Current Parental Knowledge of Concussion in Youth Ice Hockey

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INTRODUCTION: Concussions in youth ice hockey are a growing concern as participation increases. Because of the lack of medical coverage for youth sporting events, parents are the primary decision makers if their child sustains a concussion injury. Parental knowledge of concussion in youth ice hockey has not been studied. This study aimed to determine the current knowledge of concussion in youth ice hockey parents by means of a survey. **METHODS:** Local rink directors were contacted via email for permission to post recruitment flyers throughout the ice rinks and to recruit subjects in person. Parents or guardians completed the survey if their child was currently active on a youth ice hockey. Parents and guardians were divided into groups based on hockey or concussion experience. **RESULTS:** Overall, parents and guardians responded correctly to the majority of knowledge related questions and identifying common concussion signs and symptoms. There were no differences between the groups with and without hockey or concussion experience. There were also no differences among men and women. **CONCLUSION:** These findings suggest that parents do have moderate knowledge of concussion. Future research should investigate concussion knowledge and potential knowledge gaps in other geographical locations and in youth ice hockey participants.

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Preface

I would like to thank Dr. Amanda Black for permission to modify and adapt the *Concussion Knowledge, Beliefs and Behaviour Questionnaire: Parents* for the purpose of this study. I would also like to thank all of my committee members for their endless support, time, and assistance with this project.

1.0 Introduction

According to the Center of Disease Control and Prevention (CDC), a concussion, also commonly referred to as a traumatic brain injury or TBI, can be defined as the brain moving rapidly back and forth from a direct blow or hit to the head or body.[57] After a concussion is sustained, symptoms can appear immediately or have a delayed onset, appearing days later. After a concussion is sustained, there are roughly 21 possible symptoms that one may experience, but the symptoms that are most complained of are damages to one's cognitive function, such as headache, dizziness, confusion, and difficulty concentrating.[12] Loss of consciousness is commonly thought to happen when a concussion occurs but it has been reported to account for 28% of all concussions.[12] Not only can an athlete's cognitive function become temporarily or permanently impaired, but also physical and psychosocial functions.[28] The time it takes to recover from a concussion is typically 7-10 days, but children may take as much as a month to recover, even in the absence of setbacks.[6] In the early 2000s, the incidence rate of concussion was estimated at 300,000 among youth athletes.[9,11,33,49] Today, approximately 1.6 to 3.8 million concussions occur every year in the United States and are related to sports.[9,12,16,26,33,46] Although that number may seem extreme, in youth athletes 18 years of age and younger,[2,25] the estimated number of sports-related concussions occurring annually among this specific population is nearly 1.1 to 1.9 million.[8,9] Bazarian et al. stated that approximately 26.4% of concussions sustained are related to sport in children ranging in ages 5-14.[4,49] It is common for concussions in the youth population to go undiagnosed or underreported thus the number of youth concussions could be even larger.[9,24,67] Sports participation is increasing among the youth with an expected 30-45 million children and adolescents participating in sports outside of school.[22,35,56] Concussion in sports usually transpires

in sports that involve contact or occur at a high velocity, such as motor sports.[28] Studies have noted differences among male and female sports with concussions occurring at higher rates for different sports among both sexes.[7,9,62,65] In male sports, ice hockey is one of the sports with a higher rate of concussion due to the involvement of body checking.[16,33] At the youth level, ice hockey is a non-scholastic club sport, thus practices and games have little to no medical coverage available. In the event of an injury, such as a concussion, the parent or guardian is responsible for the management and to seek further medical care. Failure to seek further medical care, could result in prolonged recovery, complications, and even fatality if a player returns to play too soon after a concussion is sustained.[32,35,53,60] Although rare, Second Impact Syndrome (SIS), occurs after the initial head injury causing cerebral edema.[5] Properly educating parents, guardians, and coaches on the importance of removing an athlete from play after a suspected concussion and recognition of the signs and symptoms could prevent further injury and even death. After review of the literature, parental knowledge of concussion is sparse in youth sports, especially ice hockey, and needs to be further investigated.

1.1 Concussion in Youth Sports

As participation in youth sports continues to increase, there are concerns over a rise in sports-related concussions. A study published in 2017 stated that due to the positive outcomes, such as a boost in self-esteem and higher grades in school, more and more children are participating in sports with approximately 30-45 million youth athlete participants ages 18 and under.[22,35,56,66] However, youth athletes are more susceptible to sustaining concussions which has been linked to longer recovery times.[48] Although most sports are played differently based on gender and age,

concussions occur at a higher rate in contact sports when compared to non-contact sports.[65] Research surrounding this idea has solely focused on athletes participating in sport at the high-school or collegiate levels. There is very little literature that describes the occurrence rate in youth athletes. However, assumptions as to how often concussions occur in the youth athletic population can be made based on the literature that is available on high-school athletes between the ages 14-18,[33] as well as the data made available from visits to the emergency departments after a concussion is sustained.[41,56] In general, high-school aged athletes are more likely to have a longer recovery after a concussion is sustained than college or adult athletes over the age of 18.[33] In addition, high-school aged athletes sustain more concussions in games than during practices.[33] In most studies conducted to determine concussion incidence rate, a standard method to measure the incidence rate per 1000 athlete exposures (AE). Jinguji et al. defined one athlete exposure as each time an athlete participates in a single game or practice.[33] This can be useful for identifying the rate of concussions during practices and games, especially when comparing differences among sex of the athletes and sports.[33] Recent studies conducted have used athlete exposures to determine the incidence of concussion in youth ice hockey. For instance, Daneshvar et al. found that 6.3% of concussion occur during exposures to practices, and 10.3% of concussions occur during exposures to games.[16,33] In addition, another study found that the overall incidence rate of concussion was 21.25 concussions per 1000 AE.[19,33] Recently, Pfister et al. conducted a systematic review consisting of 23 studies to determine the incidence rate of concussion among a multitude of sports targeting athletes ages 18 and younger.[56] Out of the 14 sports identified during this review, the sports with the least amount of body contact had the lowest rates of concussion occurrence.[56] However, sports such as football, rugby, and ice hockey had the highest concussion incidence rates with due to the involvement of physical contact. Since sports with high exposure to physical

contact have higher rates of concussion, several countries have conducted studies on sports such as rugby and American football. Football, especially at the high school level, has been extensively studied due to the physicality of the sport and the rates at which chronic traumatic encephalopathy (CTE) develops in football players later in life. The age at which participation in youth football begins is eight. Although the number of concussions in youth players is unknown, it has been reported that in practices alone, children ranging in ages 8-12 years have similar concussion rates of those athletes playing at the high school or collegiate levels, but even higher rates of concussion during games compared to older athletes.[42,61] In female sports, other studies have reported soccer and basketball as having the highest rates of concussion with soccer accounting for 40.5% of concussions sustained during soccer, and 31.7% of concussions sustained during basketball.[65] Although, this study did not account for girls' ice hockey as one of the sports included in the retrospective study, another study assessed injury types, rates, mechanisms, and factors in girls' ice hockey in Canada.[18] The study consisted of girls aged 9-17 participating in ice hockey during the 2008-2009 hockey season.[18] Among 33 teams, the findings showed that concussion was not the most reported injury at 15.1%, but strains, sprains and contusions were.[18] Female ice hockey is understudied, but as participation in girls' ice hockey continues to grow, this could lead to opportunities to conduct more studies to compare males and females at the youth level.

A common misconception of concussions is that male athletes sustain concussions more frequently than females, but research has shown that female athletes sustain more concussions.[33] This may be due to female athletes expressing their emotions more than males or being more forthcoming with their feelings or female sports being overlooked and excluded from many studies.[33] Most of the information regarding concussions in youth athletes stems from surveillance studies conducted at emergency departments. Based on the findings of these studies, it can be

concluded that more than 250,000 emergency department visits are children ages 8-18 who sustained a head injury, while approximately 25% of those visits were related to sport.[33] Although, the number of visits to the ED is large, this number may not be an accurate representation of the amount of sports-related concussions that do occur on a yearly basis.

1.1.1 Concussion in Youth Ice Hockey: Then and Now

As mentioned, the sports with the highest concussion rates were football, rugby, and ice hockey. Unlike rugby and football which are two heavily researched sports, ice hockey at the youth level is not. Ice hockey is a fast-paced, contact sport that allows male players to begin body checking at age 13. Body checking can be described as a technique players use to stop their opposing players from gaining control of the puck or prevent the player from making a play. On the contrary, in the rulebook for females, body checking is not allowed regardless of age, but this does not prevent players from initiating body contact during play. To date, body checking is the primary mechanism for sustaining a concussion in the game of hockey.[29] Over the years, policy changes have been established to help decrease the number of concussions sustained and to allow for more player development prior to engaging in body checking. Additionally, the growing number of lawsuits and emergency department visits that caught the attention of the public lead to decreasing numbers of ice hockey participation for youth-aged athletes.[64] In 2011, due to the public's concern, USA Hockey, the governing organization for hockey in the United States, prompted policy changes for body checking to occur at the bantam level (13-14 years of age) instead of the pee wee (11-12 years of age) levels. After USA Hockey examined the pee wee level, they found that 11-12 years were at a much higher risk for sustaining concussions and other injuries, thus becoming a nationwide change for the sport of ice hockey.[52] This change sparked

concern for Canadian hockey leagues which lead to an investigation in 2013, but the issue remained controversial due to insufficient evidence to support the transition and was finally approved nationwide through a unanimous vote by the hockey directors of Canada.[52,64] Since these policy changes have been made, whether these new guidelines are effective remains unknown.[30] Morrissey et al. conducted a descriptive epidemiological study involving emergency departments in the United States over a fourteen-year span, noting that between 2011-2012 there was significant decrease in concussions with the hopes that these results translated into more people becoming educated on concussion and have a greater awareness of concussion injuries in youth ice hockey.[54] Eventually, all levels of competition, including the National Hockey League (NHL) and universities, implemented various rules and regulations to help reduce the incidence of concussion to make the game of hockey safer. Today, Kontos et al. reported that sports participation in youth ice hockey has increased by approximately 350,000 over the past two decades in the United States alone,[41] and over one million youth athletes are currently participating in ice hockey throughout the United States and Canada.[64]

1.2 Previous Parental Knowledge of Concussion

The incidence of sports-related concussions (SRC) is highest in the youth population, however, there has been little research done on the parental knowledge of concussion. Parents or guardians play a large role in concussion recognition and management in the youth setting.[6] Surveys and questionnaires have been widely used in previous studies throughout the world to gain a clearer understanding of parental knowledge of concussion among youth sports.[6,38,48,50,59] By gaining a general idea of the current concussion management and treatment around the world,

this could help expand upon more efficient ways to manage and treat concussion in the youth populations.

In many studies conducted to understand more about the knowledge and beliefs on concussion, parents with children playing sports, it has been shown that parents have moderate knowledge of concussions.[17,36,60] Injuries such as falls or being hit in the head by an object are seen as common childhood incidents to parents and are not taken seriously.[17] According to Lin et al., there remains misconceptions regarding SRCs within the parent population due to a time when they participated in sport and mild concussions did not warrant a physician's visit or removal from play.[48] It is common for these same thoughts and ideas to be passed down to their children. For instance, parents who participated in sports during their youth were often taught that if a mild concussion was sustained it was not necessary to seek further medical attention or be removed from play ,[48,63] thus this may allow parents to be more inclined to return their child to play if symptoms are not debilitating. Parents have an influence on their children and may pressure them to play a sport. In that instance, children might be less inclined to speak up when a possible concussion is sustained. Youth sports generally occur outside the school setting with additional costs and fees for their child to participate.

In the absence of a medical professional present at youth sporting events, the parent is responsible for identifying a suspected head injury and for taking proper action of removing the athlete from play. Recent studies suggest there is a gap in parental knowledge of concussion when identifying signs and symptoms of concussion.[17] For instance, gaps were seen when asking parents and athletes to identify signs and symptoms associated with concussion. An estimated 30 to 70% of parents[50] and athletes[13,44,45] did not realize emotional changes were symptoms of concussions.[40] Currently, concussion management and protocols in youth sports are not well known. Not only do

parents lack knowledge of signs and symptoms, but at the youth level parents also lack knowledge of the return to play protocols and at-home care. Pediatric concussion return to play protocols and management are understudied compared to middle school and high school aged children.[39,56] Concussion return to play protocols can be very similar among all age groups, however, Kim et al. suggests these guidelines should be altered to suit individual needs.[40] Additionally, it has been reported that pediatric aged athletes are more likely to react differently to head injuries as compared to adolescents or young adults,[58,59] thus it may become more difficult for parents to recognize. Because of this, in children ages 13 and under, many concussions become undiagnosed or underreported.[23,61] According to Collins et al., the reasoning behind concussions being under reported is the lack of knowledge of signs and symptoms of concussion.[11,60]

Until recently, from the years 1998-2016, only a few studies have been conducted based on parents with children ages 10-15 years in three states: Hawaii, Oklahoma, and Virginia.[38] Kerr et al. conducted a survey-based study sampling parents of middle school aged children and found that of 1224 parents incorrectly identifying symptoms that were not associated with concussion with between approximately 25% of parents saying teeth and joint pain were symptoms associated with a concussion.[38] Additionally, only 28.5% of parents identified emotional changes as symptoms of concussion.[38] These findings are consistent with other outcomes found in previous studies.[38,61] Incorrectly identifying symptoms in children could lead to further complications or a longer recovery. In general, children are more likely to have longer recovery times due to their physiological and biomechanical differences,[48] so immediately identifying concussions is crucial for this reason. Furthermore, a systematic review was conducted to gain insight of parents' general knowledge of concussion signs and symptoms. Like Kerr et al., this review found that parents were also less likely to identify the emotional signs and symptoms.[38] There is a gap in identifying the

correct signs and symptoms of concussion among parents. In a study conducted by Kay et al., there was a significant range of parents (21.6-68.1%) that considered chest pain or black eyes as symptoms and symptoms of a concussion[36] and in another study 90% of parents believed numbness and tingling to the appendages were also signs and symptoms.[20,50] Moreover, only 26.2% of parents knew the lasting effects of symptoms after a concussion is sustained.[20] Regarding proper concussion management and return to play protocols among children, only 41% of the parents had knowledge of the correct procedure.

Parental demographics may also play a role on concussion knowledge based on recent findings. Many survey-based studies collected data on parents and have found that factors such as sex, age, education, and income may be correlated to their concussion knowledge.[17] Additional factors have been found to be based on sex of the child, where males tend to have higher levels of competitiveness compared to females based on a competitiveness index.[38] Sex of the parent has also been mentioned throughout various studies suggesting that mothers are more likely to volunteer to take surveys as opposed to fathers.[48] In fact, when looking at findings regarding mothers and fathers, 68% of mothers found concussions were a critical issue whereas 38% of fathers thought it was a critical issue.[20] Age is another demographic that may be able to help identify where the gaps in knowledge remain. In the few survey-based studies available, the ages of parents have ranged from 21 years of age, being the youngest participants, and 61 years of age as the oldest participants.[6] Feiss et al. found that differences were observed when assessing concussion awareness among parents with children ages 5-18 years old,[20] the results showed that parents with the oldest child between the ages of 10-13 years were more aware of concussions than those with children ranging in ages 5-9 and 14-18 years.[20] Currently, there is no literature available comparing the ages of the parents, only the athletes. Thus, it can only be assumed that parents who

are of an older age, have a greater understanding for the importance of concussions. Although, it is easy to make that assumption, competition level of the child is also significant to note.

Concussion rates are among the highest in youth ice hockey due to the nature of the sport allowing for body contact once a certain age is met. Studies have been done specifically to target parents of those who have children playing ice hockey, but research remains scarce. The majority of these studies were conducted in Canada; therefore, there is a limited amount of data based on parental concussion knowledge in the youth ice hockey setting available in the United States. In the sport of ice hockey, players are divided into divisions based on age. In the United States, the mini mites are the youngest level of play for children ages five and six years old. On the other hand, midget major is the oldest level of youth hockey before players advance to higher levels of play such as college or juniors in which 18 years of age is the limit. Because of these significant gaps in age throughout the different levels of play, parents of children playing at higher levels of competition may have a better understanding of concussion when compared to those with children playing in the mini mites. In a recent study conducted to assess the association between concussion education and knowledge, a survey was distributed to parents of children ages 11-17 playing ice hockey. The findings of this study showed that out of 786 parents within the ice hockey community, parents with children ranging in ages 13-14 years had the highest participation with 570 total, but additionally had the highest percentage (76.9%) of parents who stated they have no concussion training or education. On the contrary, 457 parents of the same age group stated they did receive concussion education (70.9%).[6] Among the Pee Wee age group (11-12 years old), only 34 parents responded. Out of the 34 parents, only 2 stated they have never received education on concussions.[6] Additionally, it is also important to identify parents with previous or current coaching experience due to majority of states requiring annual training that coaches must complete

prior to their seasons if affiliated with USA Hockey. Based on the results of the surveys, researchers are concerned that the long-lasting effects of untreated concussions may go unnoticed well until the child's brain is fully developed.[10]

1.3 Concussion Educational Sources and Tools

To date, many educational resources on concussion have been developed, such as programs like HEADS UP, ThinkFirst, and Concussionwise, at no cost for parents, coaches, and athletes. The lack of concussion knowledge is the main reason for concussions that are undiagnosed or underreported; therefore, it is important for parents, coaches, and athletes to be properly educated on identifying and managing concussions.[6] As mentioned earlier, without a medical professional present at youth sporting events, parents are responsible for the treatment and management of their child's concussion. A low percentage of parents have credited concussion education to coaches and athletic trainers, yet they do not request additional information to learn more on the topic.[20] As of 2017, concussion training is only required for coaches at the high school level and not parents in 34 states.[20] Additionally, only 47 states require concussion handouts to be given to parents prior to the start of their sports seasons.[20] By requiring concussion education for parents, this could potentially decrease the number of athletes that return to play with a concussion.[60] In a study conducted by Hecimovich et al., they found that parents with prior first aid and concussion training were more likely to correctly identify concussions after they occurred.[1,20] In another recent study, other ways of going about concussion education were proposed. Instead of providing parents with concussion education resources prior to the start of the season, Kroshus et al. suggested giving frequent reminders and reinforcing concussion education throughout the sport season. The authors

believe that this crucial information may be forgotten during season.[43] In the absence of a healthcare professional to be a constant reminder of concussion information, implementing this idea of reinforcement throughout the sport season may not be feasible.

Through technology, people anywhere in the world can share news and information with the click of a button through their mobile devices, tablets, and laptops. A common way of sharing information with one another is through social media outlets, such as Twitter, Instagram, and Facebook. Social media and other outlets, such as the internet, have been primary sources of providing concussion education to parents. A study showed that 57% of parents obtained concussion information from various media sources and 43.1% of parents learned from the internet.[20,68] Perhaps social media is a great way to spread awareness and get a message across, but sometimes these outlets may not be the most reliable. Occasionally, local TV stations will share stories that make national headlines about concussions sustained by youth athletes during sports or even highlight developing studies that aim to focus on concussion in youth sports. Although parents may be learning through a variety of sources, educational tools developed by accredited organizations are readily available and easy for parents to access at any time, but whether these sources are being utilized is unclear.

Since concussion has become a major concern, organizations have developed tools to help expand upon concussion knowledge to athletes, parents, and medical professionals. For instance, the most distinguishable and credible organization is the Centers for Disease Control and Prevention (CDC).[57] The CDC website has handouts, fact sheets and numerous sports specific documents readily available for parents, as well as coaches, players, and officials, through a program created called ‘HEADS UP’. Aside from documents, the CDC ‘HEADS UP’ program also provides different resources such as videos, podcasts, graphics, and online concussion training

which can be accessed by all parties at any time. According to a recent study, the authors found that the CDC 'HEADS UP' toolkit has been shown to successful in educating not only parents but physicians making them less likely to allow a player to return to sport within a 24 hour time frame.[70] Additionally, 'HEADS UP' has had a positive effect on athletes as well resulting in athletes being more open and honest after sustaining a head injury rather than putting themselves at risk for further injury.[70]

Many states have taken the initiative to implement proper concussion education. Within states like Oregon, Massachusetts, and Pennsylvania, organizations have created programs to educate more than just athletes but have the goal to educate the general population as well. By educating the general population, these organizations are hopeful that the more people to have concussion knowledge, the more likely proper concussion management and treatment will be followed. For instance, in 1986 neurosurgeons developed a program called ThinkFirst. The ThinkFirst National Injury Prevention Foundation brings concussion educators to school health classes to speak and inform all students about concussions.[70] In addition to concussion educations, a person who has suffered the consequences of a severe concussion speaks about the challenges they face since their life changing injury.[70] In order to assess the audience's concussion knowledge, evaluations were handed out before and after the presentations. The program also offers the option to take online evidence-based training to inform the public of concussion prevention.

Another beneficial resource especially utilized in the state of Pennsylvania, is ConcussionWise. Developed and created by Sports Safety International, the purpose of ConcussionWise is to help eliminate sports related concussions and to emphasize the importance of safe sports participation through education.[31] The Pennsylvania Athletic Training Society (PATS) has partnered with Concussionwise by offering courses covering the critical phases of

concussion management.[31] Similar to ThinkFirst, ConcussionWise provides a short educational video with a quiz at the end. After the quiz is finished, parents have the option of obtaining a certification of completion. As of today, all states have their own legislations stating that at least the athletes, parents, guardians, or coaches needs to be trained in concussion management.[55,69] Currently 49 states require coaches at the high school level to be trained in concussion.[55] In addition, organizations may require teams to have their own concussion management guidelines and protocols, like USA Hockey.[27] However, based on the Youth Concussion Laws Facts Sheet many states still do not require all parties, such as parents, coaches, or athletes to be educated and trained on the management of concussion.[47]

1.4 Problem Statement

Youth athletics are not school sanctioned events, therefore have little to no medical providers. Parents become the primary decision makers regarding injuries, including concussions by removing their child from play and following proper return to play guidelines. Without the appropriate education or knowledge, concussions can be easily missed or left undiagnosed. Currently, knowledge of concussion signs, symptoms and return to play guidelines among youth ice hockey parents is unknown.

1.5 Study Purpose

The purpose of this study is to determine the current knowledge of concussion in youth ice hockey parents.

1.6 Specific Aims

Specific Aim 1: To analyze the relationship between parental demographics, concussion experience, and hockey experience and their concussion knowledge.

Specific Aim 2: To determine the relationship between the parents with concussion experience and their concussion knowledge.

Specific Aim 3: To determine the relationship between parents with no hockey experience and their concussion knowledge.

Specific Aim 4: To analyze the association between parental demographics, hockey experience, and concussion experience and the likelihood of the parent removing the child from participation and seeking medical care, after a suspected concussion in the absence of symptoms.

Specific Aim 5: To describe parental knowledge of the common signs and symptoms of concussion.

Specific Aim 6: To identify the educational sources of concussion information for ice hockey parents.

1.7 Study Significance

The study aims to investigate the current parental knowledge of concussion in youth ice hockey. This study also will help to expand upon the available literature to help improve concussion management and treatment in youth ice hockey without the presence of a medical professional. Currently, literature regarding youth ice hockey is scarce in the United States. In addition to possibly helping improve current concussion management and treatment, the findings of this study may also eliminate the potential for further injury and prolonged recovery in youth athletes by informing the audiences of the current gaps of knowledge while providing clarity to the parents of those who have children participating in youth ice hockey.

2.0 Methods

2.1 Experimental Design

The study design was a descriptive cross-sectional survey. The survey took approximately five minutes to complete by parents or guardians of youth ice hockey players. The survey was divided into three sections. The first section of the survey consisted of demographic information, such as age, sex, relationship to the athlete, and previous ice hockey coaching or playing experience. The second section consisted of true and false questions related to concussion. The last section consisted of correctly identifying common concussion signs and symptoms. The survey was available to parents and guardians for a four-week duration.

2.2 Subject Recruitment

Flyers with study information and QR codes were available for parents and guardians to scan with their smart phones at two ice rinks throughout the Greater Pittsburgh area. In addition, the director of one of the ice rinks sent an informative email to all parents regarding the study with a link to the survey included. The primary investigator was present at each rink for one weekend at each location for in person instruction for parents and guardians to complete the survey. Parents or guardians with children ages 8-18 years and are currently active on a youth ice hockey team were encouraged to participate in the study. The collection of survey responses was deidentified and each parent or guardian was instructed to only complete the survey once.

2.3 Subject Characteristics

2.3.1 Inclusion Criteria

Parents or guardians with children ranging in ages 8-18 years currently participating on a youth ice hockey team.

2.3.2 Exclusion Criteria

There are no exclusion criteria. All parents and guardians who meet the inclusion criteria and volunteer will be included in the study.

2.4 Power Analysis

We included a diverse sample of approximately 200 respondents with representation from various age, sex, and level of competition groups. A convenience sampling technique was utilized.

2.5 Instrumentation

2.5.1 Qualtrics Online Survey

Qualtrics Online Software licensed by the University of Pittsburgh is a tool used by individuals at the University of Pittsburgh to create and develop surveys. Qualtrics provides secure

access to the survey for people who have the link to complete it. The survey comprised of 41 questions divided into three sections to analyze each participant's knowledge of concussion. The survey was modified and adapted from the *Concussion Knowledge, Beliefs and Behaviour Questionnaire: Parents* created by Dr. Amanda Black.[6]

2.6 Procedures

The study was approved by the University of Pittsburgh's Institutional Review Board (IRB) prior to conducting. Two local rink directors were contacted via email for permission to post recruitment flyers. These flyers contained study information, including a QR code for parents to complete the survey. The recruitment flyers were posted in common areas of the ice rinks. The survey was also sent by email to team managers or parents through the ice rink director of one of the participating ice rinks to approximately 900 people. The Primary Investigator (PI) was present at each rink one time during the survey period to recruit subjects who can complete the survey via QR code. Parents or guardians completed the survey if their child is currently active on a youth ice hockey team and if their child is 8-18 years of age. The parents were encouraged to complete the survey to the best of their ability without additional resources or help from other parents completing the survey. All survey responses were recorded anonymously. The survey took approximately five minutes to complete and consisted of collecting demographic information and knowledge of concussion related questions and common concussion signs and symptoms. Data collection period lasted four weeks.

2.6.1 Subject Consent

Subjects will consent to this study by volunteering to complete the survey. Subjects will not be held accountable for not completing the survey and are free to stop the survey at any time. All responses will be anonymous.

2.7 Data Reduction

All survey responses were reviewed using the Qualtrics software. Responses were downloaded and imported into SPSS for data analysis. Parental concussion knowledge was analyzed using 41 questions consisting of multiple choice and true or false. The variables assessed were divided into two groups: experience and no experience. Parents or guardians with previous or current coaching or playing experience and/or parents or guardians with previous concussion training were included in the experience group. Parents or guardians who also stated they have received previous concussion training or have had a child sustain a concussion and assessed by a physician were also be placed in the experience group. Parents or guardians without previous playing, coaching, or concussion training were placed in the no experience group.

2.8 Data Analysis

Descriptive statistics (mean, standard deviation, median, interquartile range, proportion/percentage, as appropriate) will be calculated for all variables. Categorical variables will be compared between groups using Fishers-Exact test.

Statistical significance will be set a priori at alpha=0.05, two-sided. Statistical analysis will be conducting using SPSS Version 27 (IBM Corporation; Armonk, New York).

3.0 Results

Data collection for the study was conducted for a total duration of four weeks. A survey was published and distributed to parents via email by an ice rink director. A sample size of 111 parents and guardians (54 women, 57 men; age: 41.21±10.51y) participated in the study. Parents and guardians were also recruited in person at two local ice rinks two weekends during the study period. Out of 122 responses, a total of 11 responses were excluded due to incomplete surveys, which resulted in a total of 111 complete responses. Participants who volunteered to participate in the study ranged in ages 25-55 years old. Out the 111 participants, 54 identified as female and 57 identified as male. Only one participant is a primary guardian while all other participants are parents of the child participating in youth ice hockey.

Parents and guardians' responses to statements regarding their current concussion knowledge are displayed in Table 1. Participants had the option to choose 'True', 'False', and 'Don't Know' to the statements provided in Table 1. The majority of participants (83.8%) correctly identified that people who have had one concussion are more likely to have another concussion is true, while a small portion of participants 8/111 (7.2%) answered incorrectly. When asked if sometimes a second concussion can help a person remember things that were forgotten after the first concussion, 79/111 (71.2%) of participants correctly identified this statement to be false, while 5/11 (4.5%) believed the statement to be true and 27/111 (24.3%) reported they were unsure. 105/111 (94.6%) of participants answered correctly when they identified that there are helmets that prevent all concussions is false, while only 5/111 (4.5%) of participants believed this to be true. Interestingly, when asked if a concussion is a brain injury, 1/111 (0.9%) incorrectly responded false and 2/111 (1.8%) did not know, while the vast majority of participants answered correctly

108/111 (97.3%). A common misconception of concussion is that one must lose consciousness when a concussion is diagnosed or sustained. When participants were asked in order to be diagnosed with a concussion, one has to lose consciousness, 110/111 (99.1%) answered correctly. 105/111 (94.6%) correctly selected true when asked there is a higher risk of long term problems if someone has a second concussion before recovering from the first one, while 1/111 (0.9%) was incorrect. A large proportion of participants 104/111 (93.7%) correctly reported that concussions can sometimes lead to emotional problems and 6/111 (5.4%) did not know. Another statement that was commonly thought to be the only mechanism of injury for a concussion is a direct blow to the head. When participants were asked that a concussion can only occur if there is a direct hit to the head, 105/111 (94.6%) of participants correctly reported false, while only 2/111 (1.8%) believed this statement to still be true. Remarkably, when asked if there are few risks to long-term health and well-being from multiple concussions, the reported responses were almost split half and half. 57/111 (51.4%) incorrectly identified this statement by selecting true, while 51/111 (45.9%) correctly identified this statement to be false. When asked if younger players (under the age of 18) typically take longer to recover from a concussion that adults, only 14/111 (12.6%) of participants correctly identified this statement to be true, while 60/111 (54.1%) incorrectly identified this statement to be false. When asked if post concussion symptoms can be delayed for hours or days, the majority of participants 106/111 (95.5%) answered correctly and 1/111 (0.9%) did not.

Table 1. Responses to concussion knowledge related questions (counts(percentages))

Knowledge related question	True	False	Don't know	Not specified	Total
People who have had one concussion are more likely to have another concussion.	93 (83.8%)	8 (7.2%)	10 (9.0%)	0 (0.0%)	111

Sometimes a second concussion can help a person remember things that were forgotten after the first concussion. (F)	5 (4.5%)	79 (71.2%)	27 (24.3%)	0 (0.0%)	111
There are helmets that prevent all concussions. (F)	5 (4.5%)	105 (94.6%)	1 (0.9%)	0 (0.0%)	111
A concussion is a brain injury. (T)	108 (97.3%)	1 (0.9%)	2 (1.8%)	0 (0.0%)	111
In order to be diagnosed with a concussion, you have to lose consciousness. (F)	0 (0.0%)	110 (99.1%)	0 (0.0%)	1 (0.9%)	111
There is a higher risk of long term problems if someone has a second concussion before recovering from the first one. (T)	105 (94.6%)	1 (0.9%)	5 (4.5%)	0 (0.0%)	111
Concussions can sometimes lead to emotional problems. (T)	104 (93.7%)	0 (0.0%)	6 (5.4%)	1 (0.9%)	111
A concussion can only occur if there is a direct hit to the head. (F)	2 (1.8%)	105 (94.6%)	4 (3.6%)	0 (0.0%)	111
There are a few risks to long-term health and well-being from multiple concussions. (F)	57 (51.4%)	51 (45.9%)	3 (2.9%)	0 (0.0%)	111
Younger players (under the age of 18) typically take longer to recover from a concussion than adults. (T)	14 (12.6%)	60 (54.1%)	37 (33.3%)	0 (0.0%)	111

Post concussion symptoms can be delayed for hours or days. (T)	106 (95.5%)	1 (0.9%)	4 (3.6%)	0 (0.0%)	111

Table 2. shows the participants' responses to section three of the survey expressed as counts and percentages. In this section, parents and guardians were given a list of symptoms and had to determine whether the symptom was a related to concussion. Participants were asked to select yes or no if they believed the symptom was associated with concussion. When asked if 'Hives' was a symptom of concussion, (7/111; 6.3%) of participants answered incorrectly and (104/111; 93.7%) answered correct. All participants for the exception of one, 110/111 (99.1%) correctly identified 'Headache' as a symptom of concussion. A small proportion of participants (30/111; 27%) reported 'Fever' as a symptom of a concussion and (81/111; 73.0%) correctly identified 'Fever' as not being a symptom of concussion. Interestingly, participants (13/111; 11.7%) believed 'Arthritis' to be a symptom of concussion, when (98/111; 88.3%) answered correctly. A large proportion of participants 110/111 (99.1%) answered correctly identified both 'Sensitivity to Light' and 'Difficulty Remembering' as symptoms of concussion. An interesting finding when asked if 'Panic Attacks' were a symptom of concussion, the majority of participants 74/111 (66.7%) answered incorrectly and only 37/111 (33.3%) answered correctly by choosing no. 110/111 (99.1%) answered correctly to 'Feeling in a Fog' as a symptom of concussion. A small proportion of participants 14/111 (12.6%) believed 'Weight Gain' was a symptom of concussion, while the other 97/111 (87.4%) of participants answered correctly. As for 'Feeling Slowed Down', 109/111 (98.2%) of participants correctly identified this symptom as a symptom of concussion. When participants were asked if 'Reduced Breathing Rate' was a symptom of concussion, 49/111 (44.1%) of participants were incorrect and 62/111 (55.9%) of participants were correct when choosing no as the answer. Interestingly, 11/111 (9.9%) of participants believed 'Excessive

Studying' was a symptom related to concussion, while 100/111 (90.1%) answered correctly. As for 'Difficulty Concentrating', 110/111 (99.1%) of participants answered correctly when identifying this as a symptom of concussion. To add, 109/111 (98.2%) of participants also answered by correctly identifying 'Dizziness' as a symptom of concussion, while 2/111 (1.8%) did not. For the last symptom, 'Hair Loss', 4/111 (3.6%) participants incorrectly responded, while 107/111 (96.4%) correctly responded.

Table 2. Parents/guardians' knowledge about concussion related signs and symptoms (counts(percentages))

Symptom	Yes	No	Total
Hives (F)	7 (6.3%)	104 (93.7%)	111
Headache (T)	110 (99.1%)	1 (0.9%)	111
Fever (F)	30 (27.0%)	81 (73.0%)	111
Arthritis (F)	13 (11.7%)	98 (88.3%)	111
Sensitivity to Light (T)	110 (99.1%)	1 (0.9%)	111
Difficulty Remembering (T)	110 (99.1%)	1 (0.9%)	111
Panic Attacks (F)	74 (66.7%)	37 (33.3%)	111
Feeling in a Fog (T)	110 (99.1%)	1 (0.9%)	111
Weight Gain (F)	14 (12.6%)	97 (87.4%)	111
Feeling Slowed Down (T)	109 (98.2%)	2 (1.8%)	111
Reduced Breathing Rate (F)	49 (44.1%)	62 (55.9%)	111
Excessive Studying (F)	11 (9.9%)	100 (90.1%)	111
Difficulty Concentrating (T)	110 (99.1%)	1 (0.9%)	111
Dizziness (T)	109 (98.2%)	2 (1.8%)	111
Hair Loss (F)	4 (3.6%)	107 (96.4%)	111

Table 3. shows the counts and percentages of women and men who responded correctly to questions related to concussion knowledge. A Fisher's Exact test was conducted to determine the difference in proportions of women and men correct who responded correctly to the questions.

When comparing ‘True’ versus ‘False’ responses, a large proportion of men (49/53; 92.5%) and women (44/48; 91.5%) answered correctly when asked if people who have had one concussion are more likely to have another concussion (p=0.585).

Table 3. Percentage of women and men who responded correctly to knowledge related questions (counts(percentages))

Knowledge related question	Women	Men	Fisher’s Exact Test p-value
People who have had one concussion are more likely to have another concussion.	44/48= 91.5%	49/53= 92.5%	1.000
Sometimes a second concussion can help a person remember things that were forgotten after the first concussion.	39/41= 95.1%	40/42= 95.2%	1.000
There are helmets that prevent all concussions.	49/54= 90.7%	56/56= 100%	0.026
A concussion is a brain injury.	53/53= 100%	55/56= 98.2%	1.000
In order to be diagnosed with a concussion, you have to lose consciousness.	54/54= 100%	56/56= 100%	*
There is a higher risk of long term problems if someone has a second concussion before recovering from the first one.	52/52= 100%	53/54= 98.1%	1.000
Concussions can sometimes lead to emotional problems.	51/51= 100%	53/53= 100%	*
A concussion can only occur if there is a direct hit to the head.	52/53= 98.1%	53/54= 98.1%	1.000

There are a few risks to long-term health and well-being from multiple concussions.	23/53= 43.4%	28/55= 50.9%	0.448
Younger players (under the age of 18) typically take longer to recover from a concussion than adults.	10/39= 25.6%	4/35= 11.4%	0.146
Post concussion symptoms can be delayed for hours or days.	53/53= 100%	53/54= 98.1%	1.000

* Fisher's exact test did not run

Table 4. shows the women and men who responded correctly to questions about symptoms of concussions. The survey consisted of a total of 54 female and 57 male participants. The participants were presented with fifteen symptoms which were either related or non-related to suffering a concussion. When asked to identify if the symptoms were related to concussion, the participants were only given 'yes' or 'no' to select. When comparing correct versus incorrect responses, all females responded correctly to majority of the symptoms related to concussion such as 'Headache' (54/54; 100%), 'Sensitivity to Light' (54/54; 100%), 'Difficulty Remembering' (54/54; 100%), 'Feeling in a Fog' (54/54; 100%) and 'Difficulty Concentrating' (54/54; 100%). When asked about symptoms not related to concussion such as 'Fever', 'Weight Gain', and 'Excessive Studying', participants did not score nearly as high. Overall, a greater proportion of women (44/54; 81.5%) responded correctly when asked about 'Fever' compared to males (37/57; 64.9%). Another symptom that both male and female participants scored low on was 'Panic Attacks'. However, there was no significant difference among females and males (p= 0.317).

Table 4. Women and men who responded correctly to questions about signs and symptoms of concussions (counts(percentages))

Symptom	Women	Men	Fisher's Exact Test p-value

Hives	52/54 = 96.3%	52/57= 91.2%	0.439
Headache	54/54= 100%	56/57=98.2%	1.000
Fever	44/54= 81.5%	37/57= 64.9%	0.057
Arthritis	47/54=87.0%	51/57= 89.5%	0.773
Sensitivity to Light	54/54= 100%	56/57= 98.2%	1.000
Difficulty Remembering	54/54= 100%	56/57= 98.2%	1.000
Panic Attacks	16/54= 29.6%	21/57= 36.8%	0.546
Feeling in a Fog	54/54= 100%	56/57= 98.2%	1.000
Weight Gain	49/54= 90.7%	48/57= 84.2%	0.228
Feeling Slowed Down	53/54= 98.1%	56/57= 98.2%	0.395
Reduced Breathing Rate	31/54= 57.4%	31/57= 54.4%	1.000
Excessive Studying	49/54= 90.7%	51/57= 89.5%	1.000
Difficulty Concentrating	54/54=100%	56/57= 98.2%	1.000
Dizziness	53/54=98.1%	56/57=98.2%	0.739
Hair Loss	52/54= 96.3%	56/57= 98.2%	1.000

Table 5. illustrates the results of comparing concussion knowledge between parents and guardians with hockey experience versus parents and guardians without hockey experience. Parents who chose not to select ‘True’ or ‘False’ were not included. There were more participants without hockey experience than those with experience that participated in the study. However, there we no differences among groups when asked knowledge related concussion questions, except for one question. Fisher’s exact test was calculated to determine if there were associations among the two groups. The test did not run for two categorical variables due to both groups scoring 100%. All participants in both groups correctly identified ‘Concussions can sometimes lead to emotional problems’ and ‘In order to be diagnosed with a concussion, you have to lose consciousness’. For the first knowledge related question of the survey, ‘People who have had one concussion are more likely to have another concussion’, both groups had the same correct answers (92.1%). The group with no hockey experience (47/49; 95.9%) had more correct responses for ‘Sometimes a second

concussion can help a person remember things that were forgotten after the first concussion' than the group with hockey experience (32/34; 94.1%) but had a greater proportion of participants respond. Surprisingly, both groups scored extremely low when asked 'There are a few risks to long-term health and well-being from multiple concussions' and 'Younger players (under the age of 18) typically take longer to recover from a concussion than adults.'

Table 5. Parents/guardians with hockey experience vs. no hockey experience and their concussion knowledge (coaching or playing) (counts (percentages))

Knowledge related question	Hockey Experience Group (% correct)	No Hockey Experience Group (% correct)	Fisher's Exact Test p-value
People who have had one concussion are more likely to have another concussion.	35/38= 92.1%	58/63= 92.1%	1.000
Sometimes a second concussion can help a person remember things that were forgotten after the first concussion.	32/34= 94.1%	47/49= 95.9%	1.000
There are helmets that prevent all concussions.	38/39= 97.4%	67/71= 94.4%	0.654
A concussion is a brain injury.	39/40= 97.5%	69/69= 100%	0.367
In order to be diagnosed with a concussion, you have to lose consciousness.	40/40= 100%	70/70= 100%	*
There is a higher risk of long term problems if someone has a second concussion before recovering from the first one.	37/38= 97.4%	68/68= 100%	0.358
Concussions can sometimes lead to emotional problems.	40/40= 100%	64/64= 100%	*

A concussion can only occur if there is a direct hit to the head.	38/40= 95.0%	67/67= 100%	0.138
There are a few risks to long-term health and well-being from multiple concussions.	37/38= 97.4%	68/68= 100%	0.358
Younger players (under the age of 18) typically take longer to recover from a concussion than adults.	7/30= 23.3%	7/44= 15.9%	0.548
Post concussion symptoms can be delayed for hours or days.	38/39= 97.4%	68/68= 100%	0.364

*Fisher's exact test did not run

Table 6. shows participants responses to common signs and symptoms. There were more participants without hockey experience than there were with hockey experience. There were no significant differences in concussion knowledge between the two groups . For signs and symptoms, such as 'Hives', 'Headache', 'Sensitivity to Light', or 'Difficulty Remembering', majority of participants in both groups answered correctly and both groups scored above 95%. Overall, participants in both groups scored low for symptoms such as fever, panic attacks, and reduced breathing rate. However, the hockey experience group had a higher percentage of participants answer correctly as compared to participants with no hockey experience.

Table 6. Parents/guardians with hockey experience vs. no hockey experience and their knowledge of concussion signs and symptoms (counts (percentages))

Symptom	Hockey Experience	No Hockey Experience	Fisher's Exact Test p-value
Hives	38/40 = 95.0%	66/71= 93.0%	0.717
Headache	40/40= 100%	70/71= 98.6%	1.000
Fever	30/40= 75.0%	51/71= 71.8%	0.825
Arthritis	36/40= 90.0%	62/71= 87.3%	0.767
Sensitivity to Light	40/40= 100%	70/71= 98.6%	1.000

Difficulty Remembering	40/40= 100%	70/71= 98.6%	1.000
Panic Attacks	14/40= 35.0%	23/71= 32.4%	0.835
Feeling in a Fog	40/40= 100%	70/71= 98.6%	1.000
Weight Gain	35/40= 90.7%	65/71= 91.5%	0.134
Feeling Slowed Down	40/40= 100%	69/71= 97.2%	0.535
Reduced Breathing Rate	25/40= 62.5%	37/71= 52.1%	0.324
Excessive Studying	35/40= 87.5%	65/71= 91.5%	0.521
Difficulty Concentrating	40/40= 100%	70/71= 98.6%	1.000
Dizziness	40/40= 100%	69/71= 97.2%	0.535
Hair Loss	38/40= 95.0%	69/71= 97.2%	0.618

Table 7. shows the counts and percentages of correct responses from participants with concussion experience and without concussion experience. There were no significant differences in concussion knowledge among the concussion experience group and participants with no concussion experience. Participants were categorized as having concussion experience if they have received previous concussion training or have taken their child to be further assessed because of a concussion injury. 100% of the participants in the concussion experience group answered 4 out of the 11 knowledge related questions correctly.

Table 7. Parents/guardians with concussion experience vs. no concussion experience and their knowledge of concussion signs and symptoms (counts (percentages))

Knowledge related question	Concussion Experience Group (% correct)	No Concussion Experience Group (% correct)	Fisher's Exact Test p-value
People who have had one concussion are more likely to have another concussion.	57/61= 93.4%	34/38= 89.5%	0.479

Sometimes a second concussion can help a person remember things that were forgotten after the first concussion.	48/50= 96.0%	30/31= 96.8%	1.000
There are helmets that prevent all concussions.	63/66= 95.5%	41/43= 95.3%	1.000
A concussion is a brain injury.	65/66= 98.5%	41/41= 100%	1.000
In order to be diagnosed with a concussion, you have to lose consciousness.	66/66= 100%	42/42= 100%	*
There is a higher risk of long term problems if someone has a second concussion before recovering from the first one.	63/63= 100%	40/41= 97.6%	0.394
Concussions can sometimes lead to emotional problems.	63/63= 100%	39/39= 100%	*
A concussion can only occur if there is a direct hit to the head.	64/65= 98.5%	40/40= 100%	1.000
There are a few risks to long-term health and well-being from multiple concussions.	32/65= 49.2%	17/41= 41.5%	0.549
Younger players (under the age of 18) typically take longer to recover from a concussion than adults.	9/50= 18.0%	5/23= 21.7%	0.754
Post concussion symptoms can be delayed for hours or days.	66/66= 100%	39/40= 97.5%	0.377

*Fisher's exact test did not run

Table 8. shows the counts and percentages of the correct responses when asked common signs and symptoms of concussion in participants with concussion experience and those with no concussion experience. 'Fever' was the only statistically significant symptom identified between

the two groups with the concussion group having 53/66 (80.3%) answer correctly while only 62.8% (27/43) participants with no concussion experience answered correctly.

Table 8. Parents/guardians with concussion experience vs. no concussion experience and their knowledge of concussion signs and symptoms (counts (percentages))

Symptom	Concussion Experience	No Concussion Experience	Fisher's Exact Test p-value
Hives	62/66= 93.9%	41/43= 95.3%	1.000
Headache	66/66= 100%	42/43= 98.2%	0.394
Fever	53/66= 80.3%	27/43= 62.8%	0.049
Arthritis	62/66= 93.9%	35/43= 89.5%	0.059
Sensitivity to Light	66/66= 100%	42/43= 97.7%	0.394
Difficulty Remembering	66/66= 100%	42/43= 97.9%	0.394
Panic Attacks	23/66= 34.8%	14/43= 32.6%	0.839
Feeling in a Fog	66/66= 100%	42/43= 97.7%	0.394
Weight Gain	61/66= 92.4%	36/43= 83.7%	0.212
Feeling Slowed Down	65/66= 98.5%	42/43= 97.7%	1.000
Reduced Breathing Rate	37/66= 56.1%	24/43= 55.8%	1.000
Excessive Studying	58/66= 87.9%	42/43= 97.7%	0.085
Difficulty Concentrating	66/66= 100%	42/43= 100%	0.394
Dizziness	66/66= 100%	41/43= 95.3%	0.153
Hair Loss	66/66= 100%	40/43= 93.0%	0.059

4.0 Discussion

The aim of this study was to determine the current knowledge of concussion in youth ice hockey parents/guardians. Parental knowledge of concussion was determined by means of a survey which included knowledge related questions and signs and symptoms of concussion. The survey was modified and adapted from the *Concussion Knowledge, Beliefs and Behaviour Questionnaire: Parents* developed by Dr. Amanda Black.[6] This is the first published questionnaire investigating the parental knowledge of concussion and has been validated through concussion specialists and experts.[6] To the primary investigator's knowledge, this is the only study to use a modified version of this questionnaire. Data collection for the study was conducted over a time span of four weeks. A total of 122 surveys were collected, but only 111 of those surveys were included in the study for data analysis. A total of 54 women and 57 men participated in the study. Only one participant identified as 'other primary guardian' and all other participants were parents. Participants ranged in ages 25-55 years old.

4.1 Parental Demographics

Overall, parents and primary guardians scored high when asked to respond to concussion knowledge related questions. Parents and guardians were instructed not to use outside sources or consult with other parents while completing the survey. Additionally, parents and guardians of the same household were allowed to complete the survey separately, but we could not control for those factors. The high scoring results are consistent with previous concussion knowledge-based

studies,[6,38] which may suggest that parents are becoming more educated on concussion. However, a study conducted by Kerr et al. suggested that by only providing options, such as 'yes' or 'no', this does not allow for a true assessment of concussion knowledge when they only have a 50% chance of responding correctly.[38] By including an additional option, such as 'maybe' or 'I don't know' this could allow for a better representation of why parents and guardians may be unsure of whether their child sustained or did not sustain a concussion and thus, help researchers have a greater understanding of where the gaps of knowledge in concussion are present.[38] Majority of parents and guardians that participated in this study were in their forties and had 3-7 plus years of experience as an ice hockey parent or guardian with at least one child currently participating on a team.

During this study, parents and guardians were asked to identify the sources in which they received their concussion information. Of the 111 participants, only 23.4% participants stated their only source of concussion information was from healthcare professionals, such as athletic trainers, team physicians, or their child's pediatrician, which may suggest that their child's organization does not promote concussion awareness or provide educational tools to parents and players prior to their seasons. This may also suggest that these parents lack knowledge of concussion which may lead to children returning to play symptomatic or the inability to identify a suspected concussion after one is sustained. In addition, 9.0% participants stated they received their concussion information from their hockey association, which may include the USA Hockey organization, director of rink, coaches, and the Pittsburgh Amateur Hockey League (PAHL). An interesting finding from this data was four out of the five parents stated they never coached or played ice hockey before, never took their child to be further assessed for a concussion and have never received any type of concussion training. Yet these parents have an upwards of three or more

years of experience as an ice hockey parent. Participants also had the option to select more than one response as educational sources for receiving their concussion information. The most common responses that parents and guardians chose as their sources were healthcare professionals, hockey association, and research articles. This is consistent with Our findings suggest that these parents and guardians are receiving their concussion information from reliable and trustworthy sources,[37,38] however, there still remains a disconnect in implementing this information.

4.2 Responses to Knowledge Related Questions and Common Signs and Symptoms

Another aim of this study was to describe parental knowledge of the common signs and symptoms of concussion. In general, parents scored high overall when asked about common symptoms, such as 'Headache', 'Sensitivity to Light', 'Difficulty Remembering', and 'Dizziness', but struggled to correctly identify signs unrelated to concussion. These findings are consistent with previously conducted studies when asked about common concussion signs and symptoms in parents with children participating in youth ice hockey and parents of middle school aged and youth aged athletes participating in othersports.[6,16,40,58,67] However, when asked symptoms unrelated to concussion, parents struggled to identify whether 'Panic Attacks' or 'Reduced Breathing Rate' were symptoms of concussion, with approximately 50% of parents answering incorrectly. This may suggest the reasoning for parents having difficulties identifying concussions because they are unsure of all the symptoms. As noted in the introduction, when a concussion is sustained one is likely to experience some, if not all, of the 21 possible symptoms of concussion with the most common being headache, dizziness, -confusion, and difficulty concentrating.[12] Other symptoms that one could experience, but are not limited to, include: difficulty concentrating,

sensitivity to light and noise, and nausea. The signs used as distractors like the 'Panic Attacks' or 'Reduced Breathing Rate' may suggest parents are unsure of the signs directly related to concussion. Collins et al. developed a clinical concussion trajectory model which includes six different categories of concussion that one may fall into.[12] Out of the six, those thought to fall under vestibular or anxiety/mood trajectories do have symptoms of anxiety. More often than not, many people will associate anxiety with panic attacks, and this could explain why parents were more likely to relate 'Panic Attacks' as a sign of concussion. Although parents did correctly identify common symptoms of concussion, lack of knowledge in common signs remains an issue. Perhaps parents do not know the difference between signs and symptoms and need to be further educated on what to look for such as behavioral or physical changes like balance problems.

4.3 Comparison of Responses: Women vs. Men

Previously published studies have not looked at the differences among male and female parents or primary guardians. Most studies have only noted when more mothers than fathers have participated, but never compared their results. Although, many studies reported more women than men participating in the study,[6,59] but this was not the case. An aim of this study was to describe the parental knowledge of common signs and symptoms of concussion. While the participants were asked signs and symptoms associated with concussion, other symptoms were also included that are unrelated to concussion as distractors.[6] Overall, both men and women had high concussion knowledge of the common signs and symptoms. Based on the findings of this current study, female participants were able to correctly identify more concussion signs and symptoms as compared to males. Based upon current available literature, only one other study conducted by Coughlin et al.

noted that mothers had more concussion knowledge than fathers when asked about the common concussion signs and symptoms.[10] Additionally, this study also mentioned that mothers were able to identify symptoms unrelated to concussion. In this study, this holds true, however, there were no significant differences between groups. In addition to concussion related symptoms, symptoms both male and female participants scored relatively lower for symptoms unrelated to concussion, such as 'Fever', 'Panic Attacks', and 'Reduced Breathing Rate'. The reasons for why both male and female participants scored lower could be due to, although unlikely, the overreporting of symptoms or overly cautious of their child's health and well-being. Another reason for low scores could be due to only allowing parents to select 'Yes' or 'No', therefore giving parents a 50% chance to selecting the right answer and not allowing an option for uncertainty as used in the section related to concussion knowledge. Lastly, incorrect responses for both males and females could be due to the lack of knowledge in concussion symptoms other than the most reported symptoms after a concussion is sustained.

4.4 Concussion Experience Group vs. No Concussion Experience Group

Parents and guardians were placed in the Concussion Experience group if they have ever received concussion training or have taken their child to be further assessed for a concussion by a physician. The findings of this study suggested that there were no differences in the concussion experience group when compared to the parents and guardians who did not have concussion training or have taken their child for a further assessment. Even though there were no differences, it is still important to note that parents did have lower overall scores for some of the questions asked in the survey, which has been consistent throughout all groups. The most interesting finding

was that parents and guardians in both the concussion experience group and no concussion experience group answered 'Younger players (under the age of 18) typically take longer to recover from a concussion than adults' incorrectly. This may suggest that parents believe children are able to heal quicker as they do with orthopedic and musculoskeletal injuries, but it is not the same for concussions. Concussions can have a greater impact on young individuals, especially if not healed proper or if enough recovery time is allotted. Because youth athletes are still skeletally immature, this puts them at a greater risk for sustaining a concussion as well as longer recovery time.[14,34,40]

4.5 Hockey Experience Group vs. No Hockey Experience

Whether a parent or guardian with previous coaching or playing experience has an influence on concussion knowledge is not well known. In this current study, parents or guardians were placed in the Hockey Experience group if they responded yes to one or both questions: 'Have you ever coached ice hockey before?' and 'Do you have experience playing ice hockey? If yes, how many years?'. Lin et al. conducted a study on parental knowledge of pediatric sports related concussion and believed that parents with previous playing experience would have had increased knowledge of concussion.[48] The authors found that there were no differences among groups regardless of playing experience.[48] Our results showed that the hockey experience group and the group without experience showed no differences in concussion knowledge when asked concussion related questions, for the exception of one question. As mentioned earlier, during sport competition, concussion was often referred to as 'getting their bell rung' and were typically left untreated.[48] In addition, another study that was conducted by Register-Mihalik et al. on concussion related knowledge, although parents were not participants, youth ice hockey players had the

lowest scores suggesting that the sport may be need additional educational efforts.[59] Parents play a crucial role in educating their children about the importance of concussion and educating them.

4.6 Parents Attitudes Towards Seeking Further Medical Care

The participants were asked a question about their personal beliefs after their child could have undergone a concussion injury mechanism but reported no symptoms. The purpose of this question was to identify whether they would seek further medical care for their child to be evaluated before returning to play. The results showed that majority of the parents 79.2% would seek further medical care even if their child does not report symptoms. As for the other participants, 5.4% said 'No' and 13.5% said 'Not sure' while both groups were equally divided as to who has received previous concussion training or already has taken their child to be further assessed by a physician for a concussion. To add, out of the parents who stated they would take their child out regardless of if they were experiencing symptoms, 50.4% has received some type of concussion training or sought further medical care, while the other 29 respondents did not. Although a child may not report symptoms of a concussion immediately, symptoms can have a delayed onset appearing days later after the initial injury.

The current study had several limitations, such as subject recruitment and geographical location. Two ice rinks in the Greater Pittsburgh Area agreed to distribute and post survey information throughout their locations. Only one rink agreed to distribute the survey via email to parents and guardians. From the email alone, approximately 900 parents and guardians were reached. Based on the data provided by the Qualtrics Software, majority of the participants responded via the survey link, with a small number of participants used the QR code on the survey

flyers to access the survey. Thus, suggesting that a large proportion of participants came from the same youth ice hockey organization or geographical location, which could also be considered another limitation of the study.

Additionally, when recruiting subjects to participate in person, due to the study falling around the holidays, teams either were off or had practice in which parents would drop off their child for practice instead of physically coming into the rink. This limited the number of parents and guardians that could be recruited in person.

Since the study was based only out of two rinks in the Greater Pittsburgh area, the population may not be generalizable. Similar to concussion education, majority of the states have adopted their own youth concussion laws. In Pennsylvania, the 'Safety in Youth Sports Act' law states that an athlete must be removed from play if a concussion is suspected and cannot return to sport until he or she is cleared by a physician (M.D. or D.O.) with proper concussion training. However, this varies from state to state as to which medical professional can clear an athlete to return to play after exhibiting an obvious mechanism of a concussion or showing any signs and symptoms of concussion.

Moreover, youth ice hockey players traveling from other states, or countries such as Canada, may not be aware of the concussion laws in the state of Pennsylvania. By including parents and guardians from other states or countries in this study, this could help to close the gap in knowledge of concussion. Based on concussion training program responses, majority of parents chose the CDC 'HEADS UP' as the program they have heard of before. This could be due to the 'HEADS UP' Summer Program offered by the University of Pittsburgh Medical Center (UPMC) to promote free baseline to all athletes under the age of twelve.

Additionally, in previously conducted studies,[6,48] questions such as occupation and level of education completed were included in the demographic sections. In the current survey, these questions were not asked, however, parents or guardians with a background in health could have had an impact on the results due to previous knowledge and not necessarily from the concussion training mentioned in the survey. In addition, some parents stated they have received training through the ImPACT concussion testing which may suggest they are referring to their child participating in pre-season baseline testing or watched an informative video by a provider on the purpose of what the ImPACT concussion testing is about.

Another limitation of this study is the timing of the data collection period. For this study, data collection fell around the holidays. While in most states, this is the busiest time of the year for youth ice hockey due to increased number of tournaments and children on break from school. However, there were schedule conflicts in availability to recruit participants in person. Furthermore, by conducting this research during the pre-season, there could have been potential for more participants recruited in-person and more rink availability at other various rinks in the area.

4.7 Future Research

Future research should aim to expand the demographics to include other states and countries in the survey to determine knowledge of concussion in parents of youth ice hockey athletes. As noted, the literature on concussion knowledge in youth ice hockey is scarce, and more studies need to be conducted to distinguish the reasoning behind the gap in knowledge within this sport. This could also help to identify if parents lack educational resources to learn about

concussions. This may also stimulate further investigations as to implementing medical coverage at more facilities. In addition, further research could also look at differences among organizations that have a team athletic trainer and organizations that do not. Often, high school athletes have access to athletic trainers, but youth-aged athletes very rarely have athletic trainers as a resource. By having an athletic trainer, this could prevent athletes from returning to play after a concussion is sustained, while providing educational opportunities to encourage parents to learn more about the common signs and symptoms of concussion. Not only would an athletic trainer be able to provide parents and guardians with proper education, by being present at practices and games, this could help to eliminate any uncertainty when making return to play decisions and offer guidance on proper concussion management to ensure a safe and full recovery.

In addition to surveying parents, asking the youth ice hockey players questions to gain their knowledge of concussion may be able to provide additional insight into the gaps of knowledge in concussion. A recent study surveyed the concussion knowledge of middle-school aged athletes participating in contact sports, such as lacrosse, ice hockey, soccer and football, and found that the youth ice hockey players scored the lowest overall.[59] This may suggest that youth ice hockey players are not being properly educated on concussion by either their coaches, parents, or team organization.[59] Because youth ice hockey players may not be familiar with concussion signs and symptoms, they may be less likely to report it. Additionally, the influence of parents' attitudes and knowledge may influence their child's viewpoints, making them less knowledgeable or forthcoming after a suspected concussion injury during sport. Some organizations require baseline concussion testing prior to participating in season, but to what extent do these athletes understand why their being asked to complete this test is not well known. Furthermore, players may be afraid to speak up about symptoms and feel as though their teammates, coaches, and parents or guardians

would be disappointed in them. Cusimano et al. found that ice hockey players that were aware that they may have sustained a concussion due to being symptomatic did not want to inform their coach because they wanted to continue to play and did not want to be withheld from competition.[15,21,51] This is a huge concern and could pose serious risks for further injury. Like parents and guardians, players should be educated on the risks of continuing to play for their well-being and longevity of their athletic careers. To further emphasize, communication between parents and children may be the key to changing the way concussion is currently viewed in the sport of ice hockey. Kroshus et al. mentions that there is a possibility that parents are hesitant to have these concussion discussions with their children in fear that it would have a negative impact on their children making them hypersensitive or overreport symptoms.[43] The authors also suggest that another way to properly promote concussion awareness and knowledge is to instead of focusing on concussion alone, informing the parents of the benefits of youth athletic development while also informing them of the longer it takes them to seek further care due to misdiagnosing or underreporting could lead to longer recovery times thus more time missed or the potential for a career ending injury.[3,43]

Future research should also consider conducting a pre-test post-test survey for determining parents' concussion knowledge in youth ice hockey. By doing so, researchers could implement a preseason assessment to gauge participants' baseline knowledge of concussion and the common signs and symptoms while also providing educational handouts or in person learning opportunities to educate those interested in learning more about concussion. After the season, parents and guardians could have an opportunity to take the same assessment to see if their concussion knowledge increased, just like programs noted earlier such as ThinkFirst.[70] In this current study, 63.9% of participants said they would be interested in learning more about concussion.

4.8 Conclusion

To the primary investigator's knowledge, this is the first study to be conducted on parental knowledge of concussion in youth ice hockey in the Greater Pittsburgh area. This study aimed to determine the current concussion knowledge among youth ice hockey parents and guardians. This study was able to provide a greater understanding of the current knowledge of concussion among parents and guardians. This was a survey-based study and participants with children ranging in ages 8-18 years old currently participating in ice hockey were able to participate. Overall, parents and guardians had moderate knowledge of concussion related questions and the common concussion signs and symptoms. Based on the findings of this study, it showed that parents and guardians may struggle to identify the signs and symptoms unrelated to concussion. This may suggest further education should be implemented in order to differentiate these signs and symptoms to prevent mismanagement of concussions.

In addition, this study aimed to investigate the sources in which parents received their concussion knowledge. The majority of participants stated they received their concussion knowledge from reliable sources. Although no significant differences were found between the experience and no experience groups, this study helped to highlight the gaps that remain in parental knowledge of concussion. It is important to note that although parents and guardians answered majority of the questions correctly, this does not necessarily equate to parents or guardians being able to identify a concussion when it occurs or are knowledgeable on appropriate management for return to play.[59] Further efforts to encourage concussion training and state mandates still need to be enforced for parents to become more equipped in identification and prevention. Additionally, more studies are needed targeting the youth populations as increases of participation in youth sports continue to grow.

Appendix Figure 1: Survey

Thank you for your interest and participation in the survey "Current Parental Knowledge of Concussion in Youth Ice Hockey". Before you continue, grab a cup of coffee, and please read the summary below of what you need to know:

What is this study about?
This research is being conducted within the Sports Medicine and Nutrition Department at the University of Pittsburgh (Pittsburgh, PA). The purpose of this study is to determine the current knowledge of concussion among parents of youth ice hockey players. The aims of the study will be addressed by means of an online survey which can be accessed using the provided link. Participation is voluntary and all responses will remain anonymous. The survey will take approximately 5-10 minutes to complete. By completing the survey, you are consenting to participate in the study.

Benefits of this Study
Results acquired from this study will investigate the current parental knowledge of concussion in youth ice hockey and will help to expand upon the available literature to help improve concussion management and treatment in youth ice hockey without the presence of a medical professional. Upon completion of the survey, you will have the opportunity to be chosen at random for a $100 Gift Card to Pure Hockey. Three out of 200 participants will be randomly selected at the end of the duration of the study.

What about my privacy?
As mentioned above, all survey responses will be collected anonymously. Any information that may include your identity will be omitted. Only the research committee will have access to the survey results.

Voluntary participation:
By completing the survey, you are consenting to participate in the study. Your responses will be completely anonymous. Please answer the questions to the best of your ability without the assistance of others or the internet. Please do not share the survey or responses with others. You may stop the survey at any time. To take the survey you must be a parent or guardian of a child ranging in ages 8-18 years old currently participating in youth ice hockey.

Contact information:
If you have any questions regarding the study or the survey, please contact Amber Martinelli, LAT, ATC, graduate student in the Department of Sports Medicine and Nutrition at the University of Pittsburgh, via email at amm544@pitt.edu.

The first section consists of demographic questions and will be the quickest to complete! Only two sections left after this. You can do it!

Do you have a child between the ages 8-18 years old currently playing youth ice hockey?

- Yes
- No

What is your gender?

- Male
- Female
- Non-binary / third gender
- Prefer not to say

What is your relationship to the player(s)?

- Parent
- Other Primary Guardian

What is your age (in years)?

How many years have you been a hockey parent?

- First year
- 1-2
- 3-4
- 5-6
- 7+

How many children do you currently have playing hockey?

1

2

3

4

5

6

>6

Have you ever coached ice hockey before?

Yes

No

Do you have experience playing ice hockey? If yes, how many years?

- 0-1
- 2-3
- 4-5
- 6+
- No, I have never played ice hockey before.

Have you ever taken your child(ren) to see a physician to be further assessed for a concussion as a result of playing ice hockey?

- Yes
- No

Have you ever received information about concussion?

- Yes
- No

Where do you get your information about concussion? (Select all that apply.)

- Healthcare Professionals (Athletic Trainer, Pediatrician, Team Physician, Etc.)
- Hockey Association (USA Hockey, Coach, Director of Rink, PAHL, Etc.)
- Research Articles
- TV
- Social media (Facebook, Instagram, Twitter, Etc.)
- Internet
- Other Parents

Which of these concussion training programs have you heard of?

- HEADS UP
- Concussionwise
- ThinkFirst
- Other
- None of these

Which of these concussion training programs have you completed?

- HEADS UP
- Concussionwise
- ThinkFirst
- Other
- I have not completed a concussion training program

Are you interested in being educated about concussion?

Yes

No

Way to go- You made it to the next section! Keep going, only one section left after this one! You will now be presented with a series of True or False questions related to concussion. Please answer the questions to the best of your ability without the assistance of others or the internet.

People who have had one concussion are more likely to have another concussion.

- True
- False
- Don't know

Sometimes a second concussion can help a person remember things that were forgotten after the first concussion.

- True
- False
- Don't Know

There are helmets that prevent all concussions.

True

False

Don't know

A concussion is a brain injury.

True

False

Don't know

In order to be diagnosed with a concussion, you have to lose consciousness.

True

False

Don't know

There is a higher risk of long term problems if someone has a second concussion before recovering from the first one.

- True
- False
- Don't know

Concussions can sometimes lead to emotional problems.

- True
- False
- Don't know

A concussion can only occur if there is a direct hit to the head.

- True
- False
- Don't know

There are a few risks to long-term health and well-being from multiple concussions.

- True
- False
- Don't know

Younger players (under the age of 18) typically take longer to recover from a concussion than adults.

- True
- False
- Don't know

Post concussion symptoms can be delayed for hours or days.

- True
- False
- Don't know

Great news- You made it to the last section! Finish strong! This section will include signs and symptoms of concussion. Please answer the questions to the best of your ability without the assistance of others or the internet.

Hives

- Yes
- No

Headache

- Yes
- No

Fever

- Yes
- No

Arthritis

Yes

No

Sensitivity to Light

Yes

No

Difficulty Remembering

Yes

No

Panic Attacks

Yes

No

Feeling in a Fog

Yes

No

Weight Gain

Yes

No

Feeling Slowed Down

Yes

No

Reduced Breathing Rate

Yes

No

Excessive Studying

Yes

No

Difficulty Concentrating

Yes

No

Dizziness

Yes

No

Hair Loss

Yes

No

If you suspect that your child has a concussion, but shows no symptoms at all, will you stop them from playing ice hockey to seek medical care?

Yes

No

Not sure

→

We thank you for your time spent taking this survey. Your response has been recorded.

Please click on the link below to learn more about concussions:
Parent Education & Certificates | ConcussionWise™ - Start Online Course Now (sportsafety.com)

Please click on the link below to enter for a chance to win a **$100 Gift Card to Pure Hockey**:
https://forms.office.com/r/PX1wj2hE6A

If you have any questions or would like more information regarding the survey, please contact me at amm544@pitt.edu.

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