012; Kerr et al., 2012). However, long-term psychosocial functioning post concussion is less understood in the child and adolescent population and is said to be

controversial (McKinlay et al., 2009; McKinlay, 2010). Research suggests that the 'gold standard' to investigate the presence psychosocial difficulties in youth is a semi-structured interview with parent and child/adolescent, supplemented by input from outside sources such as a teacher (Emery et al., 2016; Nugent et al., 2013). However, most studies have used a more resource effective method such as, broad-based rating scales measuring overall health and/or adjustment (Barkley, 1997; Yeates, 2010). Typically, these scales are measuring a broad range of internalizing and/or externalizing problems that involve the ability to self regulate and are associated with executive functions of the frontal lobe. Given the relative vulnerability of the frontal lobe after an acceleration deceleration impact, it is not all that surprising that frontal lobe dysfunction is a possibility (Barkley, 1997).

Light and colleagues (1998) investigated the extent to which mTBI affected behavior as measured by the Child Behavior Checklist and school performance as measured by grades on standard achievement tests in a group of male and female youth age 8-16 (N =119). Results indicated that at baseline (before an injury occurred) the orthopedic injury group and the concussed group had higher ratings on the CBCL than the no injury (control) group suggesting that they were at risk for an injury to begin with. Further, there were no behavioral or academic differences between the three groups (concussion, orthopedic injury and no injury) at the one-year post injury follow up. This research suggests that mild head injury sustained in youth does not increase the probability of new behavioral or academic difficulties when compared to orthopedic and healthy control groups (Light et al., 1998).

Later, McKinlay, Dalrymple-Alford, Horwood and Furgusson (2002) investigated psychosocial outcomes of individuals affected by mTBI before the age of 10 in a large birth cohort. Researchers used very rigorous methodology as suggested by Satz and colleagues in

1997. Researchers showed that children who experienced a mTBI of sufficient severity to warrant temporary hospitalization between the ages of 0 to 10 years showed adverse psychosocial outcomes in terms of hyperactivity, inattention and conduct like behavior as measured by a combined version of the Rutter and Connors parental rating scales. These ratings were completed when the child was between 10 to 13 years of age. This finding was particularly salient if the child endured the injury before the age of 5. However, children whose injury was not serious enough to stay overnight in the hospital had comparable psychosocial functioning to the non-injured reference group. Additionally, the study showed that young children who sustained a mTBI did not significantly differ from the control group in terms of intelligence or academic skills (as measured by the WISC-R and PAT exams) at age 8. This research suggests that the earlier the injury and the more severe the mTBI, the more likely youth are to have later difficulties with behavior aspects of psychosocial functioning.

Additionally, some research has implicated that oppositional behavior, hyperactivity and inattention are outcomes of mild to severe TBI (Hooper et al., 2004; Max et al., 2005). However, other studies have found the opposite; no behavior problems among children after suffering a mTBI (Kinsella et al., 1999; Prior et al., 1994). It is also of some debate whether increased reporting of inattention and hyperactivity is present pre-injury (McKinlay, 2010). Often times, individuals with a particular behavior profile are at greater risk of sustaining an injury and therefore post-injury their ratings on these behaviors are still elevated. Further, the suggestion that post-injury psychosocial dysfunction is reflective of family characteristics remains a viable question in the literature (McKinlay, 2010).

In a sport concussion population, Mrazik, Brooks, Jubinville, Meeuwisse and Emery (2016) investigated psychosocial outcomes (as measured by the BASC-2) in a cohort of youth

and adolescent hockey players. Findings suggested that a history of two or more concussions led to elevated ratings on the BASC-2 self report. This finding was not present in the orthopedic injury control group, suggesting difficulties with psychosocial functioning were unique to athletes with a history of concussion. It is important to note that these players with a history of concussion reported greater difficulty with psychosocial functioning compared to the control groups; however, as a group ratings did not reach diagnosable levels of concern suggesting that these players are still functioning within normal limits but are reporting subtle elevations (Mrazik et al., 2016).

Emery and colleagues (2016) were the first to systematically review the literature surrounding psychosocial outcomes following mTBI in children and adolescents (< 19 years of age) (2016). Of the 9472 studies identified in the initial search only 30 met the methodological criteria and were included in the review. The review indicated that the most commonly investigated psychological/psychosocial outcomes were attention, depression, mood disorders, anxiety, oppositional defiant disorder and posttraumatic stress disorder following youth mTBI. However, it is important to note that these studies reviewed were referring to an increase in symptom report and not necessarily a diagnosable or clinical level of concern. Emery and colleagues (2016) reported that the research is mixed; however, studies that do not account for the presence of pre injury behavioral concerns, if the injury occurs before 6 years of age, if outcomes are assessed early in the injury, if outcomes are based on retrospective recall, if the comparison group is non-injured healthy controls, if there is a history of trauma (including or not including mTBI), if subjects sustained multiple MTBIs and if the concussion required hospitalization there is an increased likelihood for the findings to show psychosocial dysfunction (Emery et al., 2016).

As discussed above, recently there have been some advances in the exploration of the long-term psychosocial outcomes of mTBI and concussion in pediatric populations. It seems that the literature is fairly consistent in suggesting that youth and adolescents that suffer a more severe brain injury endure more adverse outcomes including behavioral, cognitive and academic difficulties (Hopper et al., 2004; Kinsella et al., 1999; McKinlay, 2010; Prior et al., 1994; Satz et al., 1997). However, these causal conclusions are unable to be drawn in the concussion population, particularly within the sport concussion population due to the lack of empirically sound research. Further, the studies that are available vary in the methodological quality (Emery et al., 2016; McKinlay et al., 2016; Satz et al., 1997). Specifically, inconsistent injury definitions, poor control groups, variable quality of instruments used to measure psychosocial constructs, varied longitudinal follow up times, insufficient sample sizes, broad age ranges, retrospective report of pre-injury functioning and differences in pre-morbid functioning all contribute to the conflicting evidence (Emery et al., 2016; McKinlay et al., 2016; Satz et al., 1997). Therefore, it is important that more methodologically sound research take place to clarify long-term psychosocial outcomes of youth and adolescent concussion.

Analyzing Agreement between Parent and Player in Healthy and Concussed samples. Researching and/or treating pediatric populations present unique challenges. Psychological questionnaires are often used to rate behavior and may both parent and child forms. Yet discrepancies between parent and child can have an impact on assessment, classification, and treatment. There has been much research in the child psychopathology literature across various populations and measures. However, there has been a paucity of research examining the extent to which parents can accurately identify psychosocial dysfunction in their children and/or adolescents post concussion. Further, many studies that include parent

measures do not directly compare degree of agreement between informants. Therefore, below will be a discussion of literature pertaining to the agreement between parent and child/adolescent informants in healthy and concussed pediatric populations.

In a healthy population of children and parents, a meta-analysis examined 119 studies investigating agreement between informants on behavioral and emotional symptom reports (Achenbach, McConaughy & Howell, 1987). Results indicated low agreement between parent and child, represented by a correlation of .22. Researchers reported correlations to be significantly higher for children ages 6 to 11 year old than for adolescents. The weak correlations between child and parent informants indicate that the parent and child are not recognizing similar behaviors/symptoms (Achenbach et al., 1897).

Specific to psychosocial outcomes, Nugent, Kline, Thompson, Reeves and Schiffman (2013) examined the agreement across informants in a sample of 1916 children and adolescents (mean age 14.7 years old) on the Behavioral Assessment System for Children, Second Edition (BASC-2). Results indicated Pearson correlation coefficients in the low range on Atypicality (r = .241), Hyperactivity (r = .218) and Depression (r = 0.316) subscales. Suggesting that in the general population the agreement between parent and child/adolescent report is low. Unfortunately, no values were reported for Anxiety and Attention subscales, which will be examined in this thesis study. Researchers also found that agreement among informants did not differ due to gender of parent or child. Further they found that the Atypicality subscale had poor inter-rater reliability. Additional analyses examining items with nearly identical phrasing across forms yielded relatively low agreement, suggesting a lack of consensus rather than divergent constructs as measured by the BASC-2. The researchers conclude with suggesting that semi-

structured diagnostic interviews are generally considered the closest to the 'gold standard' although they have their flaws as well (Nugent et al., 2013).

In general, it is important to consider what types of symptoms are being measured on parent and child report. The child psychopathology literature has determined that parents and children report different levels of symptoms depending on the symptom type (De Los Reyes & Kazdin, 2005; Hajek et al., 2011; Hodges et al., 1990; Rey, Schrader & Morris-Yates, 1992). Specifically, research has shown that children are more likely to report more internalizing symptoms, whereas parents report more externalizing symptoms (Hodges et al., 1990; Rey et al., 1992). Further, it has been well identified in the literature that parent-child agreement is typically higher for externalizing symptoms than for internalizing symptoms (De Los Reyes & Kazdin, 2005; Hajek et al., 2011).

Specific to the mTBI population, Ayr and colleagues (2009) reported low to moderate agreement (correlations of .30 to .40) between parent and child ratings on the Health and Behavior Inventory (HBI). However, they did not examine mean scores on each of the measures; therefore, it is difficult to determine if the parent and child ratings were significantly different form one another. Hajek and colleagues (2011) expanded on Ayr and colleagues findings in 2009 using the HBI and the Post Concussion Symptom Interview (PCS-I) in a population of youth and adolescents affected by concussion. Results suggested that there were low to moderate correlations (.10 to .40) between children and parents in both the concussion groups as well as the orthopedic injury control group. However, there was less agreement between the concussed children and parents in comparison to the orthopedic injury control group. Further, ratings were compared between cognitive and somatic symptoms; researchers found that correlations were higher for cognitive symptoms and lower for somatic symptoms, suggesting that parent-child

agreement was affected by symptom type (Hajek et al., 2011). When examining the means of the parent and child ratings it was discovered that mean symptom ratings tended to be significantly higher for children than parents on both the PCS-I and the HBI. Specifically, children reported higher ratings of somatic symptoms compared to parents across time (12 month period). It is important to note that the researchers found that parent and child ratings can be correlated significantly despite significant differences in their mean ratings. These findings suggest that parents may be unaware of children experiencing somatic symptoms (Hajek et al., 2011).

Research indicates that children tend to have a heightened awareness of their internal sensations and differences in cognition may have a greater impact on a child's observable behavior, which may help to explain the above findings (Hajek et al., 2011; McCrea, Hammeke, Olsen, Leo, Guskiewicz, 2004). Also, the researchers advised that it is important to consider the degree to which the child is willing to share information with their parent (McCrea et al., 2004). Overall, this research highlights that there are differences in the ways parents and children report concussion symptoms and post concussion functioning (Hajek et al., 2011).

Pieper and Garvan (2014) examined the extent to which health-related quality of life, as measured by the PedsQL parent and child report, was affected amongst 120 children/adolescents (ages 5 to 17 years) after sustaining a mTBI. Although agreement among informants was not directly assessed, using the mean scores on each domain it was determined that there were no significant differences between parent and child scores at all time points (baseline, 1, 3, 6 and 12 months post injury) across all domains, including the psychosocial health domain. Further, there were no significant differences in the mTBI group in comparison to the orthopedic and healthy controls on psychosocial health domain (Pieper & Garvan, 2014). This finding is different from the research reviewed above.

Researchers have used the BASC-2 self-report and parent-report to examine agreement between parent and child/adolescent (ages 6 to 20 years) who sustained a moderate to severe TBI (Ensign et al., 2012). The results indicated agreement between parents and children/adolescents who rated themselves in the average (normal) range. Thus, this research found parents to express no concern about their child's psychosocial functioning if the children did not express a concern. Children who rated themselves in the at risk range or clinically significant range parents also reported similarly, expressing concerns of their child's social emotional and behavioral functioning (Ensign et al., 2012). It is likely that the severity of a TBI exacerbates symptom presentation and, therefore it is more likely that parent and child/adolescent informants are in agreement.

Although the evidence is mixed, there are many possible explanations for the findings. For example, research has shown that child's age, social desirability, problem type, perceived distress, parental psychopathology, parental stress and parental acceptance are all factors that may influence parent report of their child (De Los Reyes & Kazdin, 2005). It appears research in the pediatric concussion population is beginning to place more emphasis on parent child agreement. However, studies have not exclusively investigated parent-child agreement regarding psychosocial PPCS in detail in the pediatric sport concussion population.

Current Research Objectives

Objective 1A: To assess psychosocial differences between players who have a history of concussion in comparison to players who have a history of no injury, a muscular skeletal (MSK) injury or both a concussion and MSK injury on five subscales of the self-report version of the BASC-2.

IV: Player injury history

DV: Player ratings on the 5 BASC-2 subscales

Hypothesis: *Players who have a history of concussion will produce higher ratings on the BASC-2 subscales in comparison to players with a history of no injury and a history of MSK injuries.* Research shows that after sustaining a concussion players are at an increased risk for adverse outcomes including lingering symptoms and potential psychosocial outcomes in comparison to MSK injury control.

Objective 1B: To assess psychosocial differences between players who have a history of multiple concussions (two or more) in comparison to players who have a history of one or zero concussions on five subscales of the self-report version of the BASC-2.

IV: Player concussion history

DV: Player ratings on the 5 BASC-2 subscales

Hypothesis: *Players who have a history of multiple concussions will produce higher ratings on the BASC-2 subscales in comparison to players with no history of concussion and a history of one concussion.* Research suggests that after sustaining multiple concussions players are at an increased risk for adverse outcomes including lingering symptoms and potential psychosocial outcomes in comparison to individuals who have not sustained a concussion in the past.

Objective 2A. To assess psychosocial differences between parents whose children have a history of concussion in comparison to parents of players who have a history of no injury, an MSK injury or both a concussion and MSK injury on 5 subscales of the parent-report version of the BASC-2.

IV: Player injury history

DV: Parent ratings on the 5 BASC-2 subscales

Hypothesis: *Parent BASC-2 ratings of players with a history of concussion will not significantly differ from parent BASC-2 ratings of players with a history of no injuries or MSK injuries.* It is hypothesized that the level of maladjustment experienced by the players will be subtle, consistent with the mTBI research. Therefore, it is expected that there will be little to no differences in parent report across injury groups.

Objective 2B. To assess psychosocial differences between parents of players who have a history of multiple concussions (two or more) in comparison to parents of players who have no history of concussion or a history of one concussion on 5 subscales of the parent-report version of the BASC-2.

IV: Player concussion history

DV: Parent ratings on the 5 BASC-2 subscales

Hypothesis 2. *Parent BASC-2 ratings of players with a history of two or more concussions will not significantly differ from parent BASC-2 ratings of players with no history of concussions and a history of one concussion. It is hypothesized that there will be little to no differences in parent report across concussion groups.*

Objective 3: To assess rater agreement between parent and player report on the 5 parallel BASC-2 subscales in the overall sample, by injury group and by concussion group.

IV: Player injury history, player concussion history

DV: Parent and player ratings on the 5 BASC-2 subscales

Hypothesis*: Parent and player ratings on the 5 BASC-2 subscales will not be significantly correlated. Further, parent and player ratings will be significantly different from each other, suggesting a low level of agreement.* However, it is expected that there will be a greater degree of agreement on scales that include externalizing behaviors (e.g. hyperactivity) in

comparison to internalizing difficulties (e.g. depression) as suggested in the literature. Further, there will more agreement on cognitive symptoms (e.g. attention) due to the fact that it can impact the child's behavior in daily tasks.

Chapter Three: Methods

This chapter is organized into five subsections. First, will be an overview of the research design and key terms, followed by a description of the sampled participants. Each measure included in the study will then be reviewed. This chapter also outlines the process of data collection and statistical analyses employed. Finally, this chapter concludes with a description of the study ethics obtained.

Study Design and Key Terms

A retrospective cross-sectional cohort study design was used. This study falls under the category of a quasi-experimental as the groups were formed naturally in which no random selection took place. This potentially poses a threat to internal validity because the groups may not have been similar across factors such as personality pre injury. Random selection allows for each group to have similar variability; therefore, controlling for extraneous factors such as personality traits. All information was collected at the start of the 2011 - 2012 hockey season. Inclusion criteria for the study was as follows:

a) agreement of team coach to participate in the study,
b) agreement of team designate to collect information about individual player participation and injury throughout the study as part of the larger cohort study,
c) agreement by player and parent/guardian to informed consent,
d) completion of BASC-2 self and parent report at the start of the 2011-2012 hockey season and
e) completion of the preseason medical questionnaire (PSQ)

Exclusion criteria included:

a) developmental delay,

b) unable to participate in hockey at the beginning of the season (due to illness or injury),
c) cognitive impairment (mild to moderate cognitive delay),
d) any diagnosed psychological condition (e.g. learning disability, ADHD, anxiety, depression),
e) English language learner,
f) BASC-2 performance flagged as "invalid" based on three validity indexes,
g) any diagnosed chronic medical condition and
h) diagnosed concussion within 6 months prior to the study start date or MSK within 6 weeks of completing study questionnaires.

These exclusion criteria were selected to minimize the influence of variables other than prior concussions on psychological reporting on the BASC-2. It was of interest to look at the pure effects of psychosocial functioning as a result of previous concussion. Mental health disorders are modifiers for concussions, specifically co- and pre-morbidities (McCory et al., 2013). Therefore, the decision was to exclude them from the data set.

As mentioned earlier, for the purposes of this research, the term "concussion" will be defined as McCory and colleagues did in the consensus statement outlined above (2013). Further, the term "psychosocial functioning" will refer to the psychological, behavioral, emotional and social aspects of mental health functioning. Additionally, the term "adolescents" will be used to describe the age demographic of this sample as player's age ranged from age 13 to 17 years old.

Participants

Participants were recruited as part of a large cohort study (n= 44 hockey teams) designed to evaluate a multitude outcomes following sport concussion. The participants included male and female elite athletes (AA and AAA, top 20% of players) from Bantam and Midget hockey teams

in Calgary and Edmonton, Alberta. Bantam players were ages 13 to 14 and Midget players were age 15 to 17 years old.

A total of 779 participants were enrolled into the study. However, as per the exclusion criteria outlined above players were eliminated from the study if their parents identified them as having English as a second language (n =10), cognitive delay (n = 1), attention deficit hyperactivity disorder (n = 15), learning disability (n = 22), or any other mental health disorder (n = 5). Further, players were eliminated from the sample if their parents indicated (on the preseason medical questionnaire) that they had sustained a concussion within 6 months or an MSK injury within 6 weeks before baseline testing (n= 35) leaving 691 participants.

Additionally, only 564 parents completed the BASC-2 parent report, therefore another 127 participants were excluded from the analyses. A new parent player data set was created with 564 players matched with their parents. In this new parent player data set, 64 participants were removed due to incomplete demographic information (e.g. history of concussion, history of injury, age, etc.). After examination of the BASC-2 validity scales, 8 participants were removed due to invalid response sets. Additionally, 16 participants had incomplete BASC-2 data, which only accounted for 2.8% of all cases. Therefore, these cases were retained, as it is reasonable to use the mean scores when less than 5% of data is incomplete. Overall, the final sample size (N) was 492 players matched with their parents.

Measures

Three measures were administered in this study. These included the Preseason Questionnaire, BASC-2 self-report and BASC-2 parent report.

Preseason Questionnaire. The preseason medical questionnaire (PSQ) was completed primarily by parents and used to obtain information about each player enrolled in the study (see

Appendix C). The PSQ is a previously validated measure that has been used in youth hockey injury surveillance studies (Brooks, McKay, Mrazik, Barlow, Meeuwisse, & Emery, 2013; Brooks, Mrazik, Barlow, McKay, Meeuwisse, & Emery, 2014; Emery et al., 2010). The PSQ is a paper pencil questionnaire that was developed to pre-screen athletes for medical, mental health and behavioral conditions. Demographic information collected included age, birthdate, gender, height, weight, dominant hand, address, telephone number, and city of residence. Information collected related to hockey included; division of hockey, years of hockey played, position played, safety equipment worn, previous injuries, previous concussions and medical history. Additionally, information regarding previous psychological diagnoses was collected including cognitive delay, learning disability, communication disorder, pervasive developmental disorder, attention-deficit/hyperactivity disorder, disruptive behavior disorders, mood disorders (e.g., depression & bi-polar disorder) and anxiety disorders. This questionnaire also asked specifically about previous lifetime concussions ("Have you ever had a concussion or been 'knocked out' or had your 'bell rung'?") and MSK injuries within the past year. All athletes and their parent/guardians were required to complete the PSQ prior to 2011-2012 season baseline testing in order to be enrolled in the study.

BASC-2. All players and parents completed the appropriate versions of the Behavior Assessment System for Children – Second Edition (BASC-2) at baseline (See Appendix D) to evaluate they players current psychosocial functioning. The BASC-2 is a multi-method, multi-dimensional tool used to evaluate behavior, self-perceptions and parent perception of child/adolescent (Reynolds & Kamphaus, 2004). The BASC-2 has been well researched and validated in samples of children and adolescents with severe emotional disturbance and is sensitive enough to detect mild behavior problems (Reynolds & Kamphaus, 2004). The BASC-2

questionnaire takes from 10 to 20 minutes to complete. The BASC-2 is one of the most widely used norm-referenced diagnostic tools. The norms for the BASC-2 were developed in 2004 from a normative sample of approximately 13,000 individuals ages 2 through 18 years in the United States. Normative information is available for gender, age, and grade (Reynolds & Kamphaus, 2004).

Athletes in the study completed the BASC-2 Self-Report of Personality Adolescent Version (BASC-2-SRP-A) designed for adolescents ages 12 to 21 years old. The BASC-2 SRP for ages 12 – 21 has 176 items some of which are rated with a "yes" or "no" response and some of which are rated on a scale from "Never" to "Almost Always". The BASC-2 SRP form for adolescents has 5 composite index scores and 14 subscale scores. Parents in the study completed the BASC-2 Parent Rating Scale (BASC-2-PRS-A) designed for parents of adolescents ages 12 to 21 years old. There are 150 items on the BASC-2-PRS, which are rated on a scale from "Never" to "Almost Always". The parent report has 4 composite index scores and 14 subscale scores. The self-report and parent report measure similar constructs; however, some subscales differ. Therefore, for the purpose of direct comparison of self-report to parent-report, only the five subscales (atypicality, anxiety, depression, attention, hyperactivity) that match from self-report to parent-report were analyzed. It is important to note that including only 5 BASC-2 subscales could lead to incomplete psychosocial outcome data that may have been realized had all 16 clinical scales been analyzed. However, for the purposes of this research and the nature of direct comparison it was decided to only analyze the 5 matching BASC-2 subscales.

The BASC-2 is divided into two areas including the Clinical Scales, which measure maladaptive behaviors and the Adaptive Scales, which assess pro-social behaviors. A score in the "Clinically Significant" range (t score > or = 70) suggests a high level of maladjustment, and

should be of substantial concern. Scores in the "At-Risk" range (t score > or = 60) either identify a problem that may not be severe enough to require formal treatment (but is still a concern), or the potential of developing a problem that requires careful monitoring. Any rating falling below the "At Risk" range can be considered typical functioning for that age and gender of the respondent.

The BASC-2 includes three types validity scales that are sensitive to positive or negative response sets by raters (Gladman & Lancaster, 2003; Reynolds & Kamphaus, 2004). The F or "fake bad" index, contained within the self and parent report, assesses excessively negative responses (Gladman & Lancaster, 2003; Reynolds & Kamphaus, 2004). If this index was flagged as invalid that would indicate that the individual rated more negatively than typical respondents of that demographic would (parent or adolescent). Another, validity scale is the V index, which is a general validity check for carelessness, lack of comprehension, or compliance. Finally, the L or the "fake good" index measures extremely positive response sets and may reflect a lack of insight or lack of comprehension of the question (Gladman & Lancaster, 2003; Reynolds & Kamphaus, 2004). The validity scales of the BASC-2 are particularly important to ensure that the adolescent and their caregiver have responded to the questions appropriately. The validity scales allow for a clinician to interpret results with confidence. Further, the validity scales were part of the exclusion criteria in this study, such that if any of the validity scales were flagged as invalid those participants were removed from the analysis so they would not inappropriately skew the data.

Additionally, the BASC-2 parent and adolescent report show strong internal consistency reliabilities (between .81 to .96) using general norm groups. The BASC-2 parent and adolescent report also show strong test-retest reliabilities (between .77 to .90). The parent form also has

strong interrater reliability ranging from .70 to .84. The BASC-2 also has strong construct, convergent, and discriminative validity with other behavioral rating scales such as the Conners' Rating scales. Specific details regarding the validity of the BASC-2 parent and adolescent report can be found in the BASC-2 manual (Reynolds & Kamphaus, 2004).

As indicated previously, only 5 subscales (atypicality, anxiety, depression, attention and hyperactivity) from the BASC-2 parent and adolescent report were included in the study, as they were the only ones that were directly comparable between parents and adolescents. For purposes of this study, T scores from the five subscales were used for analysis, as T scores represent the gender based norm-referenced value rather than a non-norm referenced raw score.

Data Collection

A convenience sampling approach was taken to recruit participants and their parents, largely due to accessibility and proximity to researchers. This type of sampling has the disadvantage of limited generalizability to the general population. Typically, participants were recruited as a team; although, not every player on each team participated nor was it a requirement. Participant packages were delivered to each player of a participating team. The packages included an information sheet with a description of the study as well as consent forms. Signed parental consent and assent forms were required to participate in the study. Consent forms can be found in Appendix A and B. The preseason questionnaire and the paper-and-pencil version of the BASC-2 (SRP and PRS) were administered at this time for all players and parents who consented to participate in the study.

Statistical Analysis

Study Trax was used for all data entry and storage. All statistical analyses were carried out using SPSS 24.0. Descriptive statistics were used to describe the characteristics of the participants. Independent samples t-tests were calculated comparing demographic variables and test outcomes of individuals who were included and excluded from the analysis.

Objective 1A. This analysis examined the degree to which player history of injury (no injury, concussion, MSK or both concussion and MSK) had an effect on psychosocial functioning as rated by the players on the BASC-2 SRP. To note, all BASC-2 SRP and PRS analysis used only the 5 matching subscales (atypicality, anxiety, depression, attention and hyperactivity). A multivariate analysis of variance (MANOVA) was used to compare injury group X player BASC-2 subscale t scores. Because of the exploratory nature of this study, a post hoc analysis was conducted using the Bonferroni correction method. Significance for analyses was set at an alpha level of 0.05. Cohen's d effect sizes were also computed to complement the interpretation of results. Effect sizes were interpreted as negligible/very small ($d < 0.20$), small ($d= 0.20$-0.49), medium ($d= 0.50$-0.79), or large ($d > 0.80$) (Cohen, 1988).

Objective 1B. This analysis examined the degree to which player history of multiple concussions had an effect on psychosocial functioning as rated by the players on the 5 subscales of the BASC-2 SRP. A MANOVA was used to compare history of concussion X player BASC-2 subscale t scores. Because of the exploratory nature of this study, a post hoc analysis was conducted using the Bonferroni correction method. Significance for analyses was set at an alpha level of .05. Cohen's d effect sizes were also computed to complement the interpretation of results.

Objective 2A. The second analysis examined the degree to which player injury history had an effect on psychosocial functioning as rated by the player's parents on the BASC-2 PRS. A MANOVA was used to compare injury group X parent BASC-2 subscale t scores. Because of the exploratory nature of this study, a post hoc analysis was conducted post hoc analysis using the Bonferroni correction method. Significance for analyses was set at an alpha level of .05. Cohen's d effect sizes were also computed to complement the interpretation of results.

Objective 2B. This analysis examined the degree to which player concussion history had an effect on psychosocial functioning as rated by the player's parents on the BASC-2 PRS. A MANOVA was used to compare history of concussion X parent BASC-2 subscale t scores. Because of the exploratory nature of this study, a post hoc analysis was conducted using the Bonferroni correction method. Significance for analyses was set at an alpha level of .05. Cohen's d effect sizes were also computed to complement the interpretation of results.

MANOVA Assumptions. The assumptions for MANOVA were statistically verified and no violations were discovered. Specifically, box plots were constructed to ensure the absence of outliers; Shapiro-Wilk's test of normality indicated normal distributions; Lavene's test ensured homogeneity of variance; and dependent variables were found to be moderately correlated ensuring no problems of multicolinearity. No MANOVA assumptions were violated indicating the results could be interpreted with confidence.

Objective 3. The third analysis examined the degree of agreement between player BASC-2 SRP report and the parent BASC-2 PRS report across the 5 subscales in the overall sample, by injury group and by concussion group. Five paired samples t-test were computed for each of the 5 subscales, allowing for direct comparison of player report of anxiety to parent report of anxiety, for example. Significance for analyses set at a priori *a* $p < .05$ divided by the

number of subscales to correct for the family-wise error rate ($p = .01$). Additionally, Pearson product correlation coefficients (r) were calculated to determine the degree to which the two reports were in agreement. Conventional guidelines suggest correlations to be interpreted as small ($r < .1$), medium ($r = .11$ to $.49$) and large ($r > .5$) (Hemphill, 2003). Further, descriptive statistics (proportions) were calculated to evaluate the level of agreement between parents and players with a history of concussion that reported at risk concerns on any of the 5 BASC-2 subscales. Unfortunately, the sample sizes were too small to allow statistical analysis.

Ethics

Ethics approval for the study was granted by the Conjoint Health Research Ethics Board (Faculty of Medicine, University of Calgary) and the Health Research Ethics Board - Health Panel (University of Alberta) (Ethics ID E-24026). The research ethics boards determined this study to be of low risk to participants. The only anticipated risk was mild fatigue after having to complete the BASC-2 questionnaires. A potential long-term risk of this study was that the BASC-2 could possibly identify psychological, behavioral or emotional difficulties families were unaware of prior to completion of the BASC-2. However, the benefits of this study were determined to outweigh the harm. The possible benefits of this study included: a) understanding the behavioral and emotional symptoms typically experienced by adolescent athletes with concussion, b) understanding the agreement between parent and player report and c) understanding the impact concussion may have on the day-to-day activities of an adolescent athlete. This information can be used to inform medical practitioners, parents, and athletes about the natural course of concussions and to identify potential psychological, social, behavioral, and/or emotional difficulties that may arise as a result of a concussion. This information can then be used to inform practice and treatment for these symptoms. Another benefit for participants

was that all athletes that sustained a concussion were able to see a sports medicine physician within 48 hours of sustaining a concussion. Players were given close medical supervision and only returned back to play after receiving clearance from a sports medicine physician.

All data were securely stored in an office at the University of Calgary, Sports Injury Prevention Centre or in a secured office at the University of Alberta, Glen Sather Sports Clinic. A unique study identification number was used to recognize all participants thereby making all collected data anonymous and respecting the confidentiality of the personal information and findings of the study.

Chapter Four: Results

The purpose of this study was to examine player and parent report of psychosocial outcomes following concussion in elite youth ice hockey players. This chapter provides an overview of the results in which player report is examined as well as the agreement between player and parent report on a psychosocial scale (BASC-2).

Study Participants

There were 779 participants enrolled in the overall study. However, only 564 parents completed the BASC-2; therefore, 215 participants were immediately excluded from the study sample. Independent samples t-tests were performed to determine any differences between individuals included and individuals excluded from the sample, alpha level set at $p < .05$. Results showed no significant differences between player age ($t(729) = -1.92$, $p = .570$), previous concussions ($t(724) = -1.88$, $p = .073$) or previous MSK injury ($t(697) = -1.17$, $p = .142$). Chi square tests were used for categorical variables and determined there were no differences in player gender (X^2 (1, $n = 779$) = 0.316, $p = .574$) handedness (X^2 (1, $n = 779$) = 0.33, $p = .564$) or level of play (X^2 (1, $n = 779$) = 0.601, $p = .438$). This suggests that conclusions can be interpreted with confidence and results are still applicable to the larger population sampled for the overall study.

Additionally, a t-test was performed to determine if there were any differences between the 564 parents and players who completed the BASC-2 to the 492 parents and players who were included in the primary analysis due to exclusion criteria. Importantly, the t-test determined that there were no statistically significant differences between the included and excluded sample on the dependent variable (BASC-2 outcomes) on player (anxiety [$t(777) = 0.645$, $p = 0.519$], depression [$t(777) = -0.019$, $p = 0.985$], attention [$t(777) = 0.711$, $p = 0.478$], hyperactivity

[$t(777) = 0.724$, $p = 0.469$], atypicality [$t(777) = -0.001$, $p = 0.999$]) and parent (anxiety [$t(777) = -0.500$, $p = 0.617$], depression [$t(777) = -0.966$, $p = 0.335$], attention [$t(777) = 0.523$, $p = 0.601$], hyperactivity [$t(777) = -0.570$, $p = 0.569$], atypicality [$t(777) = 0.338$, $p = 0.698$]) report. This suggests that removing those participants did not skew or compromise the results in any way (See table 1).

A total of 492 players were included in the following analyses. The player's age ranged from 12 to 17 years, with a mean of 14.93 years ($SD = 1.22$). The majority (84.8%) of player participants were male ($n = 417$). The sample contained 15.2% female players ($n = 75$). The majority (64.6%) of the parent participants were female ($n = 319$). The sample consisted of 35.2% male parent participants ($n = 173$). The players were mostly right handed ($n = 427$, 86.8%). Players were from both Bantam ($n = 204$, 41.8%) and Midget ($n = 288$, 58.2%) teams in Edmonton and Calgary, Alberta. Players were split into groups based on their injury history as reported on the PSQ; history of no injuries ($n = 214$), history of concussion ($n = 127$), history of MSK ($n = 84$) and history of both a concussion and MSK ($n = 67$). Additional PSQ data allowed the sample to be further separated into individuals with a history of no concussion ($n = 301$), one concussion ($n = 159$) and two or more concussions ($n = 32$). Details of male versus female participants can be found below in Table 2.

Table 1

Differences in the Dependent Variable between Participants Included and Excluded

Primary BASC Scale	*t*-score	2-tailed *p* value	Mean Difference
Player Anxiety	.645	.519	0.801
Parent Anxiety	-.500	.617	-0.742
Player Depression	-.019	.985	-0.012
Parent Depression	-.966	.335	-1.055
Player Attention	.711	.478	0.922
Parent Attention	.523	.601	0.702
Player Hyperactivity	.724	.469	1.010
Parent Hyperactivity	-.570	.569	-0.666
Player Atypicality	-.001	.999	-0.001
Parent Atypicality	.388	.698	0.450

Table 2

Participant Characteristics

	Males (n = 417), Frequency (%) or Median (range)	Females (n = 75), Frequency (%) or Median (range)
Age	14.9 (12-17)	15.1 (13-17)
Handedness	Right (84.5)	Right (93.8)
Competitive Level		
AAA	226 (53.5)	73 (97.5)
AA	191 (46.5)	2 (2.5)
No History of Injury	177 (42.1)	37 (47.5)
History of Concussion	106 (26.4)	21 (30)
History of MSK	72 (17.1)	12 (16.3)
History of Both	62 (14.4)	5 (6.7)

Objective 1.A: Comparison of the BASC-2 Subscale Scores between Players in the Four Injury Groups

Table 3 depicts the means for each subscale score on the BASC-2 for the four injury groups. The overall model did not reach statistical significance [$F(15, 1328) = 1.31$, $p = .187$, partial $\eta^2 = .013$]. However, tests of between subject's effects reached significance for the attention subscale [$F(3, 487) = 3.26$, $p = .022$, partial $\eta^2 = .020$]. Although the overall test was not significant, for exploratory proposes a post hoc analyses using the Bonferonni method was conducted. This post hoc analysis indicated that players who had a history of concussion

reported greater difficulties with attention ($M = 47.6$) in comparison to individuals with a history of MSK injuries ($M = 43.8$) [F (3, 488) = 3.35, $p = .019$, $d = 0.41$ (small effect)].

Table 3

Results from the Player BASC-2 subscales by Injury Group

BASC-2 Subscale Score [mean t-score (SD)]	No Injury ($n = 214$)	Concussion ($n = 127$)	MSK ($n = 84$)	Concussion and MSK ($n = 67$)
Atypicality	45.3 (6.0)	45.7 (5.7)	44.4 (5.6)	45.3 (4.5)
Anxiety	46.7 (8.3)	47.4 (8.2)	46.1 (8.7)	48.6 (8.5)
Depression	42.5 (5.0)	43.2 (4.6)	41.9 (4.1)	42.8 (3.3)
Attention	45.6 (8.3)	47.6 (9.6)*	43.8 (8.5)*	46.0 (8.6)
Hyperactivity	49.9 (8.4)	51.3 (9.6)	49.4 (11.3)	52.4 (10.3)

* Statistically significant at $p < .05$

Objective 1B: Comparison of the BASC-2 Subscale Scores between Players who had a History of Concussion

Table 4 depicts the means for each subscale score on the BASC-2 for the three concussion groups (zero, one and two or more concussions). The overall model did not reach statistical significance [$F(10, 964) = 1.67$, $p = .085$, partial $\eta^2 = .017$]. Although the overall test was not significant, for exploratory proposes a post hoc analyses using the Bonferonni method was conducted. The tests of between subject's effects reached significance for depression [$F(2, 488) = 4.10$, $p = .017$, partial $\eta^2 = .017$] , attention [$F(2, 488) = 4.00$, $p = .019$, partial $\eta^2 = .016$] and hyperactivity [$F(5, 484) = 1.67$, $p = .014$, partial $\eta^2 = .017$]. However, there were no statistically significant differences on the atypicality or anxiety subscales. Table 5 depicts the post hoc results as well as the Cohen's d values for the depression, attention and hyperactivity subscales. There was a statistically significant difference and a medium effect size between players with a history of zero concussions and players with a history of two or more concussions across the depression, attention and hyperactivity subscales. Additionally, Figure 1 graphically depicts the findings.

Table 4

Results from the Player BASC-2 Subscales by Concussion History

BASC-2 Subscale Score [mean t-score (SD)]	Number of Previous Lifetime Concussions		
	Zero (*n* = 301)	One (*n* = 159)	Two or more (*n* = 32)
Atypicality	45.0 (5.9)	45.2 (5.2)	47.3 (5.8)
Anxiety	46.5 (8.4)	47.5 (8.2)	49.9 (8.8)
Depression	42.3 (4.8)	42.6 (3.5)	44.8 (5.9)
Attention	45.2 (8.4)	46.5 (9.1)	49.4 (9.3)
Hyperactivity	49.8 (9.3)	51.0 (9.7)	54.7 (9.9)

Table 5

Results from Post Hoc Analysis on Player BASC-2 Subscales by Concussion History

	Number of Previous Concussion Comparison					
	0 to 1		0 to 2		1 to 2	
BASC-2 Subscale	P value	Cohen's d	P value	Cohen's d	P value	Cohen's d
Depression	.999	0.069	.013*	0.510	.037*	0.564
Attention	.325	0.150	.029*	0.495	.268	0.317
Hyperactivity	.515	0.127	.016*	0.524	.142	0.380

* Statistically significant at $p < .05$

Note:

0 = No history of concussion

1 = History of one concussion

2 = History of two or more concussions

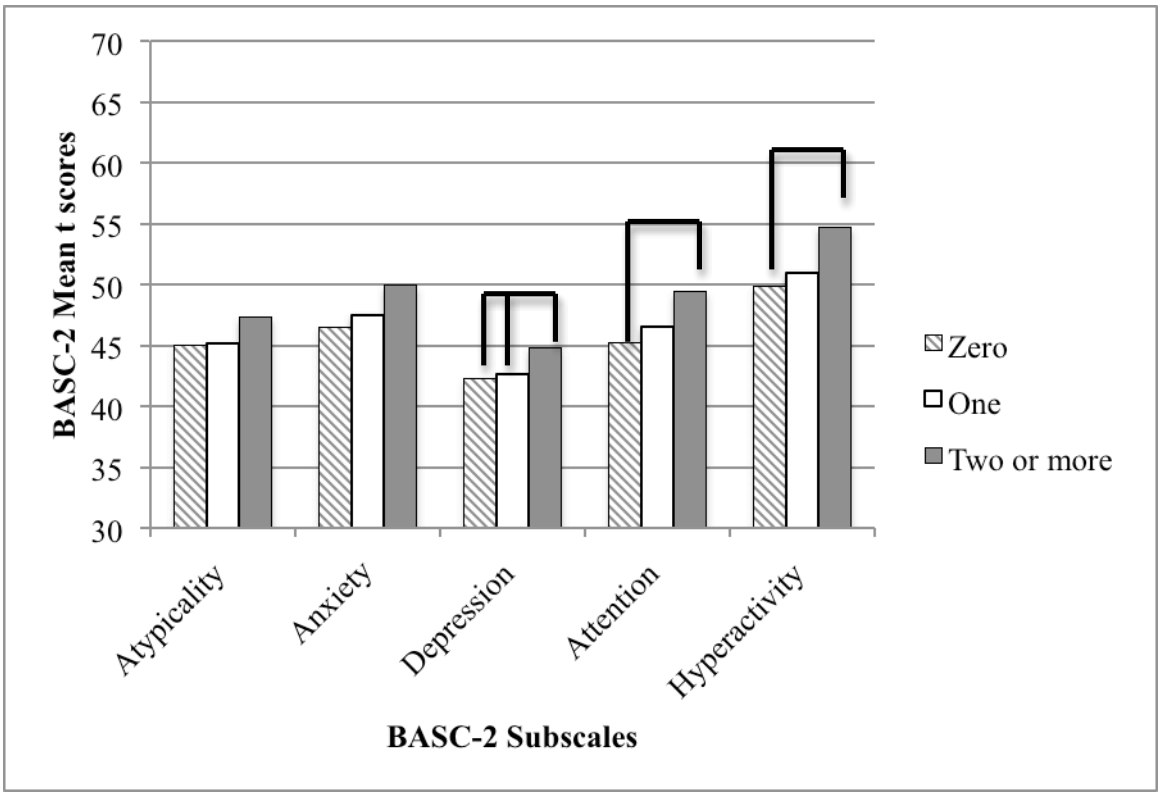

Figure 1. Player mean t scores for each measured BASC-2 subscale by concussion group.

Objective 2A: Comparison of the Parent BASC-2 Subscale Scores by Injury Group

Table 6 depicts the means for each subscale score on the BASC-2 PRS for the four injury groups. The overall model did not reach statistical significance [$F(15, 1328) = .692$, $p = .789$, partial $\eta^2 = .007$]. Although the overall test was not significant, for exploratory proposes a post hoc analyses using the Bonferonni method was conducted. Tests of between subject's effects also did not reach significance for any of the subscales in any of the four injury groups suggesting that player injury history had no impact on parental BASC-2 ratings.

Table 6

Results from the Parent BASC-2 subscales by Injury Group

BASC-2 Subscale Score [mean t-score (SD)]	No Injury (n = 214)	Concussion (n = 127)	MSK (n = 84)	Concussion and MSK (n = 67)
Atypicality	48.2 (7.8)	47.0 (5.6)	48.9 (7.0)	48.3 (8.3)
Anxiety	47.9 (9.1)	48.0 (8.9)	48.9 (9.6)	49.3 (9.6)
Depression	46.1 (7.9)	45.3 (5.4)	46.9 (6.4)	46.4 (6.7)
Attention	47.5 (8.7)	47.7 (7.1)	47.5 (8.6)	49.0 (8.7)
Hyperactivity	47.1 (7.2)	47.0 (6.5)	47.9 (8.5)	48.0 (7.7)

Objective 2B: Comparison of the Parent BASC-2 Subscale Scores by Concussion History

Table 7 depicts the means for each subscale score on the BASC-2 PRS for the three concussion groups (zero, one and two or more concussions). The overall model did not reach statistical significance [$F(10, 964) = 1.30$, $p = .226$, partial $\eta^2 = .013$]. Although the overall test was not significant, for exploratory proposes a post hoc analyses using the Bonferonni method was conducted. Tests of between subject's effects also did not reach significance for any of the subscales in any of the three concussion groups suggesting that history of player concussion did not impact parent ratings.

Table 7

Results from the Parent BASC-2 Subscales by History of Concussion

	Number of Previous Lifetime Concussions		
BASC-2 Subscale Score [mean t-score (SD)]	Zero (n = 301)	One (n = 159)	Two or more (n = 32)
Atypicality	48.5 (7.7)	47.3 (6.8)	47.3 (5.6)
Anxiety	48.2 (9.2)	48.5 (9.7)	48.3 (6.1)
Depression	46.3 (7.4)	45.7 (6.1)	45.7 (5.9)
Attention	47.6 (8.3)	47.7 (7.2)	50.1(10.1)
Hyperactivity	47.4 (7.6)	46.8 (6.7)	49.2 (7.7)

Objective 3: Agreement between Parent and Player BASC-2 Report

Overall Sample. Table 8 depicts the means for the 5 subscale t scores on the BASC-2 for both parent and player. Paired samples t tests indicated that there was a significant difference between parent and player report on all 5 subscales (atypicality [$t(488) = -7.6$, $p = 0.000$], anxiety [$t(488) = -2.9$, $p = 0.004$], depression [$t(488) = -10.6$, $p = 0.000$], attention [$t(488) = -4.6$, $p = 0.000$], hyperactivity [$t(488) = 6.6$, $p = 0.00$] . See table 9 for paired sample t test results. Further, Pearson product correlation coefficients all reached statistical significance ($p < .01$) and indicated medium agreement among parent and player informants. Table 10 displays the correlation coefficients for each of the subscales.

Table 8

Results comparing Parent and Player Report in the Overall Sample

BASC-2 Subscales	Player [mean t score (SD)]	Parent [mean t score (SD)]
Atypicality	45.2 (5.7)	48.0 (7.3)
Anxiety	47.0 (8.4)	48.3 (9.3)
Depression	42.6 (4.5)	46.1 (6.9)
Attention	45.8 (8.7)	47.8 (8.3)
Hyperactivity	50.5 (9.4)	47.4 (7.3)

Table 9

Results from the Paired Samples t test Comparing Parent to Player Report in the Overall Sample

BASC-2 subscale pair (parent and player)	t	df	Sig. (2-tailed)
Atypicality	-7.6	488	.000*
Anxiety	-2.9	488	.004*
Depression	-10.6	488	.000*
Attention	-4.6	488	.000*
Hyperactivity	6.6	488	.000*

* Significant at $p < .01$

Table 10

Correlation between Parent and Player report on the BASC-2 Subscales in the Overall Sample

BASC-2 Subscale	Pearson Correlation (r)	Sig. (2-tailed)
Atypicality	.257	.000*
Anxiety	.366	.000*
Depression	.252	.000*
Attention	.403	.000*
Hyperactivity	.247	.000*

* Significant at p < .01

History of Injury. Based on results from player report examined previously (objective 1A), players with a concussion reported greater difficulties with attention in comparison to the MSK group. Therefore, it was of interest to examine the degree of agreement of between parents and players with a history of concussion on the attention subscale, in which the players were reporting difficulties. Results from the paired samples t test indicated no significant difference between parent (M = 47.7) and player (M = 47.6) report ($t(127) = -0.068$, $p = .946$) on the attention subscale. Further, there was a medium positive correlation between parent and player report ($r(127) = .252$, $p = .004$).

History of Concussion. Based on significant results from player report, it was of interest to determine the degree of agreement between parents and players with a history of 2 or more concussions on the depression, attention and hyperactivity subscales. Results showed a significant difference between parent and player report of hyperactivity [$t(32) = 2.8$, $p = 0.008$] such that players with a history of 2 or more concussions rated themselves higher on the hyperactivity subscale in comparison to their parents ratings. There was a medium non-significant positive correlation between parent and player ratings on the hyperactivity subscale ($r(32) = .267$, $p = .140$). However, there was no significant difference between parent and player

ratings on the attention [$t(32) = -0.328$, $p = 0.745$] and depression [$t(32) = -.645$, $p = 0.524$] subscales suggesting that parents and players with a history of two or more concussions reported similar psychosocial functioning. There were small to medium non-significant positive correlations between parent and player ratings on the attention ($r(32) = .251$, $p = .166$) and depression ($r(32) = .088$, $p = .631$) subscales. Table 11 displays the mean subscale scores for parents and players with a history of 2 or more concussions on the depression, attention and hyperactivity subscales.

Additionally, it was of interest to evaluate agreement between parents and players with a history of concussion who rated themselves in the at risk range (T score >= 60). For each subscale the cross tabs function in SPSS indicated the number of players that rated themselves in the at risk range on that BASC-2 subscale and how many parents were accurate in also rating their adolescent in the at risk range (see table 12). For example, on the anxiety subscale 16 players rated themselves at risk and only 3 of the 16 parents rated their adolescent in the at risk range. Correlations were not computed as the sample size varies depending on the subscale and in some cases were too small to obtain a valid correlation. The opposite analysis was then performed in which the cross tabs function in SPSS indicated the number of parents that rated their adolescents in the at risk range along with the number of adolescents what were in agreement, also rating themselves in the at risk range (see table 13). Again, the sample of at risk previously concussed athletes was too low to continue with more rigorous statistical evaluations.

Table 11

Mean BASC-2 Subscale scores for parents and players with a history of 2 or more concussions

	Parent		Player	
BASC-2 Subscale t scores	Mean	SD	Mean	SD
Depression	45.6	5.9	44.8	5.9
Attention	50.1	10.1	49.4	9.3
Hyperactivity*	49.3	7.7	54.7	10.0

* Significant at $p < .01$

Table 12

Number of At Risk Players with a history of Concussion compared to the number of Parents who also rated the Player At Risk

BASC-2 Subscale	Number of Player who rated themselves "At Risk"	Number of Parents who rated their adolescent "At Risk"	Percentage of parents who accurately identified their adolescent in the "At Risk" range (%)
Atypicality	7	1	14.3
Anxiety	16	3	18.8
Depression	1	0	-
Attention	27	4	14.8
Hyperactivity	41	3	7.3

Table 13

Number of At Risk Parents compared to the number of Players with a history of Concussion who also rated themselves At Risk

BASC-2 Subscale	Number of Parents who rated their adolescent "At Risk"	Number of Players who rated themselves "At Risk"	Percentage of players who agreed with parental concern (%)
Atypicality	10	1	10.0
Anxiety	15	3	20.0
Depression	4	0	-
Attention	20	4	20.0
Hyperactivity	7	3	42.9

Chapter Five: Discussion

Concussion has recently become a public health concern in the pediatric population. It is suggested by the literature that adults who sustain a concussion may be at risk for adverse long-term psychosocial consequences, which may affect cognitive, social and emotional health (Chen et al., 2008; Guskiewicz et al., 2007; Kerr et al., 2012). However, long-term consequences of pediatric concussion are less understood and the research that has been published is mixed (Emery et al., 2016; McKinlay, 2010). Recently research seems to suggest that that after multiple concussions, children and adolescents are at risk for psychosocial dysfunction (Emery et al., 2016; Hooper et al., 2004; Max et al., 2005; McKinlay et al., 2002; Mrazik et al., 2016). However, some evidence suggests that pediatric concussion does not place individuals at risk for psychosocial dysfunction (Kinsella et al., 1999; Prior et al., 1994). There is a paucity of methodologically sound research investigating the long-term psychosocial outcomes of sport pediatric concussion.

Further, the pediatric population presents a unique set of challenges from a clinical and research perspective. Specifically, often times it is difficult to obtain a level of agreement between parent and pediatric patient informants on reports of psychological, behavioural, emotional, and social functioning (Ayr et al., 2009; Hajek et al., 2011). This informant discrepancy can have an impact on assessment, classification and treatment of concussion. Further, it is important to have an understanding of the impact of multiple informants; whether they provide diagnostic sensitivity or cloud the clinical picture.

Taken together, the current study examined psychosocial outcomes of elite youth ice hockey concussion. Additionally, this study examined the degree of agreement between parent and player informants on a measure of psychosocial functioning. The intention of this research

was to increase knowledge around psychosocial outcomes of sport related concussion in the pediatric population in order to facilitate future research and inform psychosocial management and treatment strategies for youth athletes who sustain a concussion. This was the first study to directly compare long term psychosocial outcomes of adolescent sport concussion as reported by parent and player.

Objective 1A: Player Injury History and Player Report

The first analysis examined differences between players who had no history of injuries, a history of concussion, history of MSK injuries or a history of both MSK and concussion injuries on a self report of psychosocial functioning. It was hypothesized that individuals with concussion would report greater difficulties on all subscales of the BASC-2 in comparison to the MSK and non-injured control groups. Although the overall model was not significant, exploratory post hoc analyses using the Bonferroni method indicated a small effect, indicated that players with a history of concussion reported greater difficulties with attention in comparison to individuals with a history of MSK injuries. Further, the players with a history of concussion were no different from the non-injured players and the players with a history of both a concussion and a MSK injury.

This finding is consistent with previous research indicating that youth and adolescents may have subtle inattention difficulties post concussion (Emery et al., 2016; McKinlay et al., 2002; Mrazik et al., 2016). However, that research also indicated maladaptive psychosocial functioning across other psychosocial domains such as depression and hyperactivity, which were not found in this study (Emery et al., 2016; McKinlay et al., 2002; Mrazik et al., 2016).

The finding of elevated attention difficulties is also consistent with research in the mild to severe TBI pediatric population, which indicated that two years post concussion 19.2% of

participants met criteria for Attention Deficit Hyperactivity Disorder (Levin et al., 2007). Additionally, research has shown that socioeconomic status is a significant predictor of the development of ADHD post mild to severe TBI (Max et al., 2005). Socioeconomic status was not a variable controlled or accounted for in this study and is a potential explanation for the results in this population.

It is unlikely that these findings reflect inattention problems at baseline, which has been a concern of researchers in past (McKinlay, 2010). In this study, parents who reported their child to have ADHD were removed from the analysis to obtain a purer understanding of the effects of concussion on attention. Research has also suggested that players who sustain injuries have a different behavior profile pre injury making them more likely to be injured (McKinlay, 2009). However, in this study this is unlikely to be a reason for the results as there were differences between the MSK and concussion group suggesting that the difficulty with attention is unique to concussion. This research seems to suggest that elite youth hockey players with a history of concussion may display an increased difficulty with attention. It is important to note that this increase in attention difficulty did not reach the threshold for clinical concern. The vast majority of these players were rating within the normal range as determined by the BASC-2 manual (Reynolds & Kamphaus, 2004). However, it is noteworthy that players with a history of concussion produced elevated concerns with attention in comparison to MSK controls.

Objective 1B: Player Concussion History and Player Report

This portion of the analysis examined differences between players who had no history of concussion, a history of one concussion and a history of two or more concussions on a self-report of psychosocial functioning. It was hypothesized that individuals with a history of two or more concussions would report higher ratings on all subscales of the BASC-2 in comparison to players

with no history of concussion and players with a history of one concussion. Although there were not many differences in overall sample demonstrated by objective 1A, it appears that when examining the concussion group closer there are differences in psychosocial report. Results indicated a medium effect for players with a history of two or more concussions reporting greater difficulties with depression, attention and hyperactivity in comparison to individuals with a history of zero concussions. However, there were no differences on the anxiety and atypicality subscales. Additionally, players with a history of two or more concussions reported greater difficulty with depression in comparison to individuals with a history of one concussion, also exhibiting a medium effect.

This finding is consistent with the literature that suggests that after multiple concussions children and adolescents may be more at risk for adverse outcomes (Iverson et al., 2012; Iverson et al., 2004; Mrazik et al., 2016). This study seems to suggest that after adolescent elite athletes suffer two or more concussions they experience greater difficulties with psychosocial functioning, specifically with regards to attention, depression and hyperactivity, in comparison to individuals that have never sustained a concussion. Further, the difference between players with a history of one versus two concussions on the depression subscale could indicate that players are more sensitive to their internal feelings or are experiencing slightly more mood-based symptoms after multiple concussions. However, it is important to keep in mind that report of depression was well within the average range, indicating no level of maladjustment. This is consistent with research that suggests youth are more likely to produce higher ratings for internalizing difficulties in comparison to externalizing difficulties (Hodges et al., 1990; Rey et al., 1992).

Objective 2A: Player Injury History and Parent Report

The second analysis examined differences between parent report based on whether their adolescent had a history of no injuries, a history of concussion, history of MSK injuries or a history of both MSK and concussion injuries on a parent report of psychosocial functioning. It was hypothesized that there would be no differences across parent report based on their child's injury history, as if the players were experiencing any maladjustment it was hypothesized that it would be subtle and therefore, difficult to recognize by parents. The results were consistent with the hypothesis indicating no differences in parent report based on their child's injury history. Even though the players with a history of concussions reported subtle psychosocial difficulties in comparison to MSK controls, their parents did not identify these subtle difficulties.

There is no research directly comparable to these results. However, previous research in mTBI literature has suggested that if problems are small to moderate parents are not always able to detect these subtle difficulties (Ayr et al., 2009; Hajek et al., 2011). Ponsford and colleagues (1999) reported similar findings such that there were no elevations of anxiety post injury as reported by parents in a sample of 130 children who sustained a concussion. Further, research suggests that parents are more likely to report more externalizing symptoms in comparison to internalizing symptoms (Hodges et al., 1990; Rey et al., 1992). In this study, parents reported the lowest ratings (indicating little to no concerns) on the depression subscale, consistent with the literature. However, report of atypicality, attention, hyperactivity and anxiety were similar. An analysis such as this has not been performed in the pediatric sport concussion population; therefore, these results are unique to the literature.

Objective 2B: Player Concussion History and Parent Report

The next analysis examined differences between parent report based on whether their adolescent had a history of no concussions, a history of one concussion or a history or two or more concussions on a parent report of psychosocial functioning. It was hypothesized that there would be no differences across parent report based on their child's concussion history, as if the players were experiencing any maladjustment it was hypothesized that it would be subtle and therefore, difficult to recognize by parents. The results were consistent with the hypothesis indicating no differences in parent report based on their child's concussion history. Even through the players with a history of two or more concussions reported subtle psychosocial difficulties in comparison to individuals with a history of no concussions, their parents did not recognize these subtle difficulties.

The literature has not specifically investigated parent report of youth with a history of multiple concussions or mTBI's. However, previous research suggests that after one mTBI parents have difficulty detecting small to moderate difficulties experienced by their child (Ayr et al., 2009; Hajek et al., 2011). Again, this finding is unique to the pediatric sport concussion population.

Objective 3: Agreement between Parent and Player Report

The third analysis examined the degree of agreement between parent and player report on a measure of psychosocial functioning in the overall sample, by injury history and by history of concussion. It was hypothesized that there will be a low level of agreement between parent player ratings. However, it was hypothesized that there would be a greater degree of agreement for cognitive and externalizing symptoms type subscales (attention, hyperactivity and atypicality) in comparison to internalizing/somatic type subscales (depression and anxiety).

Overall Sample. Results indicated that in the overall sample, there was a significant difference between parent and player report across all 5 subscales. This suggests that parents and players perceive the players psychosocial functioning differently. Further, a correlation indicated that the level of agreement on each of the 5 subscales was medium, signifying that there was a trend in the agreement across informants but they were still quite different from one another. Overall, there was a trend for parents producing higher ratings across all subscales with the exception of hyperactivity, in which the players reported more difficulty in comparison to their parents. The greatest agreement between player and parent report was on the anxiety subscale and the greatest disagreement between player and parent report was on the depression subscale. Evidently, had t test correlation analysis been performed in isolation, one may come to very different conclusions. However, Hajek and colleagues also reported that there can be significant mean differences that still produce a significant correlation. These two analyses together help to better clarify what the nature and strength of agreement between parent and player report.

These results are consistent with Hajek and colleagues (2011) indicating significantly different mean scores between child/adolescent and parent report and significant small to medium correlation suggesting a trend in agreement. However, Hajek and colleagues (2011) also reported that children/adolescents produce consistently higher ratings on somatic and cognitive like scales; however, this study showed the opposite trend (players reported higher on externalizing scales). This difference could be due to differences in participant demographics, Hajek and colleague's (2011) study was based on a non-sport injury population of males ages 8 to 15. Based on the literature it was anticipated that the lowest level of agreement between player and parent report would be on the depression scale (internalizing subscale) (Hodges et al., 1990; Rey et al., 1992). The results from this study are consistent showing the greatest level of

disagreement was on the depression subscale. Further, these results are similar to Nugent and colleagues (2013) who determined the agreement between parent and child/adolescent report on the BASC-2, in a healthy sample, to be small on the atypicality, hyperactivity and depression subscales. The current results are similar, which suggests that perhaps the level of agreement is an artifact of the BASC-2 and not necessarily influenced by a child's sport injury history.

History of Injury. Based on results from objective 1A, players with a concussion reported greater difficulties with attention in comparison to the MSK group. Therefore, it was of interest to examine the degree of agreement of between parents and players with a history of concussion on the attention subscale, in which the players were reporting difficulties. Results indicated no differences between parent and player report on the attention subscale, suggesting that parents of players with a history of concussion are able to accurately identify difficulties with attention reported by their adolescent. Further, this finding was supplemented by a medium correlation suggesting that parents are able to accurately identify inattention difficulties expressed by their adolescent. Attention is a cognitive construct and research suggests a higher level of agreement on cognitive in comparison to somatic type symptoms (Hajek et al., 2011), which was indicated in this finding.

History of Concussion. Based on significant results from objective 1B, it was of interest to determine the degree of agreement between parents and players on the depression, attention and hyperactivity subscales. Results indicated that parents and players perceived similar difficulties on the attention and depression subscales. However, on the hyperactivity subscale players were reporting significantly more difficulties than their parents perceived. In the overall sample, this analysis suggested that parents and players perceive attention and depression functioning differently. However, this additional analysis (only including players with a history

of two or more concussions) indicated that parents are able to perceive these difficulties with attention and depression expressed by their adolescent. This suggests parents are able to pick up on subtle psychosocial outcomes reported by players with a history of two or more concussions. It is interesting that similar results were not found on the hyperactivity subscale, as it is more of an externalizing construct and research would suggest a higher level of agreement on this subscale (Hajek et al., 2016). One possible explanation for this finding is that the players are experiencing increased hyperactivity in settings such as school where their parents are not present. This is an example of why multiple informants may be useful in obtaining a complete understanding of the adolescent's functioning across settings.

The last portion of the analysis sought to determine if parents were able to pick up on the difficulties reported by players with a history of concussion who rated themselves in the "at risk" range on each of the 5 of the BASC-2 subscales. It was hypothesized that parents would be able to recognize the difficulties the players were reporting, therefore indicating a high level of agreement. Due to the low number of athletes who had a history of concussion and reported concerns in the at risk range only proportions could be calculated. However, it was observed that parents did not perceive the same difficulties reported by the players who rated themselves at risk on any of the 5 subscales. There was a very low level of agreement, which is interesting considering these players were reporting difficulties that would be considered serious enough for close monitoring or potential to develop into a significant problem. This suggests that parents of players who have a history of concussion are not identifying psychosocial difficulties experienced by their adolescents.

These above findings are less consistent with the mTBI literature that suggests that if children/adolescents are experiencing difficulties parents typically perceive similar difficulties

(Ensign et al., 2012; Pieper & Garvan, 2014). Reasons for the observed differences in reporting could be due to the intimacy level between parents and players (De Los Reyes & Kazdin, 2005; Hajek et al., 2011; McCrea et al., 2004). Further, the mean age of players was 14.93 years of age. At this age children are transitioning into their adolescent/early young adult years and may be spending more time with friends than their parents. Additionally, research shows that the older the children become the less agreement is expected between parent and adolescent informants (Achenbach et al., 1987). Another possible explanation is that adolescents tend to have a heightened awareness of their internal, visceral sensations which is difficult to be observed by a parent (McCrea et al., 2004).

Strengths and Limitations

General strengths of the current study included stringent inclusion/exclusion criteria, mindfulness of concussion modifiers, reliable measures of psychosocial functioning, healthy sample size and use of a MSK injury control group. Emery and colleagues (2016) suggested that studies that compare pediatric mTBI to healthy controls are more likely to discover significantly increased rates of psychological and psychiatric problems in comparison to studies that compare pediatric mTBI to children with pediatric orthopedic injuries. The use of an orthopedic control group helps to control for the nonspecific effects of sustaining an injury or the risk of sustaining an injury based on pre-existing risk factors (Emery et al., 2016). Due to the inclusion of the orthopedic control group in this thesis research the results can be interpreted with confidence.

General limitations of the study included attrition due to parents not completing the BASC-2 PRS; therefore, the analysis was unable to include the entire original sample, which would have afforded more statistical power. Another limitation included the sample being largely male skewed. However, this overrepresentation of males is representative of elite youth hockey players in Alberta such that there are more male than female players. However, generalization of results to non-elite athletes, younger athletes and non-sport concussion populations should be done with caution. The cross-sectional study design is a potential limitation, as it required the retrospective report of concussion, which will be further discussed below. Additionally, this study design generates less power than a longitudinal design. Having the ability to evaluate the persistence of symptoms long term could help better describe the natural history associated with concussion in youth. It is also important to note that although the overall effects were not significant in objectives 1A and 1B exploratory post hoc analyses were

conducted using the Bonferroni correction, which is less stringent than other corrections; therefore, readers should be mindful of the potential of a type 1 error.

Strengths to Limitations Specific to Measures

BASC-2. It should be emphasized that the BASC-2 PRS is a parent-response questionnaire measuring the perceptions of their child's psychosocial functioning. Perception alone cannot be equated with actual behavior or psychiatric disturbance (Ensign et al., 2012). For example, in a study, children, parents and teachers predicted their level of anxiety on a social task they were about to perform (DiBartolo & Grills, 2006). Children's report was most predictive of their actual behaviors during the task and both the parent and teacher reports were significantly different from the child report suggesting they did not share the same perception of psychosocial functioning as the child did (DiBartolo & Grills, 2006). It is also possible that because these players were assessed at baseline they produced a positive response bias to minimize problems and present the best clinical picture possible. Although the validity scales built into the BASC would help with this potential problem, it is still possible that they underplayed symptoms that did exist in order to appear "normal". Further, individuals with a history of concussion may be more sensitive to reporting symptoms and behaviors due to potential increased self-awareness that could arise from repeated post concussion testing. It is also important to mention that although the BASC-2 is a norm-referenced measure, the norms were created from a sample of children and adolescents from the United States. There is a possibility that there may be differences in psychosocial functioning of children and adolescents between these two countries.

However, the BASC-2 was chosen, as it is a widely used assessment tool commonly chosen for clinical and school settings. Further, it offered parallels between parent and child

report as well as validity scales, which helped to ensure the results were not skewed due to a poor response set. Further, this tool was chosen as an exploratory measure to see what specific areas of psychosocial functioning were affected by concussion. Further research in this area should use specific scales to investigate attention, hyperactivity, and depression in closer detail in hopes to provide more support for the findings in this thesis research. In addition, it will be important to select measures that include both parent and player rating scales to allow for further comparison between informants.

PSQ. As mentioned earlier, the PSQ was selected as it has been validated in sport injury and concussion samples previously. However, research has shown that it is difficult to obtain an accurate history of concussion and injuries as reported by parents and players (McKay, Schneider, Brooks, Mrazik & Emery, 2014). It is thought that having parents report the player's injury and concussion history may have helped with collecting more accurate information. However, this potentially could be a limitation to the study as the grouping of the injury and concussion variables were based on PSQ report. Further, this research suggested that it is difficult to obtain accurate report of history of LD's and ADHD (McKay et al, 2014). This is another potential limitation as individuals with a history of these difficulties were eliminated from the analysis. It was of interest eliminate participants with diagnosed pre injury pathologies so the results were less likely to be driven by pre injury difficulties.

Conclusion and Future Directions

This study represents one of only a few published studies evaluating psychosocial outcomes arising from pediatric sport concussion. Further, this research presents the only study that examined the degree of agreement between parent and adolescent informants on a measure of psychosocial functioning in a pediatric sport concussion population. Results indicated that even currently healthy youth hockey players who had not been concussed within the past 6 months reported higher persisting psychosocial symptoms among those with a history of multiple concussions. It is important to keep in mind that significantly more symptoms do not necessarily translate into clinical significance or a diagnosable condition. Such as, in this thesis research, there were significant differences in report between players who had a history of concussion in comparison to those who did not; however, they were still reporting within the normal range in most cases.

The results of this study also suggest that in general there is low agreement between parent and player report. However, the level of agreement increased for players who were reporting difficulties and had a history of two or more concussions. The discrepancies between parent and adolescent informants argue for comprehensive assessments, which include multiple raters designed to reflect the overall clinical picture of adolescent psychosocial functioning.

Future studies should incorporate semi structured interviews with parent and adolescents, supplemented by input from outside sources such as teachers to provide a comprehensive evaluation of the adolescent's functioning as suggested in the literature (Emery et al., 2016). It is important to explore whether multiple informants enhance diagnostic sensitivity, a particularly important issue in the reliable assessment of post-concussion symptoms in children. Understanding the typical degree of agreement between adolescent and their parents or even

teachers is important information necessary to facilitate integration of data. The literature to date is insufficient for providing a causal link between concussion and psychosocial outcomes in pediatric populations. Nevertheless, the current findings support the existence of long-term psychosocial symptoms associated with multiple concussions in adolescent athletes. Additionally, these findings provide information regarding psychosocial symptoms experienced by adolescent athletes that may be useful in clinical management of pediatric concussion. This research will inform future prospective evaluation of psychological outcomes following a concussion in adolescents and agreement between parent and player informants.

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Appendix A: Information Sheet

Letter of Invitation: Elite Youth Ice Hockey Concussion Study

Dear coaches, players and parents,

This is an invitation to participate in an upcoming Ice Hockey Concussion Study that will begin in the fall of 2011 and run throughout the 2011-2012 season. Please find a brief description of the study below.

Background and Purpose:

Concussions are the most common injury type in elite youth ice hockey. Concussions can lead to longer term sequelae including prolonged symptoms (i.e. headache, dizziness, neck pain) and neurocognitive deficits. **The primary purpose of this study is to evaluate two** neurocognitive **tools** (SCAT2 and ImPACT computerized neurocognitive test) in the assessment of neurocognitive function (i.e. reaction time, memory, concentration, attention and processing speed) both **pre-season and following concussion**. The SCAT2 is a standardized evaluation of concussion used on the bench and in clinical return-to-play decisions in elite levels of play (i.e. major junior, NHL). The validity of the SCAT2 and the added value of the ImPACT in return to play decisions in youth elite ice hockey is unknown. This study will evaluate the validity of baseline neurocognitive testing (i.e. SCAT2 and ImPACT) and examine the utility of these tools in medical return to play decisions and in predicting prolonged recovery from concussion.

What is involved?

Baseline Testing:

We will recruit 30 teams from Bantam and Midget AAA and AA Quadrant Hockey and Female AAA Bantam and Midget in Calgary (and 10 teams in Edmonton). Pre-season testing will be completed at the Sport medicine Centre, University of Calgary or at the Glen Sather Clinic, University of Alberta in September 2011. This will provide a baseline to evaluate neurocognitive changes that may occur following a concussion and throughout recovery. This testing is not the current standard of practice in elite youth ice hockey but more typical in elite adult leagues (i.e. major junior, NHL). Baseline testing will take approximately 90 minutes.

Before baseline testing, there will be an information package sent home that includes a consent form, a preseason medical questionnaire and a behavioral questionnaire. On the day of testing, each participant will complete the SCAT2 (which is completed with a research assistant and an iPad) and one ImPACT test on a computer. Each participant will also be wearing a heart rate monitor (to monitor fluctuations in heart rate that occur during the session) and will do tests of neck and balance function. These measures will allow for evaluation of changes that occur following concussion, many of which have not been evaluated in youth ice hockey players previously.

During the season:

During the season, if the team trainers suspects a player has sustained a concussion, they will have the opportunity to follow-up with the study sport medicine physician at the Sport Medicine Centre at the University of Calgary or at the Glen Sather Clinic at the University of Alberta within a week following the injury. At this time, the player will also repeat the baseline tests. Athletes will be assessed weekly until return to play and at three months following concussion. The same measures will be repeated at each visit.

Why do this study?

This research is important when one considers the potential for concussion in elite youth ice hockey and the large numbers of youth participating. The preseason measures will facilitate assessment of changes that may occur following a concussion and allow monitoring of recovery. This will help develop a greater understanding of concussion outcomes in youth ice hockey players and inform the development of standard of care assessment and treatment guidelines.

We hope that you will consider participating in this study and look forward to working with you and your team during the season.

For more information, please contact:

Dr. Carolyn Emery
Sport Injury Prevention Research Centre
University of Calgary
(403) 220.4608

Appendix B: Consent Form

CONSENT FORM

TITLE: Elite Youth Ice Hockey Concussion Study

INVESTIGATORS:

Principal Investigator: Dr. Carolyn Emery, University of Calgary

Co-Investigators (University of Calgary): Dr. Willem Meeuwisse, Dr. Brian Brooks, Dr. Karen Barlow, Kathryn Schneider, Tracy Blake, Kirsten Taylor

Co-Investigators (University of Alberta): Dr. Martin Mrazik, Dr. Connie Lebrun, Andrea Krol

This consent form is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. For further details about this study, or to have your questions addressed please contact us. Please take the time to read this carefully and to understand any accompanying information. If you choose to participate, please keep your copy of this form and return the study copy (signed and witnessed) to your team designate.

BACKGROUND

Concussions are the most common injury type in elite youth ice hockey. Concussions can lead to long-term sequelae including prolonged symptoms (i.e. headache, dizziness, neck pain) and neurocognitive deficits. The SCAT2 is a standardized evaluation of concussion used on the bench and in clinical return-to-play decisions in elite levels of play (i.e. major junior, NHL). The validity of the SCAT2 and the added value of the ImPACT in return to play decisions in youth elite ice hockey is unknown. This study will evaluate the validity of baseline neurocognitive testing (i.e. SCAT2 and ImPACT) and examine the utility of these tools in medical return to play decisions and in predicting prolonged recovery from concussion.

In addition to neurocognitive changes that may occur with concussion, we will also be looking at other changes to functions in the body that may occur with concussion. These include changes in heart rate and heart rate variability, changes in neck function and balance, and behavioural changes.

Measuring Heart Rate (HR) and HR variability (the time between heartbeats) have been shown to be a non-invasive way of measuring the ability of the nervous system to regulate the function of the heart and cardiac system. HR and HRV have been shown to change depending on age and sex, and depending on the training or exercise capacity of the individual. They have also been shown to change after an individual has sustained a concussion. There is very little information looking at HR and HRV in a pediatric population in general, and none examining the changes they undergo after a concussion in athletes under 18 years old.

Balance problems and dizziness are commonly reported following concussions. The inner ear is a primary contributor to balance and is important to enable clear vision when the head is moving quickly (dynamic visual acuity). Little is currently known about changes in dynamic visual acuity (DVA) that may occur following a concussion Baseline values for dynamic visual acuity in youth ice hockey players are not currently known. Headaches and neck pain are also commonly reported following a concussion and may occur secondary to injury to the neck. Alterations in clinical tests for the vestibular system and cervical spine may occur following a concussion. Baseline and follow-up evaluation of commonly used neck and vestibular tests will be included as part of this study.

Behavioral, emotional and social changes have also been shown to occur after concussion in some individuals. We will be using a behavioural questionnaire to assess for any changes before and after concussion. Currently there is little research that has been conducted in this area.

A number of Alberta Bantam, Minor Midget and Midget Hockey Teams have agreed to take part in this research project. We would like to invite your child to participate. Your child's team has been randomly selected to participate in this survey. There are expected to be more than 1000 hockey players in this study.

WHAT IS THE PURPOSE OF THE STUDY?

The primary purpose of this study is to evaluate two neurocognitive tools (SCAT2 and ImPACT computerized neurocognitive test) in the assessment of neurocognitive function (i.e. reaction time, memory, concentration, attention and processing speed) both during the pre-season and following a concussion.

WHAT WOULD MY CHILD HAVE TO DO?

We will be recruiting 30 teams in Calgary (and 12 teams in Edmonton) from Bantam and Midget AAA and AA Quadrant Hockey and Female AAA Bantam and Midget. Pre-season testing will be completed at the Sport medicine Centre, University of Calgary as well as in the Glen Sather Sports Clinic, University of Alberta in September 2011. Testing will occur after team rosters have been finalized but before regular season games begin. This will provide a baseline to evaluate neurocognitive changes that may occur following a concussion and throughout recovery. This testing is not the current standard of practice in elite youth ice hockey but more typical in elite adult leagues (i.e. major junior, NHL). Baseline testing will take approximately 90 minutes.

Before baseline testing, there will be an information package sent home that includes a consent form, a preseason medical questionnaire and a behavioural questionnaire. On the day of testing, each participant will complete the SCAT2 (which is completed with a research assistant on an iPad) and one ImPACT test on a computer. Each participant will also be wearing a heart rate monitor (to monitor fluctuations in heart rate that occur during the session) and will do tests of neck function and balance. These measures will allow researchers to evaluate changes that occur following concussion, many of which have not been evaluated in youth ice hockey players previously.

During the season:

During the season, if a team trainer suspects that a player has sustained a concussion, they will have the opportunity to follow-up with the study sport medicine physician at the Sport Medicine Centre at the University of Calgary or at the Glen Sather Clinic at the University of Alberta within a week following the injury. At this time, the player will also repeat the baseline tests. Athletes will be assessed weekly until return to play and at three months following concussion. The same measures will be repeated at each visit.

ARE THERE ANY BENEFITS FOR MY CHILD?

If you agree to participate in this study there may or may not be a direct medical benefit to your child. His/her injury risk may be decreased during the study but there is no guarantee that this research will help him/her. If your child experiences a sports injury during the study duration, the team therapist (who will be attending every practice and game) will be assessing for injuries and making recommendations for follow-up treatment. The information we get from this study may help us to provide better sport injury prevention in future adolescent sport activities.

DOES MY CHILD HAVE TO PARTICIPATE?

No, your child does not have to participate.

WILL THERE BE FINANCIAL COMPENSATION, OR WILL THERE BE COSTS FOR THE PARTICIPANT?

There will be no financial compensation to the child or costs to the child as a participant in this study.

WILL MY CHILD'S RECORDS BE KEPT PRIVATE?

All of the information collected from the survey will be anonymous and will remain strictly confidential. Only the investigators responsible for this study, the research assistants who will be doing the baseline assessments, the statistician who will analyze the data, the University of Calgary, Conjoint Health Research Ethics Board and the University of Alberta Research Ethics Board will have access to this information. Confidentiality will be protected by using a study identification number in the database. Any results of the study, which are reported, will in no way identify study participants.

IF MY CHILD SUFFERS A RESEARCH RELATED INJURY, WILL WE BE COMPENSATED?

In the event that your child suffers an injury because of participating in this research, the University of Calgary, University of Alberta, the Calgary Health Region or the researchers, will provide no compensation. You still have all your legal rights. Nothing said here will in any way alter your right to seek damages.

SIGNATURES

If you agree to allow your child to participate, we require you to sign and return this form to your designated team study personnel. Two copies of the form are provided. Please keep one for your records. Please have another adult witness your signature on the copy that you return to us. Your signature on this form indicates that you have understood to your satisfaction, the information regarding participation in this research project and agree to allow your child participate as a subject. In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. Your child is free to withdraw from the study at any time without jeopardizing your health care. Continued participation should be as informed as your initial consent, so you should feel free to ask for clarification throughout your child's participation. You will be informed if there is new information

available through this study period. If you have further questions concerning matters related to this research, please contact:

Dr. Martin Mrazik (780)-492-8052

The plan for this study has been reviewed for its adherence to ethical guidelines and approved by the Health Research Ethics Board-Health Panel (REB) at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the University of Alberta Research Ethics Office at (780) 492-2615.

Please keep this letter for your own information, in case you would like to contact us later.

CONSENT FOR ELITE YOUTH ICE HOCKEY CONCUSSION STUDY

Parent/Guardian's Name (Printed)	Signature and Date
Child's Name (Printed)	Signature and Date
Investigator/Delegate's Name (Printed)	Signature and Date
Witness Name (Printed)	Signature and Date

PLEASE SIGN THIS PAGE AND RETURN THE FULL DOCUMENT TO YOUR TEAM DESIGNATE.

KEEP THE OTHER COPY FOR YOUR RECORDS

Appendix C: Assent Form

Assent Form for Players (under 18 yrs)
TITLE: Elite Youth Ice Hockey Concussion Study

INVESTIGATORS:
Principal Investigator: Dr. Carolyn Emery
Co-Investigators (University of Calgary): Dr. Willem Meeuwisse, Dr. Brian Brooks, Dr. Karen Barlow, Dr. Tish Doyle-Baker, Dr. Jian Kang, Kathryn Schneider (PhD Candidate), Tracy Blake, Kirsten Taylor
Co-Investigators (University of Alberta): Dr. Martin Mrazik, Dr. Connie Lebrun, Andrea Krol (PhD Student)

This consent form is only one part of agreeing to be in this study. It should give you the basic idea of what the research is about and what being a part of it will mean. Please, take the time to read and understand the information. If you have questions or need more information about this study, please let us know. ***If you choose to participate, please keep a copy of this form and return the other copy (signed and witnessed) to your team designate.***

BACKGROUND

A concussion is a mild brain injury. It is the most common injury in elite youth ice hockey. Concussions can lead long lasting problems like headache, dizziness, and neck pain as well as problems with concentration and memory. The SCAT2 is a standardized test for those who have had concussions. It is used to help doctors to make return-to-play decisions. ImPACT is a test that checks reaction time, how fast your brain makes sense of information, and memory. We do not know how important the SCAT2 and the ImPACT are in return-to-play decisions in youth elite ice hockey. This study will look at the validity of the SCAT2 and ImPACT; how helpful they are in making choices about returning to sport; and predicting who will take longer to get better after a concussion.

Concussions can also change how other parts of your body works, like your heart, your neck, how well you can balance, and how you act, think and feel. Part of this study will look at if your heart works differently after a concussion by measuring your heart rate and the time in between heartbeats. We do not have a good understanding about how these change after a concussion.

Many people have dizziness and problems balancing after a concussion. The inner ear plays a big part in balance and is important in order to have clear vision when the head is moving quickly. We do not have a good understanding about these things change after a concussion.

Headaches and neck pain are also common after a concussion. In this study, we will test balance, how the neck moves and how strong the neck muscles are before and after a concussion and to see if there is a difference.

Concussions can make some people think, feel and act differently. We will ask you to answer some questions that will help us see if any changes happen after a concussion.

Your team has been randomly selected to participate in this study. We would like to invite you to be involved. More than 1000 hockey players are expected to take part in this study.

WHAT IS THE PURPOSE OF THE STUDY?

The purpose of this study is to look at how well the SCAT2 and ImPACT work for testing how hockey players 13-17 years old think, react, remember and focus before and after a concussion.

WHAT WOULD I HAVE TO DO?

We will be asking 30 teams in Calgary (and 12 teams in Edmonton) from Bantam and Midget AAA and AA Quadrant Hockey and Female Bantam and Midget AAA teams to be in the study. Pre-season testing will take place at the Sport Medicine Centre, University of Calgary in September 2011. Testing will be done after team rosters are set but before the regular season starts. This will give us information that we can look back on so we can see any changes that may happen after a concussion. This testing is not currently done in every elite youth hockey league, but is used regularly in major junior hockey and the NHL. Pre-season testing will take about 90 minutes.

Before pre-season testing, there will be an information package sent home that you and your parents will fill out. It includes this consent form, questions about your medical and injury history and questions about how you think, act and feel. These forms must be returned to your team designate BEFORE you are allowed to take part in the study. The name of your team designate will given to you when you receive your package. On pre-season test day, you will do the SCAT2 on the iPad and one ImPACT test on a computer. You will also be wearing a heart rate monitor and will do tests for neck function and balance.

During the season:

During the season, if your team trainer thinks that you have had a concussion, you will be able to see the study sport medicine doctor at the Sport Medicine Centre at the University of Calgary within a week. You will see the doctor every week until you are back to sport as well as three months after your concussion. You will repeat the pre-season tests at each visit.

If one of your teammates has a concussion, you might be asked to act as a healthy control. This will involve coming into the Sport Medicine Centre and repeating the baseline tests at the same time as your teammate.

If you get injured and have to miss more than one week of hockey (practices and/or games), you will have the chance to see the study sport medicine doctor at the Sport Medicine Centre at the University of Calgary.

ARE THERE ANY BENEFITS FOR ME?

If you agree to be in this study there may or may not be a direct medical benefits. You may have less risk of injury during the study but there is no guarantee that this research will help you. If you have a sports injury during the study, your team therapist will assess you and give you advice about any treatment they think would help you.

DO I HAVE TO BE IN THE STUDY?

If you agree to be in the study, we need you to sign and return one copy of this form to your volunteer team designate. Please have another adult witness your signature on the copy that you return to us. Please keep the other copy for your records.

Taking part in this study is voluntary. You may leave the study at any time by telling the Research Coordinator, Maria Romiti, by phone (403-220-8949) or by email (maromiti@ucalgary.ca). Your involvement and registration in the club/team will not change if you do not want to be in the

study. Your coaching staff will know who is or is not in the study. This knowledge will not have any effect on how your relationship with your coaches or on the coaches' decisions about playing time. Please feel free to ask any questions you have that come up during the study that you think will help your understanding. You will be told of any new information that is available during the study.

WILL I BE PAID FOR BEING IN THE STUDY, OR DO I HAVE TO PAY FOR ANYTHING?

You will not get paid for being a part of this study. You will not have to pay for anything.

WILL MY RECORDS BE KEPT PRIVATE?

All of the information collected throughout the study period will have the names taken off and will remain private. Only the investigators responsible for this study, the research coordinator who will be doing the pre and post season testing, the statistician who will analyze the data and the University of Calgary, and the Conjoint Health Research Ethics Board will have access to this information. Using only a study identification number in the database will protect privacy. The reported results of the study will not identify you in any way.

IF I SUFFER A RESEARCH RELATED INJURY, WILL WE BE COMPENSATED?

If you are injured from participating in this research, the University of Calgary, Alberta Health Services and the researchers will not provide compensation. You still have all your legal rights. Nothing said here will in any way alter your right to seek damages.

SIGNATURES

Your signature on this form means that you have understand the information about taking part in the research project and agree to be a subject. This does not waive your legal rights nor release the investigators, or involved institutions from their legal and professional responsibilities. You are free to leave the study at any time without jeopardizing your health care. If you have more questions related to this research, please contact:

Ms. Maria Romiti (Research Coordinator)	(403) 220-8949
Dr. Carolyn Emery (Principle Investigator)	(403) 220-4608

If you have any questions concerning your rights as a possible participant in this research, please contact The Director, Office of Medical Bioethics, University of Calgary, at 403-220-7990.

Player´s Name (Print)

Signature and Date

Contact Information

Address:

Phone:

Witness' Name (Print)

Signature and Date

Dr. Carolyn Emery

Investigator/Delegate's Name

The University of Calgary Conjoint Health Research Ethics Board has approved this research study.

PLEASE SIGN THIS PAGE AND KEEP ONE COPY FOR YOUR RECORDS

Appendix D: Preseason Baseline Questionnaire

UNIVERSITY OF CALGARY

Study Subject ID# _____
(to be completed by study coordinator):

Sport Injury Prevention Research Centre
UNIVERSITY OF CALGARY

HOCKEY STUDY 2011-2012

Preseason Baseline Questionnaire

Name:	**Today's Date:** ____ / ____ / ____ (Day / Month / Year)
Gender: ☐ Male ☐ Female	
Age: **City:**	**Phone #:** ( ) -
Height: _____ feet ____ inches **or** _____ cm	**Date of Birth:** ____ / ____ / ____ (Day / Month / Year)
Weight: (lbs) **or** (kg)	
Dominant Hand (for writing): ☐ Right ☐ Left	**Age Group:** ☐ Bantam ☐ Minor Midget ☐ Midget
Association:	**Division:** ☐ AAA ☐ AA ☐ A
Position: ☐ Forward ☐ Defense ☐ Goalie	**Team Name:**

Please check off how many years of organized hockey you have played prior to this season (check only one):

☐ 0 years	☐ 5 years	☐ 10 years
☐ 1 year	☐ 6 years	☐ 11 years
☐ 2 years	☐ 7 years	☐ 12 years
☐ 3 years	☐ 8 years	☐ 13 years
☐ 4 years	☐ 9 years	☐ Other: _____

EQUIPMENT (check all that apply):

a) Mouthguard:

At games:	☐ always	***At practices:***	☐ always
	☐ less than 75%		☐ less than 75%
	☐ never		☐ never

Type of mouthguard worn: ☐ Dentist custom-fit ☐ off the shelf

b) Helmet:

Make: ☐ Bauer ☐ CCM ☐ Itech ☐ Jofa ☐ Mission ☐ Nike ☐ RBK ☐ Other: _____

Type: ☐ full clear visor ☐ full wire cage ☐ combination visor/cage

Age: ☐ new this season ☐ new last season ☐ 2-3 years old ☐ >3 years old

INJURY AND MEDICAL HISTORY:

1. Have you ever had a concussion or been "knocked out" or had your "bell rung"?

☐ Yes ☐ No *if **yes**, please list:*

Date:	Activity at the time	Time unconscious		Memory loss (yes or no)	Time loss before FULL return to sport
eg. (DD/MM/YY)	*hockey, skateboarding, etc.*	*0 min*	*30 sec*	*no*	*1 day, 10 days, etc*

If you answered **yes** to Question 1, please indicate whether you have any persistent problems with:

a) memory	☐ Yes	☐ No
b) dizziness	☐ Yes	☐ No
c) headaches	☐ Yes	☐ No

2. In the past **6 weeks**, have you had an injury requiring medical attention AND at least one day of time lost from physical activity?

☐ Yes ☐ No

*If **yes**, please describe this injury or these injuries to the best of your ability:*

Injury Date	Injury Type	Body Part	Sport of Occurrence	Treatment description	Estimated time loss from sport (days/wks)
eg. (DD/MM/YY)	*sprain, bruise, etc.*	*knee, nose, etc.*	*soccer, wakeboarding, etc.*	*first aid, physio, etc.*	*1 day, 3 weeks, etc*

3. In addition to any injury described in questions 2, have you had any other injury requiring medical attention AND at least one day of time lost from physical activity in the past **ONE YEAR**?

☐ Yes ☐ No

*If **yes**, please describe this injury or these injuries to the best of your ability:*

Injury Date	Injury Type	Body Part	Sport of Occurrence	Treatment description	Estimated time loss from sport (days/wks)

4a. Do you have any incompletely healed injuries?

☐ Yes ☐ No

*If **yes**, describe this injury to the best of your ability:* _____

4b. Are you currently receiving treatment for this injury/these injuries?

☐ Yes ☐ No

*If **yes**, describe this injury to the best of your ability:* _____

5. Are you currently taking any medication **for injuries**? (Please check all the apply)

☐ Advil

☐ Tylenol

☐ Other If Other, please list: _____

6. Do you take any medications (asthma inhaler, advil, tylenol, etc) on a regular basis ?

☐ Yes ☐ No

*If **yes**, please list:* _____

7. Are you currently taking any supplements (Vitamins, Minerals, Protein Powder, etc) ?

☐ Yes ☐ No

*If **yes**, please list:* _____

8. Have you been diagnosed by a physician with a bone fracture, arthritis, or other muscle or bone related condition?

☐ Yes ☐ No Year: _____

*If **yes**, describe this condition(s) to the best of your ability:* _____

9. Have you been diagnosed by a physician with a systemic disease (ie. cancer, thyroid disease, heart disease)?

☐ Yes ☐ No Year: _____

*If **yes**, describe this condition(s) to the best of your ability:* _____

questionnaire continues →

10. Have you ever been diagnosed by a physician with a circulation or heart-related problem (ie. heart murmur, irregular heart beat, congenital deformity of the heart)?

☐ Yes ☐ No Year: _____

*If **yes**, describe this condition(s) to the best of your ability:* _____

11. Have you been diagnosed by a physician with a neurological disorder (ie. Brain injury, cerebral palsy, pinched nerve, "stinger", multiple sclerosis, etc)?

☐ Yes ☐ No Year: _____

*If **yes**, describe this condition(s) to the best of your ability:* _____

12a. Have you ever experienced headaches?

☐ Yes ☐ No

12b. If yes, are they associated with (please check all that apply):

☐ Nausea
☐ Vomiting
☐ Sensitivity to Light
☐ Sensitivity to Noise

12c. Does anyone else in your family experience headaches?

☐ Yes ☐ No

*If **yes**, please list:* _____

13a. Have you ever been concerned that you have an attention or learning issue?

☐ Yes ☐ No

*If **yes**, describe to the best of your ability:* _____

13b. Have you ever been formally diagnosed by a health care professional (physician, psychologist, etc) as having an attention or learning issue?

☐ Yes ☐ No

*If **yes**, describe to the best of your ability:* _____

13c. Have you ever been formally diagnosed by a health care profession (physician, psychologist, etc) with any of the following: (please check all that apply)

☐ Cognitive Delay
☐ Communication Disorder
☐ Pervasive Developmental Disorder
☐ ADHD
☐ Learning Disability
☐ Anxiety Disorder
☐ Other: _____
☐ Disruptive Behaviour Disorder:
  ☐ Oppositional Defiant Disorder
  ☐ Conduct Disorder
☐ Mood Disorder:
  ☐ Depression
  ☐ Bi-Polar

questionnaire continues →

14. Have you had surgery in the past year?

☐ Yes ☐ No Date: _____

*If **yes**, describe this condition(s) to the best of your ability:* _____

15. In the past **6 weeks**, how many weeks and how many hours per week (on average) did you participate in a school PE class?

_____ *number of weeks* _____ *hours per week*

16. Based on the past **6 weeks** of activity, did you participate in any sports on a weekly basis **(NOT including PE class)**?

☐ Yes ☐ No

*If **yes**, please estimate the average number of hours per week you participated in each sport:*

SPORT	hrs/week	SPORT	hrs/week	SPORT	hrs/week
Aerobics		Floor hockey		Skateboarding	
Alpine skiing		Football		Snowboarding	
Badminton		Golf		Soccer	
Baseball		Gymnastics		Squash	
Basketball		Hiking/ Scrambling		Speed skating	
Boxing (incl. kick)		Hockey		Swimming	
Cross-country skiing		Horse riding		Tennis	
Cycling (road or mtn)		Lacrosse		Track and field	
Dance		Martial arts		Volleyball	
Dirt biking		Rock climbing		Waterpolo	
Diving		Rollerblading		Weight training	
Field hockey		Rugby		Wrestling	
Figure skating		Running		*Other:	
				**Please describe:*	

Appendix E: Adolescent & Parent BASC-2

Self-Report–Adolescent
Computer-Entry Form

SRP–A
Ages 12–21

BASC-2

Behavior Assessment System for Children, Second Edition

Cecil R. Reynolds, PhD, and Randy W. Kamphaus, PhD

Your Name _____ Date _____ Birth Date _____
First Middle Last Month Day Year Month Day Year

School _____ Grade _____ Sex: ☐ Female ☐ Male

Age _____ Other Data _____

Directions:

This booklet contains sentences that young people may use to describe how they think or feel or act. Read each sentence carefully. For the first group of sentences, you will have two answer choices: **T** or **F.**

Circle **T** for **True** if you agree with a sentence.

Circle **F** for **False** if you do not agree with a sentence.

Here is an example:

1. I like parties. (T) F

For the second group of sentences, you will have four answer choices: **N, S, O,** and **A.**

Circle **N** if the sentence **never** describes you or how you feel.

Circle **S** if the sentence **sometimes** describes you or how you feel.

Circle **O** if the sentence **often** describes you or how you feel.

Circle **A** if the sentence **almost always** describes you or how you feel.

Here is an example:

2. I enjoy doing homework. N (S) O A

If you wish to change an answer, mark an X through it, and circle your new choice, like this:

2. I enjoy doing homework. N (X) (O) A

Give the best response for you for each sentence, even if it is hard to make up your mind. There are no right or wrong answers. Please do your best, tell the truth, and respond to every sentence.

Before starting, please fill in the information in the box above these directions.

PEARSON Assessments

Product Number 30038

Mark: T – True F – False

1. I like who I am. ..... T F
2. I hate taking tests. ..... T F
3. Nothing goes my way. ..... T F
4. My muscles get sore a lot. ..... T F
5. People tell me I should pay more attention. ..... T F
6. Things go wrong for me, even when I try hard. ..... T F
7. I get mad at my parents sometimes. ..... T F
8. I used to be happier. ..... T F
9. I often have headaches. ..... T F
10. I don't care about school. ..... T F
11. I can never seem to relax. ..... T F
12. I always go to bed on time. ..... T F
13. My classmates don't like me. ..... T F
14. I worry about tests more than my classmates do. ..... T F
15. My parents are always right. ..... T F
16. If I have a problem, I can usually work it out. ..... T F
17. I never break the rules. ..... T F
18. I have not seen a car in at least 6 months. ..... T F
19. What I want never seems to matter. ..... T F
20. I worry about little things. ..... T F
21. Nothing is fun anymore. ..... T F
22. I never get into trouble. ..... T F
23. I tell the truth every single time. ..... T F
24. I never seem to get anything right. ..... T F
25. I have never been mean to anyone. ..... T F
26. My friends have more fun than I do. ..... T F
27. I like loud music. ..... T F
28. I always do what my parents tell me. ..... T F
29. No matter how much I study for a test, I am afraid I will fail. ..... T F
30. I cover up my work when the teacher walks by. ..... T F
31. I wish I were different. ..... T F
32. I have just returned from a 9-month trip on an ocean liner. ..... T F
33. Nobody ever listens to me. ..... T F
34. Often I feel sick in my stomach. ..... T F
35. I think that I have a short attention span. ..... T F
36. My parents have too much control over my life. ..... T F
37. My teacher understands me. ..... T F
38. I just don't care anymore. ..... T F
39. Sometimes my ears hurt for no reason. ..... T F
40. I don't like thinking about school. ..... T F
41. I worry a lot of the time. ..... T F
42. I get along well with my parents. ..... T F
43. Other children don't like to be with me. ..... T F
44. I wish I were someone else. ..... T F
45. I tell my parents everything. ..... T F
46. I can handle most things on my own. ..... T F
47. I like to take chances. ..... T F
48. I am sometimes jealous. ..... T F
49. My parents are always telling me what to do. ..... T F
50. I often worry about something bad happening to me. ..... T F
51. I don't seem to do anything right. ..... T F
52. I like everyone I meet. ..... T F
53. I have attention problems. ..... T F
54. Most things are harder for me than for others. ..... T F
55. I have some bad habits. ..... T F
56. Other children are happier than I am. ..... T F
57. I would rather be a police officer than a teacher. ..... T F
58. I always do homework on time. ..... T F
59. I take a plane trip from New York to Chicago at least twice a week. ..... T F
60. I never quite reach my goal. ..... T F
61. I feel good about myself. ..... T F
62. Sometimes, when alone, I hear my name. ..... T F
63. Nothing ever goes right for me. ..... T F
64. I get sick more than others. ..... T F
65. I give up easily. ..... T F
66. My parents blame too many of their problems on me. ..... T F
67. My teacher cares about me. ..... T F
68. Nothing about me is right. ..... T F
69. My stomach gets upset more than most people's. ..... T F

Remember: N – Never S – Sometimes O – Often A – Almost always

70. My school feels good to me. ..... N S O A
71. I get so nervous I can't breathe. ..... N S O A
72. I am proud of my parents. ..... N S O A
73. Other kids hate to be with me. ..... N S O A
74. I like the way I look. ..... N S O A
75. People say bad things to me. ..... N S O A
76. I am dependable. ..... N S O A
77. I like it when my friends dare me to do something. ..... N S O A
78. When I get angry, I can't think about anything else. ..... N S O A
79. I get blamed for things I can't help. ... N S O A
80. I worry when I go to bed at night. .... N S O A
81. I feel like my life is getting worse and worse. ..... N S O A
82. School is boring. ..... N S O A
83. I forget things. ..... N S O A
84. Even when I try hard, I fail. ..... N S O A
85. My teacher trusts me. ..... N S O A
86. People act as if they don't hear me. ... N S O A
87. I like to play rough sports. ..... N S O A
88. I have trouble standing still in lines. .. N S O A
89. I can't seem to turn off my mind. ..... N S O A
90. I am disappointed with my grades. ... N S O A
91. I get upset about my looks. ..... N S O A
92. I feel like people are out to get me. ... N S O A
93. I feel depressed. ..... N S O A
94. I sleep with my schoolbooks. ..... N S O A
95. I listen when people are talking to me. ..... N S O A
96. I stay awake for 24 hours without getting tired. ..... N S O A
97. Teachers make me feel stupid. ..... N S O A
98. No one understands me. ..... N S O A
99. I feel dizzy. ..... N S O A
100. Someone wants to hurt me. ..... N S O A
101. I feel guilty about things. ..... N S O A
102. I like going places with my parents. ... N S O A
103. I feel that nobody likes me. ..... N S O A
104. I am good at things. ..... N S O A
105. I am lonely. ..... N S O A
106. I can solve difficult problems by myself. ..... N S O A
107. I like to experiment with new things. ..... N S O A
108. I get nervous. ..... N S O A
109. My parents expect too much from me. ..... N S O A
110. I worry but I don't know why. ..... N S O A
111. I feel sad. ..... N S O A
112. I get bored in school. ..... N S O A
113. I have trouble paying attention to the teacher. ..... N S O A
114. When I take tests, I can't think. ..... N S O A
115. Teachers look for the bad things that you do. ..... N S O A
116. I am left out of things. ..... N S O A
117. I like to ride in a car that is going fast. ..... N S O A
118. I talk while other people are talking. ..... N S O A
119. Even when alone, I feel like someone is watching me. ..... N S O A
120. I want to do better, but I can't. ..... N S O A
121. My looks bother me. ..... N S O A
122. I hear voices in my head that no one else can hear. ..... N S O A
123. I am good at making decisions. ..... N S O A
124. I have trouble sitting still. ..... N S O A
125. I pay attention when someone is telling me how to do something. ..... N S O A
126. My parents are easy to talk to. ..... N S O A
127. Teachers are unfair. ..... N S O A
128. I have a hard time slowing down. .... N S O A
129. I like going to bed at night. ..... N S O A
130. I see weird things. ..... N S O A
131. I get nervous when things do not go the right way for me. ..... N S O A
132. My mother and father like my friends. ..... N S O A
133. People think I am fun to be with. ..... N S O A
134. I feel like I have to get up and move around. ..... N S O A
135. Other people find things wrong with me. ..... N S O A
136. I like to make decisions on my own. .. N S O A
137. I like to be the first one to try new things. ..... N S O A

Remember: N – Never S – Sometimes O – Often A – Almost always

138. Little things bother me. ..... N S O A
139. I am blamed for things I don't do. .... N S O A
140. I worry about what is going to happen. ..... N S O A
141. My mother and father help me if I ask them to. ..... N S O A
142. I feel like I want to quit school. ..... N S O A
143. I have trouble paying attention to what I am doing. ..... N S O A
144. I fail at things. ..... N S O A
145. My teacher is proud of me. ..... N S O A
146. I feel out of place around people. .... N S O A
147. I like to dare others to do things. ..... N S O A
148. I talk without waiting for others to say something. ..... N S O A
149. Someone else controls my thoughts. ..... N S O A
150. I quit easily. ..... N S O A
151. I am slow to make new friends. ..... N S O A
152. I do things over and over and can't stop. ..... N S O A
153. My friends come to me for help. ..... N S O A
154. People tell me to be still. ..... N S O A
155. My parents listen to what I say. ..... N S O A
156. I like to be close to my parents. ..... N S O A
157. My teachers want too much. ..... N S O A
158. When I get angry, I want to break something. ..... N S O A
159. I get phone calls from popular movie actors. ..... N S O A
160. I hear things that others cannot hear. ..... N S O A
161. I get mad at others. ..... N S O A
162. I have trouble sleeping the night before a big test. ..... N S O A
163. I am liked by others. ..... N S O A
164. People tell me that I am too noisy. .... N S O A
165. I feel that others do not like the way I do things. ..... N S O A
166. I am someone you can rely on. ..... N S O A
167. When I get angry, I want to hurt someone. ..... N S O A
168. When I start talking, it is hard for me to stop. ..... N S O A
169. People get mad at me, even when I don't do anything wrong. ..... N S O A
170. I am afraid of a lot of things. ..... N S O A
171. My parents trust me. ..... N S O A
172. I hate school. ..... N S O A
173. My parents are proud of me. ..... N S O A
174. Ideas just race through my mind. ..... N S O A
175. My teacher gets mad at me for no good reason. ..... N S O A
176. Other people are against me. ..... N S O A

Parent Rating Scales–Adolescent
Computer-Entry Form

PRS–A
Ages 12–21

BASC™-2

Behavior Assessment System for Children, Second Edition

Cecil R. Reynolds, PhD, and Randy W. Kamphaus, PhD

Child's Name _____ (First Middle Last)

Date _____ (Month Day Year) Birth Date _____ (Month Day Year)

School _____ Grade _____

Sex: ☐ Female ☐ Male Age _____

Other Data _____

Your Name _____ (First Middle Last)

Sex: ☐ Female ☐ Male

Relationship to Child: ☐ Mother ☐ Father ☐ Guardian ☐ Other _____

Instructions:

On the pages that follow are phrases that describe how children may act. Please read each phrase, and mark the response that describes how this child has behaved recently (in the last several months).

Circle **N** if the behavior **never** occurs.

Circle **S** if the behavior **sometimes** occurs.

Circle **O** if the behavior **often** occurs.

Circle **A** if the behavior **almost always** occurs.

Please mark every item. If you don't know or are unsure of your response to an item, give your best estimate.

How to Mark Your Responses

Be certain to **circle** completely the letter you choose, like this:

N (S) O A

If you wish to change a response, mark an X through it, and circle your new choice, like this:

N (X) (O) A

Before starting, be sure to complete the information in the boxes above these instructions.

PEARSON

PsychCorp

Product Number 30035

Remember: N – Never S – Sometimes O – Often A – Almost always

1. Adjusts well to new teachers. ..... N S O A
2. Accurately takes down messages. .... N S O A
3. Volunteers to help clean up around the house. ..... N S O A
4. Calls other adolescents names. ..... N S O A
5. Pays attention. ..... N S O A
6. Compliments others. ..... N S O A
7. Is creative. ..... N S O A
8. Cries easily. ..... N S O A
9. Complains of being sick when nothing is wrong. ..... N S O A
10. Annoys others on purpose. ..... N S O A
11. Has eye problems. ..... N S O A
12. Worries about making mistakes. ..... N S O A
13. Uses foul language. ..... N S O A
14. Makes friends easily. ..... N S O A
15. Cannot wait to take turn. ..... N S O A
16. Has stomach problems. ..... N S O A
17. Joins clubs or social groups. ..... N S O A
18. Adjusts well to changes in plans. .... N S O A
19. Steals. ..... N S O A
20. Acts without thinking. ..... N S O A
21. Seems unaware of others. ..... N S O A
22. Complains about being teased. ..... N S O A
23. Is nervous. ..... N S O A
24. Encourages others to do their best. .. N S O A
25. Is cruel to animals. ..... N S O A
26. Is unclear when presenting ideas. ... N S O A
27. Sees things that are not there. ..... N S O A
28. Says, "I'm not very good at this." ..... N S O A
29. Drinks alcoholic beverages. ..... N S O A
30. Says, "Nobody understands me." ..... N S O A
31. Adjusts well to changes in routine. ... N S O A
32. Communicates clearly. ..... N S O A
33. Acts in a safe manner. ..... N S O A
34. Teases others. ..... N S O A
35. Has a short attention span. ..... N S O A
36. Congratulates others when good things happen to them. ..... N S O A
37. Is good at getting people to work together. ..... N S O A
38. Is negative about things. ..... N S O A
39. Complains of shortness of breath. ... N S O A
40. Threatens to hurt others. ..... N S O A
41. Has a hearing problem. ..... N S O A
42. Worries about what teachers think. .. N S O A
43. Sneaks around. ..... N S O A
44. Refuses to join group activities. ..... N S O A
45. Has poor self-control. ..... N S O A
46. Says, "I think I'm sick." ..... N S O A
47. Will speak up if the situation calls for it. ..... N S O A
48. Is a "good sport." ..... N S O A
49. Smokes or chews tobacco. ..... N S O A
50. Interrupts parents when they are talking on the phone. ..... N S O A
51. Stares blankly. ..... N S O A
52. Says, "I hate myself." ..... N S O A
53. Tries too hard to please others. ..... N S O A
54. Says, "please" and "thank you." ..... N S O A
55. Has headaches. ..... N S O A
56. Tracks down information when needed. ..... N S O A
57. Has strange ideas. ..... N S O A
58. Says, "I get nervous during tests" or "Tests make me nervous." ..... N S O A
59. Is in trouble with the police. ..... N S O A
60. Says, "I want to kill myself." ..... N S O A
61. Recovers quickly after a setback. .... N S O A
62. Is effective when presenting information to a group. ..... N S O A
63. Needs help from others to get up on time. ..... N S O A
64. Argues when denied own way. ..... N S O A
65. Listens to directions. ..... N S O A
66. Tries to bring out the best in other people. ..... N S O A
67. Works well under pressure. ..... N S O A
68. Changes moods quickly. ..... N S O A
69. Complains about health. ..... N S O A
70. Hits other adolescents. ..... N S O A
71. Repeats one activity over and over. .. N S O A
72. Worries about things that cannot be changed. ..... N S O A
73. Breaks the rules. ..... N S O A
74. Is shy with other adolescents. ..... N S O A
75. Acts out of control. ..... N S O A
76. Pays attention when being spoken to. ..... N S O A

Remember: N – Never S – Sometimes O – Often A – Almost always

77. Makes decisions easily. ..... N S O A
78. Adjusts well to changes in family plans. ..... N S O A
79. Lies. ..... N S O A
80. Interrupts others when they are speaking. ..... N S O A
81. Needs to be reminded to brush teeth. ..... N S O A
82. Is easily upset. ..... N S O A
83. Worries about what other adolescents think. ..... N S O A
84. Shows interest in others' ideas. ..... N S O A
85. Complains of chest pain. ..... N S O A
86. Is able to describe feelings accurately. .. N S O A
87. Says things that make no sense. ..... N S O A
88. Prefers to be alone. ..... N S O A
89. Gets into trouble. ..... N S O A
90. Says, "I want to die" or "I wish I were dead." ..... N S O A
91. Complains when asked to do things differently. ..... N S O A
92. Is clear when telling about personal experiences. ..... N S O A
93. Organizes chores or other tasks well. .. N S O A
94. Bullies others. ..... N S O A
95. Eats things that are not food. ..... N S O A
96. Volunteers to help with things. ..... N S O A
97. Is a "self-starter." ..... N S O A
98. Seems lonely. ..... N S O A
99. Complains of pain. ..... N S O A
100. Loses temper too easily. ..... N S O A
101. Hears sounds that are not there. ..... N S O A
102. Is fearful. ..... N S O A
103. Uses illegal drugs. ..... N S O A
104. Quickly joins group activities. ..... N S O A
105. Fiddles with things while at meals. ... N S O A
106. Listens carefully. ..... N S O A
107. Has difficulty explaining rules of games to others. ..... N S O A
108. Is stubborn. ..... N S O A
109. Breaks the rules just to see what will happen. ..... N S O A
110. Falls down. ..... N S O A
111. Sets realistic goals. ..... N S O A
112. Says, "Nobody likes me." ..... N S O A
113. Worries. ..... N S O A
114. Sleeps with parents. ..... N S O A
115. Gets sick. ..... N S O A
116. Responds appropriately when asked a question. ..... N S O A
117. Babbles to self. ..... N S O A
118. Is chosen last by other adolescents for games. ..... N S O A
119. Deceives others. ..... N S O A
120. Attends after-school activities. ..... N S O A
121. Sets fires. ..... N S O A
122. Writes messages that are unclear or incorrect. ..... N S O A
123. Attends to issues of personal safety. ..... N S O A
124. Seeks revenge on others. ..... N S O A
125. Throws up after eating. ..... N S O A
126. Offers help to other adolescents. .... N S O A
127. Gives good suggestions for solving problems. ..... N S O A
128. Says, "I don't have any friends." ..... N S O A
129. Is afraid of getting sick. ..... N S O A
130. Is cruel to others. ..... N S O A
131. Seems out of touch with reality. ..... N S O A
132. Eats too little. ..... N S O A
133. Disobeys. ..... N S O A
134. Has trouble making new friends. .... N S O A
135. Disrupts other adolescents' activities. ..... N S O A
136. Is easily distracted. ..... N S O A
137. Answers telephone properly. ..... N S O A
138. Eats too much. ..... N S O A
139. Lies to get out of trouble. ..... N S O A
140. Runs away from home overnight. .... N S O A
141. Picks out clothes that match the weather. ..... N S O A
142. Is sad. ..... N S O A
143. Says, "I'm afraid I will make a mistake." ..... N S O A
144. Is easily annoyed by others. ..... N S O A
145. Expresses fear of getting sick. ..... N S O A
146. Has trouble getting information when needed. ..... N S O A
147. Acts strangely. ..... N S O A
148. Avoids other adolescents. ..... N S O A
149. Has seizures. ..... N S O A
150. Is usually chosen as a leader. ..... N S O A