

CONCUSSION EDUCATION PRACTICES AMONG  
HIGH SCHOOL COACHES IN MONTANA

by

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DEDICATION

This paper is dedicated in part to my mother, my first teacher and inspiration to become an educator. I would also like to dedicate this dissertation to my children, Logan and Landon. May they develop a life-long love of learning and always seek to understand truth.

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## ABSTRACT

Concussions in high school sports present a legitimate threat to athletes across the United States. In the absence of qualified healthcare providers, coaches are most often the individuals who are tasked with making sideline analyses of removing the injured athlete from participation. To help ensure the most optimal outcomes for these athletes, it is important to accurately determine the most effective ways of training coaches. This study analyzed high school coaches in the state of Montana to determine their familiarity with different types of concussion education programs. In addition, particular focus was placed on determining if coaches' familiarity of concussion education programs differed significantly between coaches in urban versus rural school settings and between coaches of different sports.

## CHAPTER 1

### INTRODUCTION

#### Background

One of the most important issues in sports today is the concussion epidemic. According to the Centers for Disease Control (CDC, 2014), concussion related emergency department visits went up 60% in the last decade. Langlois et al. (2006) found between 1.6-3.8 million sport-related concussions are diagnosed per year. The reason there is so much variance in these statistics is that many concussions go undiagnosed and are not reported. Concussion occurs when direct mechanical trauma causes injury to the brain that result in altered metabolic and cognitive status. Concussions are a unique injury in that no two concussions will present in an identical manner, confronting athletic trainers and other clinicians who are pressed to recognize concussions among athletes with a daunting challenge. Increased public awareness of the seriousness of concussions and other mild traumatic brain injuries (mTBI) has also placed increased emphasis on accurate and timely sideline concussion assessment, especially among youth athletes. While concussion risks in NFL players may garner the lion's share of media attention, NFL players do not constitute the largest number of athletes vulnerable to sport-related concussion. That "honor" – as dubious as it is—belongs to high school football players. In 2018-2019, high school football was played by 1,006,013 youth according to the National Federation of State High School Associations. While every NFL team has medical staff on the sideline at every game, an undetermined but large number of high school football players

compete without such support. According to a recent report by the National Athletic Trainer's Association (Huggins, 2019), only 66% of high school athletes have access to an athletic trainer. Those schools without access to athletic training services may rely on personnel such as coaches, athletic directors, and parents to make the evaluation decisions about whether the athlete has truly suffered a concussion. Without proper training, many sideline concussion assessments may not be appropriate for the layperson to administer to an athlete with a head injury. Although the need for valid and reliable sideline assessment instruments that can screen athletes who may have suffered a concussion is of utmost importance, especially for non-medically trained personnel, perhaps even more important is consistent training and education on concussion assessment and management for those individuals who are on the sidelines responsible for making decisions about concussions. This need may take on additional importance in rural and under-served areas where there may be inadequate access to a qualified healthcare provider to assist in this process.

Data from sideline concussion screenings such as the Standardized Assessment of Concussion and the Sport Concussion Assessment Tool 3 (SCAT3), administered by clinicians such as athletic trainers on the sideline, provide critical information related to diagnosis and return-to-play decisions. These assessment tools are designed to be administered by a professional trained in the evaluation and management of sport concussion. They are tools used by the clinician to help them make their clinical assessment. The time and training needed to effectively administer these tests is usually above the level of training of many coaches. Other computerized neurocognitive tests, such as ImPACT, also require training to accurately interpret test results and are not practical as sideline assessments.

In 2009, the state of Washington passed the Zachery Lystedt Law, which required athletes suspected of having sustained a head injury to be evaluated and cleared by a healthcare provider trained in concussion assessment before being returned to sport-related activity. As of February 2014, all other 49 states followed suit and passed similar legislation to protect youth athletes (NFL Health and Safety Committee, 2015). However, in many situations there is no healthcare provider trained in concussion assessment available on the sidelines to make these decisions. The dilemma becomes deciding who, and with what assessment tools, should make the decision whether or not an athlete has suffered a concussion.

On September 12, 2014, Robert Back, a high school football player from Belt, Montana suffered a head injury during a football game (Billings Gazette, 2014). He was allowed to go back into the game where he suffered another serious blow to the head resulting in a life-threatening condition known as Second-Impact Syndrome. Second-Impact Syndrome (SIS) is an auto-regulatory condition in which blood flow to the brain is greatly increased resulting in increased intracranial pressure that can lead to coma and death (Arnheim & Prentice, 2013). SIS is caused by receiving a second biomechanical insult to the brain before the recovery of the initial trauma. Although it wasn't fatal, Robert Back was left with permanent physical and mental disabilities as a result of his injury. Had this been properly diagnosed initially, he would have been prevented from returning to play after the initial head trauma. This tragic story could have been prevented by following simple protocol that requires individuals who work with youth sport to immediately remove any athlete who is suspected of sustaining a concussion.

Rural populations are at increased risk of sustaining undiagnosed concussions as they are generally further from qualified healthcare providers. In many cases, it is not a qualified athletic trainer or team physician that is making critical return to play decisions, but rather coaches,

parents, or administrators (McGuine et al., 2018). Based on previous experiences of the investigator, assessments may include nothing more than asking an athlete “how many fingers am I holding up?” and “where are you?” These questions are of little diagnostic value. To compound the problem, athletes, especially in high school, are often under pressure to “shake it off” and return to play (Lininger, et al., 2017). To help coaches, parents, and other amateur sports volunteers recognize concussions in such situations, a written concussion plan should be implemented in each school district to outline the roles and duties of all individuals involved in the assessment plan (Davies, 2016). This plan should include any objective sideline assessment tools to be used during the evaluation and how individuals will be trained to use these assessment tools. Along with assessment responsibilities, the concussion plan should have detailed instructions on referral protocol and return-to-play criteria.

Murphy et al. (2012) found that although high school coaches in Washington state were familiar with the state statute regarding concussion assessment, there was a statistically significant difference in the standard of care of assessing athletes in rural populations compared to athletes in urban populations. Proximity to qualified medical providers was correlated positively with level of competence in the sideline concussion evaluation, with rural populations most often receiving sub-par care. This study discovered a decreased reporting rate in rural populations compared to urban schools. The reasons for this decreased reporting rate are open to some speculation, but it is very possible that urban schools had better access to qualified healthcare providers. Another possible explanation is that coaches in urban schools have received more training in concussion assessment and management. Both of these factors put rural schools at a distinct disadvantage when dealing with athletes who have suffered from sport-related concussion. Yue et al. (2020) found similar results with rural populations experiencing

higher rates of concussion when compared to urban populations. In addition to the decreased availability of qualified medical personnel to evaluate athletes who had sustained head injuries, this study also determined that decreased use of standardized testing and inadequate access to ambulatory medical services contributed to these poor outcomes.

According to the Center for Frontier Communities, about half of all Montanans fit the criteria for being in a frontier community based on the population density and distance to medical facilities (Konger, 2010). This presents several unique challenges to address regarding concussion management. First, who will make the sideline decision to remove the athlete from play after a suspected concussion? Secondly, what is the minimum level of training and competence needed to make a return-to-play decision? Many rural providers, although licensed and trained in their respective fields, do not possess the current knowledge and training required to make sound clinical decisions (Lebrun et al., 2012). Ultimately, high school coaches need to have a thorough working knowledge of current concussion assessment and management practices to ensure athlete safety and prevent potential catastrophic events from occurring.

Concussion education is problematic in that it requires the coach, parent, athlete, and provider to all be in agreement regarding the health and safety of the athlete. A study by Duenas, White, & Jandial (2014) selected 43 high-school football players to be subjects to take a baseline concussion test prior to the season. Only 13 of the 43 agreed to participate with the others refusing because they did not want the data used “against them” in case they suffered a head injury. That is, athletes were anxious about participation because they were worried about not achieving a minimal score consistent with their baseline if they were to suffer a concussion. Many parents refused to let their children participate because they thought it would hurt their son’s chance of being recruited by a college football team. Clearly, there is a serious lack of

understanding by all stakeholders when the concern is a scholarship over the safety and long-term well-being of the athlete. This misunderstanding could also manifest itself when coaches of different sports or different levels of concussion education are involved. This study seeks to understand some of these layers of concussion awareness and hopefully be able to inform better decisions on concussion education policies.

### Research Purpose

The purpose of this study is to evaluate how familiarity with several types of concussion education differs among Montana high school coaches of different sports and between coaches in rural and urban settings. This study will also seek to determine which concussion training programs have the greatest awareness among coaches in all settings in Montana. Given the dichotomy regarding availability of trained healthcare providers in urban and rural settings, it is possible that coaches in rural settings have more responsibility in sideline assessment practices than their urban counterparts. The question becomes whether or not coaches in rural settings exhibit the same familiarity in educational practices as their urban counterparts. Equally as important is the question of whether coaches in collision, contact, and non-contact sports display the same awareness of concussion educational materials. By determining the current level of awareness, it is then possible to make recommendations based on best practices and to find objective educational strategies and tools to assist high school coaches in making informed concussion assessment decisions.

With the recent media blitz on concussions, it is imperative that coaches in all settings and in all sports receive concussion education materials and training from reputable sources. To

this end, several professional medical organizations, sports associations, and government agencies have produced documents or educational materials designed to help coaches with the basics of sideline concussion awareness and protocol. What may be complicating this process is that there are so many educational programs available. The aim of this study was to determine if there is a deficiency in concussion education awareness between rural and urban coaches and to illustrate the need to consistent concussion education between coaches of different sports and in different settings.

### Research Questions

1. Is there a significant difference in familiarity of concussion education training programs between rural and urban high school coaches in Montana?
2. Is there a significant difference in familiarity of concussion training programs between head coaches of different categories of sports?

### Hypotheses

Ha1: Urban coaches will have a greater familiarity with concussion education materials than rural coaches.

Ha2: Sport categories will impact familiarity.

Ha21: Collision sport coaches will be more familiar with concussion education materials than contact and non-contact coaches.

### Significance of the Study

The need for a protocol to accurately and quickly assess sport-related concussion is critical in youth sports, especially in the rural settings where access to trained healthcare providers may be limited. This study provided critical information on the familiarity of common types of concussion training that coaches and other non-medical personnel receive before they perform them in real-life situations. By determining this, it could potentially change the way sport-related concussion assessment is performed in areas with limited access to trained medical personnel.

Concussion education is delivered by many different educational programs. This study examined which of these methods coaches in different settings are most familiar. By examining the current trends in these educational practices, it may be possible to determine the most effective ways of delivering concussion training to coaches of all sports and in rural and urban settings.

### Theoretical Framework

Concussion evaluation training is a skill that can be taught, practiced, and evaluated in a clinical setting to develop proficiency. Clinical education of adult learners can follow one of several different education models. Problem-based learning (PBL) is an education method of teaching individuals by posing problems for them to critically assess in order to acquire knowledge and understanding (Hartling et al., 2010). PBL could be utilized in concussion education through the use of case studies and scenarios that place coaches in the role of primary evaluator of a suspected sport-related concussion. By implementing a medically-focused PBL

methodology into a non-traditional environment (football fields, gyms, etc.), lay personnel such as coaches and athletic directors could begin to develop objective decision-making skills in basic concussion evaluation within the scope of their position. As many of these individuals are the first and only link to appropriate medical referral for athletes with head injuries, it is crucial they have the proper skill and ability to make sound decisions based on objective test findings and not just observations and athlete reporting.

The informal learning style is a very effective method for helping coaches learn (Walker, Thomas, and Driska, 2018). This method scaffolds previous knowledge with new relevant experiences to produce a framework through which they evaluate and process new information. According to Eraut (2004), informal learning is the ability to gain knowledge and proficiencies away from a traditional learning environment such as the classroom. This on-the-job training builds on acquired skill and experience that is gained in the workplace to develop a more competent and extensive schema. This theory also implies that much of this learning is tacit and is acquired without the realization by the learner.

Most coaches and administrators receive their concussion education through online training modules. At the completion of the training, they are allowed to print a certificate of completion. This training is asynchronous as an individual can progress at their own pace over an extended period of time. This demonstrates the principle of self-regulated learning. Dabbagh and Kitsantis (2012) described how certain factors such as goal-setting, intrinsic motivation, and self-efficacy affect learning in non-traditional settings. By evaluating which self-regulated learning techniques are most effective, it is possible to promote greater understanding and recognition of sport-related concussion. These theories are especially applicable to training

programs for coaches in rural settings as they can be implemented at both a convenient time and location.

### Methodology

In this study, coaches completed a survey that explored concussion education practices for coaches in Montana. This survey was distributed to all high school coaches in different classes in the Montana High School Association. The objective of this survey was to identify what are the most common concussion education methods currently used by high school coaches in Montana. The survey also determined the extent to which a disparity existed in concussion education between coaches of different sport categories: collision(football), contact(basketball, soccer, baseball, softball, volleyball, and wrestling), and non-contact(cross-country, golf, tennis, and track and field).

### Limitations

The subjects for my study are high school coaches in Montana and therefore the results may not be representative of coaches in all states and demographic groups. One assumption is that all coaches will be honest on the survey and not misrepresent their level of familiarity in various forms of concussion training, however, due to the anonymity of the responses, this risk is considered minimal. Coaches may also tend to report the answers they think are correct rather than report on the actual level of awareness they possess on each type of concussion training.

### Delimitations

This research is delimited to high school coaches in Montana during the 2016-17 school year. As such, it can be expected that the respondents to the survey had differing levels of experience coaching high school sports. It can also be reasonably assumed that respondents came from a wide range of sports sponsored by the MHSAA and from both rural and urban schools.

### Summary

It was the intent of this study to provide accurate and useful information regarding familiarity with concussion education practices to high schools for use in athletic concussion evaluation. By determining which concussion training techniques are familiar with high school coaches in Montana, it may be possible to evaluate current training practices and implement strategies that are more successful in improving knowledge and comprehension in high school coaches. In turn, this may improve head injury detection in sports, especially in young athletes. By examining fundamental theories in how coaches learn and which types of education they are familiar with, it gives state high school associations, especially those with large rural populations, some direction on how to improve education across diverse settings. This study sought to utilize survey research to determine current practices in concussion education among high school coaches in rural and urban settings, as well as coaches of collision, contact, and non-contact sports. Establishing consistency across the board for all high school coaches regardless of size of school or sport will be critical in developing and maintaining a minimum standard of proficiency and care in concussion evaluation and management.

## CHAPTER TWO

## LITERATURE REVIEW

Introduction

One of the most important issues in sports today is the concussion epidemic. While much attention has been placed on proper concussion evaluation and management at all levels from youth football through the National Football League, there are still questions that must be answered regarding the most effective ways to educate coaches. To understand the importance of why coaches must be kept current in concussion education, it is imperative to realize that they are the first line of defense against sport related concussion in many cases. According to a study by Huggins et al. (2019), only 66% of schools nationwide have regular access to an athletic trainer to evaluate and provide care for concussed athletes. Pryor et al. (2018) estimates this number to be approximately 70% of schools currently have access to athletic training services. However, that statistic still begs the question of who is evaluating the other 30-34% of high school athletes when they sustain a head injury. In addition to determining who will be evaluating these athletes, it is critical to consider the level of training these individuals receive along with deciding which assessment tools should be used when making the decision whether or not an athlete has suffered a concussion. Without regularly scheduled and ongoing training in concussion evaluation and management, it seems likely that many athletes would not receive optimal care which could result in disastrous consequences. It is critical to identify the various types of concussion training programs that coaches are familiar with and what is being done to

ensure implementation of best practices to protect young athletes from unnecessary risks related to concussions.

This section will provide information on the importance of proper sideline treatment of athletes with sport-related concussion which is the major justification for this study. It will also analyze current methods of how coaches in high schools are trained in concussion assessment and management. Educational theories will be explored to strategize how to establish an educational model that ensures a minimum level of consistency and competency in concussion education for high school coaches. By examining these concepts, it may be possible to establish an evidence-based plan by assessing current familiarity of different concussion curricula that high schools can use to ensure that all their coaches have an appropriate level of knowledge and skill in sideline concussion assessment.

### Importance of Proper Sideline Treatment

As previously mentioned in the introduction, all 50 states have a concussion law in place to protect youth athletes who sustain a traumatic brain injury. However, according to a study by Coxe et al. (2018), many of these state laws are inadequate for the intended purpose of regulating how concussions are handled in youth sports. While 83% of state concussion laws include a removal from play tenet, less than 35% of these laws describe who should make this decision and discuss any type of protocol to accomplish this. Furthermore, less than 35% of these statutes mention any requirement for educational competency of coaches in relation to concussion training (Coxe et al., 2018). This crux of the issue is that effective evaluation and management guidelines need to be implemented locally with sound focus on best-practices and special detail

paid to ensure kids with concussions receive the highest quality care within their particular context of circumstances.

Concussions not only affect the ability of the individual to participate in sports, but also affect cognitive and academic pursuits. There is often confusion in which activities concussed students can participate. Lines of communication need to be established between the medical, sports, and academic communities, as well as with the family of the concussed individual. Hughes and Gabel (2018) discuss a team-based approach in which communication is presented to members of the aforementioned groups to ensure understanding in return to play and return to learn activities. Without this communication, there could be a serious lack of understanding by all stakeholders when the concern is a scholarship over the safety and long-term well-being of the athlete. Education of coaches, administrators, teachers, and parents is a crucial step to ensure that young athletes will receive the appropriate medical care after sustaining a head injury. Development and implementation of new objective concussion assessment measures and protocols are also of critical importance to ensure the safety of athletes. Figure 2-1 illustrates the importance of shared responsibility of all of these stakeholders.

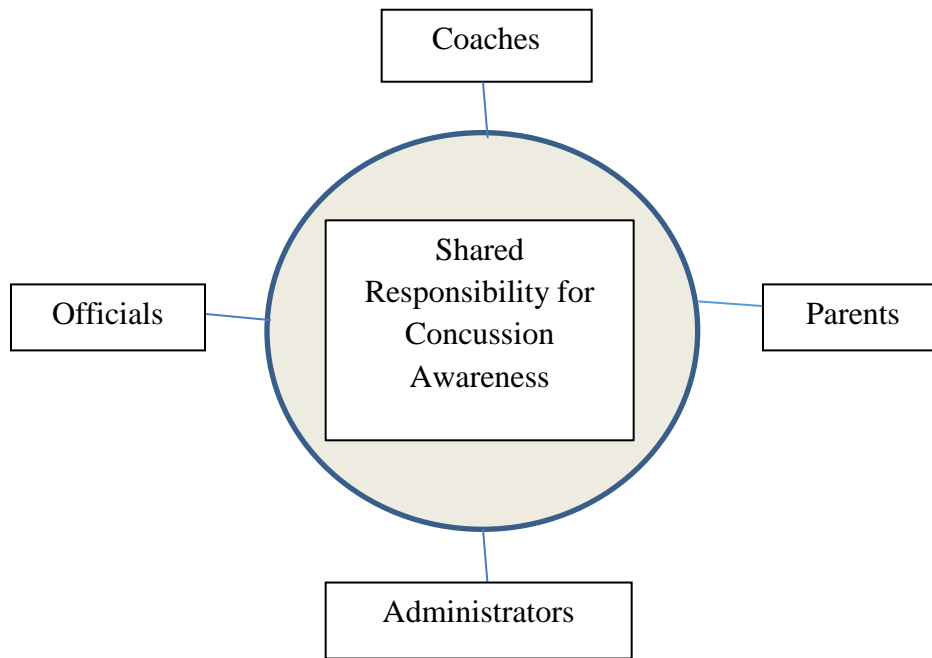


Figure 2-1. Stakeholders involved in concussion education and management.

### Curricula of Concussion Education and Training

What is known in the medical community is that concussion research has evolved tremendously and continues to do so. What is not known is how all of the advances in concussion assessment and treatment pertain to the non-medical community. In Montana, many rural schools do not have access to an athletic trainer or other medical specialist trained in concussion management. This leaves the responsibility for evaluating athletes suspected of a concussion to the coaches, athletic directors, or other lay personnel. Currently, there are limited resources for untrained personnel who must make sideline clinical assessments for athletes with suspected concussions. In order to provide a more objective approach and eliminate subjective bias, a protocol must be developed that can be used by untrained personnel and is valid, reliable, sensitive, and specific enough to detect minor concussions. Most of these tools are provided by the Center for Disease Control Heads-Up Training packet for Coaches, Parents, and Officials and

include symptom checklists, signs to observe, and personal judgment (CDC, 2013). The Montana High School Association (MHSA) mandates that all coaches undergo a concussion training program based on the CDC's Heads Up program (MHSA, 2016). The Heads Up program is unique in that it provides web-based training modules specific to coaches, officials, parents and administrators (CDC, 2016). Included in this training program are informational modules on concussion presentation, signs and symptoms and post-concussion action plans. This program is designed to be a guideline to help schools set up comprehensive concussion plans based on their individual situations. Coaches must have proof of completion before they are able to coach in Montana. This program also provides fact sheets, posters, and sideline reference cards to help coaches learn about their role in sideline assessment of concussion.

Sarmiento et al. (2017) completed a study designed to measure coaches' knowledge, attitudes, and behaviors in regard to concussion prevention. Coaches were mailed copies of the CDC Heads Up toolkit that contained all necessary concussion education materials. After the toolkit was distributed, coaches were sent a survey that measured their knowledge, attitude, and behaviors regarding concussions along with barriers to implementing these standardized plans. Interestingly, some of the major barriers indicated were related to personal traits of the athlete or the parents. Some of the more common reported barriers were "parents' or athletes' excessive competitiveness, viewing injuries as a weakness, underestimating the potential risk of concussion and lack of health insurance (Sarmiento et al., 2017). In addition to these barriers, coaches also reported that they believed that the Heads Up tool kit was helpful in learning more about concussions and they now viewed concussions more seriously than before they received the Heads Up tool kit. 68% of coaches reported that the Heads Up material helped them educate others on concussions, specifically parents, as all they had to do was to give them a handout with

all the pertinent information on acute treatment of sport-related concussion (Sarmiento et al., 2010).

Covassin, et al. (2012) followed up on this study when they developed a survey to distribute to youth sport coaches evaluating the effectiveness of the CDC Heads Up concussion training program. Results from this study were very encouraging in that almost half of the coaches surveyed felt that they were able to educate others on concussions after reviewing the Heads Up materials. To further illustrate the significance of this specific method of concussion education, 69.6% of respondents reported not having access to any other concussion education materials prior to taking the Heads Up course (Covassin, et al., 2012). From this perspective, the CDC Heads Up program is the most popular method of concussion education among youth coaches. Coaches also reported that the additional fact sheets, magnets, clipboards, and sideline reference cards were reasons why they found this program useful. Easy online access and the no-cost accessibility are potential reasons why this program is the most widely used concussion education model, though further research is necessary to determine the exact reasons for these findings. Limitations to this study included a small sample size and lack of control measures for previous knowledge of concussions among the participants.

Although the CDC Heads Up continues to enjoy the most popularity, there are some notable findings that diminish its efficacy. Feiss, et al. (2020) report that while the CDC program provides valuable resources for coaches to share with athletes, school personnel, and parents, only about 22% of coaches actually distributed this information to the proper stakeholders. Being too busy was the primary reason listed by coaches who did not disseminate these materials. Further studies are needed to determine the most effective way to get information to athletes and parents in the case of sport-related concussion.

The National Federation of State High School Associations (NFHS) is a partner with the CDC in the Heads Up program. Their website ([www.nfhs.org](http://www.nfhs.org)) provides coaches access to Heads Up training materials along with links to other sports medicine organizations that specialize in the prevention and recognition of concussion. These websites allow coaches to view best-practice information and other evidence-based concussion evaluation and management documents at their convenience. The flexibility of the online concussion education platform ensures ease of access to coaches regardless of geographic location and individual time constraints. This accessibility to concussion education material also ensures that all coaches have the opportunity to complete required training material within a given timeframe, thus ensuring compliance with statewide sport association requirements.

While the CDC Heads Up program and the NFHS programs were designed specifically for coaches, other methods for concussion assessment and management, such as the NATA position statement on sport related concussion and the Consensus Statement on Concussion in Sport, are more specific to healthcare providers such as athletic trainers and physicians. These final two provide more in-depth information that would be consistent with education and knowledge possessed by healthcare providers with more extensive training in concussion management, but are considered by some to represent the highest standards in concussion assessment and management.

With many options for coaches to utilize to get training on concussions, it is not surprising that there could be a tremendous amount of variance in which types of training they receive. Mrazik, et al. (2015) reported that one of the major issues with concussion education for coaches is that there is not currently an accepted standardized training protocol for non-healthcare providers. Such a “gold standard” would eliminate confusion on what materials,

skills, and knowledge constitute a reasonable and acceptable standard of care for coaches who are tasked with the responsibility of recognition and management of sport-related concussion.

Best practices in concussion management have been instituted by an international concussion symposium and position statements by several professional organizations dealing with concussion assessment. Esquivel, et al. (2013) performed a survey study among coaches, athletic directors, and athletic trainers investigating how well they were informed of these best practices. According to their findings, only 31% of coaches had any familiarity with the International Conference on Concussion in Sport Consensus Statement (McCrory, et al., 2013). This statement is revised every 3 years to reflect current changes and trends in concussion assessment and treatment. This document is specifically directed at healthcare professionals, but provides a current revised list (approximately every 3 years) of standards that could be of benefit for coaches and school and sport administrators. It is evident that a different educational strategy is needed to ensure that coaches are well-versed in the most current practices, especially if they are making the initial sideline diagnosis themselves. Gleadhill, et al. (2014) published a systematic review that included the Esquivel, et al (2013) and focused on papers dealing with concussion education. Key findings in this study included taking a multi-faceted, comprehensive approach to concussion education that included videos and interactive presentations that promote a holistic approach to concussion management. It should be noted that significant gaps were found in addressing specific needs in concussion education. Specifically, entities such as the National Collegiate Athletic Association (NCAA) mandate that member institutions provide concussion education, but provide no specifics for which method of delivery or educational program is the most appropriate.

### Awareness and Behavioral Change in Coaches

Despite the fact that there are a multitude of options for coaches to learn how to assess and properly treat sport related concussions, there is a growing body of evidence that questions whether annual training translates into awareness, competence, and implementation of learned materials by coaches. Black et al. (2020) described a Health Action Process Approach which is “a theoretical framework to understand the processes involved in health behavioral change” (pg.2). In this model, a coach must go through an intentional phase in which the decision is made to adopt a behavior and a volitional phase that involves the planning and self-efficacy needed to make the behavioral change permanent. Thus, for a coach to successfully implement the concussion education they have learned, it needs to be intentional, voluntary and of significant enough value to make the change in behavior permanent. Kim et al. (2020) also examined how coaches’ attitudes could affect concussion practices. Specifically, by exploring the relationship between knowledge and attitude, it may be possible to increase the likelihood of better outcomes for concussed athletes. Kim et al. (2020) identified a causal relationship between increased knowledge and a subsequent improvement in associated behaviors. This stands to reason that the more knowledge we can provide high school coaches, the more likely they may be to act appropriately in the event of a concussion. It may also help explain how changes in behaviors and practices are attributed to a combination of both knowledge and attitude, particularly in a health behavior model, such as concussion management.

Concussion education cannot start and stop with the coach. By its very nature, it must include several stakeholders such as student athletes, parents, school administrators, and other affiliated healthcare providers. Sarmiento et al. (2017) discussed the need for a paradigm shift in

concussion education for coaches. The importance of concussion education of all high school coaches is well established. However, the authors of this study posit that education of sideline concussion evaluation and treatment is not enough, rather there needs to be a movement to progress the spectrum of concussion education towards prevention. This includes examining those social and environmental factors that could potentially lead to a decrease in overall incidence of sport related concussions. In order for this to happen, it is imperative that coaches take a more active role in the development of education strategies and programs that start with the coach and involve student-athletes and parents.

Coaches must also demonstrate a continued dedication to staying current with new and emerging assessment techniques and technology. Feiss et al. (2020) reported that while coaches become more educated on concussions, there is often a gap between the required training and actual implementation of policies and plans to reduce sport related concussions and manage them better when they do occur. This study analyzed coaches who utilized the CDC Heads Up program and resources. They reported that while 76% of coaches who received educational materials intended to be distributed to athletes and parents, only 7.2% of coaches actually disseminated this information. This identifies a significant barrier to implementing a best practice comprehensive concussion plan. Coaches must continue to expand their roles as trained first responders in the event of a head injury to one of their athletes and promote concussion awareness and prevention prior to the occurrence of injury.

#### Issues in Rural Settings

High school coaches in remote and rural settings are at an increased disadvantage for in-person concussion training courses as the distance could make participation challenging. As

such, they may not be as apt to attend these concussion seminars as coaches from urban areas or those in close proximity to the training site. These are opportunities to develop peer-learning communities that are highly valuable in that they allow the coaches to learn from trained healthcare providers on new advances in concussion evaluation and treatment. The discussion that occurs at these sessions allows the participants to challenge the presenters with questions that may be particular to their own situation. Specifically, coaches build on previous experiences and scaffold new knowledge and practices into their assessment and management protocols.

Rural coaches are often faced with a bevy of challenges. Yue et al. (2020) reported that rurality not only impacts the physical distance from an injured athlete to a medical center, but that “rural location was associated with increased athlete risk through the lack of mTBI/concussion education for athletes and caregivers and lack of appropriately trained athletic personnel on-site due to funding and availability”. With limited access to a team of medical professionals, coaches in rural settings shoulder more of the responsibility in the assessment and care of sport related concussions and it could be argued that they have a greater need for additional concussion training when compared to coaches in urban settings.

### How Theory Informs Practice

The science surrounding concussion assessment and management has undergone a massive paradigm shift in the last 10-15 years. Thankfully, it seems the days when a minor concussion was just referred to as getting a “ding” in the head or “getting your bell rung” are in the past. It is difficult today to read the newspaper or watch television without seeing something related to concussions in sports. Much of the additional attention can be attributed to advances in diagnosis and treatment of concussion, while still more news is focused on the deleterious

effects of head injuries on a professional athlete. However, it is not reasonable to expect an individual, particularly a high school coach, to stay abreast of all the newest developments. Many coaches take a constructivist view on their knowledge of sideline concussions. This is to say that they build new knowledge on the foundation of previous experiences and constructs that form the fundamental schema of the individual. Terwell (1999) cautions against the use of strict constructivism because it allows the individual to construct their own base of knowledge rather than use a more scientific evidence-based approach. This constructivist view is especially dangerous in concussion assessment as the assessment and treatment paradigm has completely shifted in the last decade. By examining and understanding the process of constructivist scaffolding, it is possible to develop educational strategies that would help to facilitate learning more about current issues regarding concussion management. This approach could be successful in a workshop-like approach where coaches and healthcare providers discuss old theories and techniques and explain how, and more importantly, why changes have transpired in the field of sport-related concussion.

Coaches may approach learning in ways that align with the principles of andragogy, or adult learning theory. Adult Learning Theory has been described in many ways. Malcolm Knowles described this process of andragogy as the science of adult learning. To frame the concept of andragogy in terms of concussion assessment, Knowles' Assumptions and Principles of Andragogy (Knowles, 1984) must be explained. The first premise is that adults need to become involved in the process of their own education. For coaches, this would involve taking more ownership in sideline assessment of concussion. Realizing that they are often the most critical first link in the chain of care of a concussed athlete should motivate the individual to want to learn more and share that knowledge with other peers. The second principle states that

adult learners have a need to be recognized by peers as being responsible and competent in self-directing their own educational attainment. Coaches should be confident in their belief that other members of their coaching circle have similar levels of educational experience regarding concussions. By establishing programs that require a minimum level of competence or familiarity with concussion education and management, it provides the individual coach with some self-efficacy knowing that they are recognized alongside other coaches as having achieved individual educational attainment. Knowles' postulates that the basis for most forms of adult education is experience. This is a crucial point to consider as most coaches were once athletes in their respective sports. Coaches may display attitudes and beliefs that are instilled in them based on these experiences as a player and by other influences such as mentors and other coaches who have previously influenced them. Many coaches are familiar with the symptoms of a concussion due to their own experience being concussed. From this experience, an opportunity to scaffold their previous knowledge with current practices can be very productive. The fourth principle involves readiness to learn. This principle implies that adult learners are most engaged when they feel the learning objective pertains to a current issue or situation in their personal or professional life. Education must be presented in a way that the coach feels that being current with the concussion training protocols is an essential part of his/her job. The next principle describes how the coach must take a problem-based approach to learning. With the overwhelming press coverage surrounding traumatic brain injuries, the coaches must realize that a responsibility and legal duty exists to protect injured athletes from developing further complications following a concussion. The context of the training surrounding concussion assessment and management must be presented to the coaches in a manner relating to their ability to help be a part of the solution of this problem, rather than in a contextual manner that

simply conveys information. While the ease of access to educational materials on the internet is crucial, peer-based interactions and more proactive solutions should be developed to promote a higher level of comprehension and engagement in the coaching ranks. Finally, motivation of the coach needs to be explored. Some individuals are driven by an intrinsic desire to be at the forefront of their field or profession. So it is with coaches who choose to be leaders in current best-practices regarding concussion management. Other coaches may derive their motivation extrinsically in that they are pressured by their peers, institution, or state association to maintain their educational competency level in concussion assessment and management.

Prior experiences play a large role in adult learning theory. According to Ozuah (2016), experiential techniques such as simulation, group discussion, problem-based learning, and case methods provide outlets whereby coaches can share rich personal experiences with others to foster excellent learning environments. Techniques such as coaches' conferences and sports medicine training sessions would be appropriate avenues to gather large numbers of coaches to share experiences and learn collectively. Informal learning practices such as podcasts or putting information on social media has also been shown to be an effective way of getting information in front of a target audience (Chen & Bryer, 2012).

Cox et al. (2014) describe a process by which coaches take Knowles' Principles of Andragogy (1984) and apply it to coaching. They posit that coaches are motivated, self-directed individuals who learn material based on specific task-based needs. Coaches want to know what they will be required to learn and be autonomous to a degree when processing required knowledge. This theory helps to support online concussion training programs that coaches, when properly motivated, can complete the material as part of their pre-season preparation. Computer training also affords the coach an opportunity to increase the potential for experiential

learning opportunities in a supported learning environment (Lajoie et al., 2013). By creating real-life scenarios and computer simulations, clinicians are able to teach and assess proper management techniques in a realistic safe and risk-free environment. Indeed, by providing coaches the tools necessary to build on previous cognitive foundations, the online model of concussion education helps to support self-regulated learning as an effective method of concussion education.

Unfortunately, there are limitations to self-regulated learning strategies. Brookfield (1995) described some assumptions that can strongly influence the effectiveness of this type of online learning. The first assumption to address would be the paradigmatic assumption. These types of assumptions can be difficult to process because they are often our own views and beliefs that are held as truth. For example, a paradigmatic assumption a coach may have regarding concussions could be that it is a simple matter of “getting your bell rung”. This was a commonly held belief in sports that often negated the seriousness of a concussion (Stevens, et al., 2013). These personally held beliefs can be difficult to challenge even when evidence is presented.

In the matter of concussion training for lay individuals and coaches, we would first assume that their intentions for taking the training are altruistic. It could therefore be assumed that the specific individual required to take the training would be honest and not have someone else take the training and subsequent testing for them. Without this basic virtue of trustworthiness, the entire value system of youth coaches could be put in question.

Another paradigmatic assumption would be that all people who took the training were adequately able to: 1) understand the information, 2) critically interpret important concepts, and 3) implement them in a real-life situation if needed. This is not always the case. Davis and Taylor-Vaisey (1997) described multiple levels of comprehension that were attained by different

types of interventions in a healthcare setting. The first intervention included mailing published guidelines to providers. It should be noted that at the time this article was published, the internet was not as widely used for immediate dispersal of information as it is now. This group achieved a low level of comprehension of the educational material. The second group involved peer interactions and multiple reminders for the providers to review the required materials. The second group showed a very high comprehension and retention rate compared to the first group. This type of model could be implemented in concussion assessment by making a mandatory requirement to attend a symposium or training session with other peers to review the most current guidelines and implement new evaluative procedures

Contradictory findings were reported in a 2010 study utilizing a computer-based concussion education tool. ACTive: Athletic Concussion Training using Interactive Video Education is a type of interactive online training program designed to help train youth sport coaches on issues regarding concussion assessment and management. Glang, et al (2010) studied this program to determine if there was a difference in knowledge, attitudes, and self-efficacy in coaches that completed this training versus those who did not. This program is based on the Health Belief Model (HBM) by Rosenstock et al. (1988). The HBM is informed by Bandura's (1977) Social Cognitive Theory in that perceptions of risk and outcome may influence an individual's behavior. In this case, a coach perceives a risk of concussion for his athlete and the possible sequelae of responding to this injury either appropriately or incorrectly. Since there is sufficient incentive in the Dylan Steigers Youth Protection Act that establishes a legal duty for a coach to appropriately handle a situation with an athlete with a suspected head injury, we can assume that the coach will take the proper precautions to be prepared for such a situation. Coaches in the experimental group of this study who completed the ACTive program showed

measurable improvement in concussion knowledge, attitudes, and self-efficacy when compared to the control group who did not complete the training. The results of this study provide evidence that helps to validate the use of online training tools.

### Integrating New and Emerging Practices

The next theoretical method incorporates a method by which old treatment and assessment practices are evaluated and compared with new management strategies. Baumgartner (2001) postulates that transformational learning is a way that individuals could create knowledge by reflection and assessment of new experiences and how those relate to previously held beliefs. This theory is applicable to concussion education, especially for coaches that have seen the recent evolution of concussion assessment and management practices. By reevaluating previous beliefs and assumptions, coaches are presented with a challenge to learn current evidence-based techniques, while letting go of outdated treatment paradigms. Conversely, some coaches with long-held belief systems regarding concussions may not respond as effectively to this form of education. Mezirow (1997) stated that this theory is grounded in the frame of reference of the individual. Once established, this frame of reference is responsible for our cognitive processes, expectations, feelings, and belief systems. In order to promote growth and change through transformational learning, we must first understand the lens and set of experiences through which the individual has established their behaviors and belief systems. There is an ever-shrinking group of coaches who view themselves as “old-school” (Reese, 2002). These individuals view the issue of concussion assessment through a different lens than most coaches do. During their days of playing, a concussion was considered part of playing the game. They were not viewed with such intense scrutiny, rather the individual was returned to play as soon as they felt ready.

Mezirow (1997) described the transformative learning that affects positive change through altering the frame of reference of the learner to fit the current paradigm. Much of the learning that occurs here involves mutual discourse from examination of the issue through the point of view of the other. By presenting the evidence to the coach and putting them in the shoes of the experts, they may be able to shift their frame of reference to a position more closely aligned with current practices. Once these new ideas are experienced in a more concrete rather than conceptual way, it is theoretically possible to accept these ideas as the new standard actions of habit. Other lenses that a coach may view an athlete with a concussion as if they were their own family member. Many coaches have children and when they view the injured athlete as a son or daughter first, instead of an athlete, then the emotional response can be quite visceral (Gourley et al., 2010). By considering the long-term consequences and sequelae of concussions and how they may affect the athlete's future quality of life, it is possible that coaches may consider altering their approach to concussion management.

The theoretical concept with perhaps the greatest potential for success among high school coaches is that of self-regulated learning (SRL). SRL is currently the model that many organizations use to disseminate concussion training and other educational and regulatory materials, especially through online delivery. The online concussion education platform supports the self-regulated learning theory in that there are multiple opportunities for coaches to complete their concussion education in remote locations and on asynchronous time schedules. To be effective, SRL operates under a set of specific assumptions. According to Pintrich (2004), SRL requires the participant to be an active learner who is motivated to share in the role of their own education. While this is normally a very positive stance in education, it allows the learner to construct their own conclusions and meanings to external educational materials. In the case of

concussion assessment, there is often room for a very limited amount of individual interpretation in objective testing. While many reported signs and symptoms can be subjective and present great variability, the response by the clinician or coach should always be one of deliberate caution. A second assumption is that the learner is goal or outcome oriented and that results often provide the motivation for the learning. This is true in the case of most coaches as they are required to pass a concussion certification test to be allowed to coach at a school. However, the testing is more of a summative approach that just relies on the final score of the test when it should probably be more formative. A formative education program can build on pre-existing constructs and not only address current levels of knowledge, but seek to address deficiencies with more follow-up training materials. Butler and Winne (1995) stressed the need for feedback in SRL as a critical part to closing the educational loop for the student. In this way, the athletes must have someone to discuss questions about concussions just as the coach must. Accurate and timely feedback is crucial to correction of incorrect knowledge or beliefs and the reinforcement of best practices.

To fully grasp the learning style that is most appropriate for coaches in rural settings, it is important to understand the lens by which these coaches view concussion management. To this point, it is imperative to gather data that describes why they do or do not use specific concussion evaluation instruments or assessment techniques. Reasons why they are or are not compliant with current concussion standards could be derived from their previous experiences with sport-related concussions. The type of sport the individual coaches could also play a factor.

Concussion incidence rates increased an average of 15% every year among 12 boys and girls high school sports from 1998-2008 (Lincoln et al., 2011). The increase in incidence in all sports could be attributed to increased awareness by coaches and athletes or improved reporting

practices. This is an encouraging sign that educational efforts could be having a positive effect on concussion reporting rates.

A study by Esquivel et al. (2013) determined that there were significant differences in how concussions were reported between sports. Football displayed a much higher rate of reporting than did ice hockey and soccer. This study also reported gender differences in that football coaches received more concussion education than did girls' soccer coaches. The primary aim of the Esquivel et al (2013) study was to determine if there were differences in concussion education, evaluation, management, and return to play decisions based on the sport. This is the basis of this dissertation. It seeks to expand on this information and apply it to a specific population (H.S. coaches in Montana). By broadening the parameters of the study to examine the differences between urban and rural coaches, it may be possible to examine the challenges in ensuring all coaches have adequate access and familiarity with current concussion management plans.

Cultural forces such as the National Football League and the CDC Head's Up in Sport program place a great deal of importance on concussion training specifically for football. With increased focus on the concussion risk of other sports, such as girls' soccer, it is plausible to assume that increased educational efforts for those coaches would help to increase reporting rates for those respective sports.

Football has always reinforced a culture of "toughness" and that reporting an injury could be interpreted as a sign of weakness. This macho persona permeates not only their behaviors on the field, but the desire to not show perceived weakness in front of their peers. This phenomenon is described by Bryan and Morrow (2011) as the "warrior culture". In their piece, they analyze the stigma of mental health in combat veterans and how it influences traditional approaches to

mental healthcare referrals. While this is not exactly the same thing, the underlying issues remain constant. Individuals of many associations have self-identity issues that are deeply rooted in this “warrior culture”. Coaches and other individuals involved in sideline assessment of concussions need to be aware of this phenomenon and be the advocate for the athletes who will not advocate for themselves. As many former athletes might attest, from a young age, athletes are taught not to let their teammates down. This concept is repetitively ingrained into the collective schema of young athletes. Education programs need to be more vigorously disseminated to not only coaches and other administrators, but to the athletes themselves. Many state high school athletic organizations have a specific rule regarding reporting concussive signs and symptoms of teammates to coaches or other healthcare personnel such as athletic trainers, team physicians, and school nurses (LaRoche, et al., 2016). This principle operates under the belief that an athlete is more likely to take action to protect a teammate from serious injury than they are for themselves. Coaches have a solemn responsibility here as well. It is their duty to reinforce a culture of safety and accountability from the very first practice. When players see their coach reinforcing this attitude, players may be more likely to model the same behavior.

There is growing evidence that the issue is not isolated to concussion education, but to translational implementation of that knowledge. Mrazik et al. (2015) suggested that increased access of coaches to training and education of sport-related concussion does not always correlate with behavioral change among participants. This line of thought posits that simply having access to printed and online material is not enough if traditional attitudes and behaviors regarding concussion management does not change in a corresponding manner. This reinforces the point that culture change in sports may be a fundamentally more difficult fix than just handing out information and expecting different results.

### Cultural Considerations

A potential obstacle in concussion assessment, especially in many rural and medically underserved communities is cultural competence. According to the CDC (2020), cultural competence is “a set of congruent behaviors, attitudes, and policies that come together in a system, agency, or among professionals that enables effective work in cross-cultural situations.” In the realm of concussion education, evaluation, and management, this involves the process of integrating clinical evidence with cultural beliefs, language differences, and varying community needs. There are many factors that can affect the delivery of care that are unique to different student-athlete populations and require a different approach than traditional concussion treatment. Language barriers are a huge issue when dealing with patients that do not speak English as their first language. This is also a problem when the coach is not a native English speaker. To address this concern, the CDC Heads Up program now has their entire program on their website in Spanish. Even when this communication is adequate, there are many cultural differences in how signs and symptoms are presented (Betancourt et al., 2005). Few of these differences are familiar to an evaluator who is not a part of that culture. Many athletes of different racial and ethnic backgrounds are inherently distrustful of an evaluator who is not of their same race (Boulware et al., 2003). This could be due to socio-economic disparities, poor previous medical experiences, or individual beliefs and biases. Cultural competence is not exclusive to racial and ethnic groups. It can be applied to other populations such as LGBTQ, women, people with disabilities, and other minority groups (Abrams & Moio, 2009). Abrams and Moio (2009) asserted that the term “cultural competence” is not always the most accurate way to describe intercultural experiences. They advanced using the term “cultural

consciousness” because it is important to be aware that there will always be cultural differences that are not understood by people who are not of that particular group. Cultural consciousness seems to be much more accurate than the term “cultural competence”, which indicates a mastery or thorough understanding of a particular culture. Cultural consciousness was described by Azzopardi and McNeill (2016, p.10) as “an ongoing and dynamic developmental process that maintains a continuous, mindful awareness of culture and diversity, including the complex ways in which they construct meaning and experience, and promotes effective and ethical practice”. Cultural consciousness also implies that the practitioner or teacher will experience certain behaviors or phenomena that they will not understand, but must still be sensitive to the needs or customs of the studied population.

In Montana, there are several ways cultural consciousness can be applied. The first way is racial or ethnic sensitivity. Ethnic sensitivity can be described as a way of addressing issues such as race, oppression, and cultural identity through the lens of a particular group or culture (Logan, 2018). Since Montana is such a homogeneous state from a racial perspective, it is easy to overlook the intricacies and individuality of other racial and ethnic groups. The Native American population is one of the largest minorities, but even in this classification there are differences between each tribe and clan. A “one-size-fits-all” approach to educating coaches is inappropriate for this reason. Certain efforts should be made to deliver concussion education information that is accurate, yet comprehensible to individuals of multiple cultural and ethnic backgrounds.

Lifestyle consciousness is a critical part of cultural consciousness because this is not always as obvious as someone’s external appearance. Lifestyle consciousness is described by Azzopardi and McNeill (2016, p. 11) as “a multidimensional view of culture that extends beyond

race and ethnicity to include multiple, intersecting, and shifting identities, thereby not limiting its utility to visible minorities.” In the case of a coach, all it would take would be one off-color joke or ill-conceived comment to cause a player to lose trust in them. A recent example of this is the suspension served by Creighton men’s basketball coach, Greg McDermott who used the word “plantation” to encourage team unity (Borzello, 2021). It cannot be assumed that because an individual plays a certain sport or comes from a certain family; they have the same values as those around them.

Individuals who are involved in concussion assessment with very diverse athletic populations may benefit from diversity training to learn how to effectively deliver sideline assessments. This is not to ensure that all populations are treated equally, but that each population receives the appropriate accommodations that are necessary to achieve accurate assessment data. Kroshus et al. (2017) stated “there is growing concern that even effective interventions can increase inequalities if there is different uptake or impact by socioeconomic status or other demographic factors”. Cultural competence is of utmost importance when critically comparing concussion education strategies. Individuals and communities with low literacy and high poverty rates are at greater risk of not meeting basic evidence-based standards for concussion awareness and management practices (Kroshus et al., 2017). Strategies must be developed to eliminate barriers in these at-risk populations to ensure that coaches, parents, and student-athletes have adequate access to proper concussion education and risk-management tools.

The purpose of this study was to gain understanding into the familiarity of high school coaches in Montana with various concussion education curricula, especially the differences between those coaches in urban vs. rural settings and coaches of different types of sports. To tie

all of the theoretical concepts in a successful model for concussion education for coaches in Montana, it is important to first discover which concussion education curriculum coaches are currently being used and then seek to formulate a plan that would deliver accurate and timely these educational materials effectively. The MHSA must then work collaboratively with local school officials to ensure proper implementation and execution of the plan. By understanding the needs and expectations of coaches in both urban and rural settings, we may be able to better deliver more appropriate methods of concussion education.

## CHAPTER 3

## METHODOLOGY

This chapter describes how this research was executed. Variables are explained along with the theoretical constructs, sampling methods, survey instrumentation, and data analysis. This study's methodology bears much semblance to the Esquivel et al. (2013) study conducted in Michigan. The most significant difference between that study and this one was the target population. The primary aim for this research was to examine the familiarity with concussion education curricula within a largely rural state to see if a level of awareness differed between coaches by the geographic population density of their area and the type of sport coached. Murphy, et al. (2012) found that the level of concussion education decreased in rural settings when compared to urban counterparts. That is to say those rural coaches had significantly less training in concussion assessment and management than urban coaches. This is extremely concerning for states that have much of their population scattered in small, rural communities like the state in the present study. This study focused on differences in concussion education awareness in parts of the state that are further from major medical centers where it is easier to access trained medical personnel and educational resources.

A highly important reason for conducting a similar study to Murphy et al. (2012) is that Murphy's study was performed before many states had a concussion law in place requiring a minimum standard of care for concussed athletes. It was important to investigate coaches' concussion education awareness again now that all 50 states have passed some form of concussion legislation. By analyzing the results of the present study, it may be possible to shed light on the extent to which legislative efforts in Montana had the desired effect of providing

competent sideline care for all youth athletes who sustain a concussion. The choice to administer a survey instead of employing a different methodological design is that the purpose is to get a representative sample from enough coaches in different sports and settings to make generalizable claims of the current state of concussion education in Montana high schools of different population densities and for different sports.

### Research Purpose and Questions

The first purpose of this research was to compare the differences between coaches' familiarity with concussion education materials based on their location, i.e. population density (urban versus rural). The research hypothesis of this question posited that coaches in urban settings have greater access to multiple types of training, as well as healthcare providers who specialize in the assessment and treatment of sport-related concussion and thus have greater familiarity with concussion education curricula. This could give them an advantage when assessing concussion education and training. Significant differences in coaches' familiarity with concussion education could lead to decreased concussion reporting rates at rural schools which could potentially have tragic consequences.

The secondary purpose is to identify if the sport category affects coaches' familiarity with concussion education materials. Coaches of contact and collision sports statistically see more of their athletes suffer from concussions (Pfister, et al. 2016). The research hypothesis holds that coaches of collision and contact sports will have more familiarity with various concussion training programs due to the increased exposure and likelihood of concussions in their sports. Likewise, coaches of sports in which players statistically sustain fewer concussions may have less familiarity with concussion education, which could lead to decreased competency

among those coaches to deal with a potential serious head injury should one occur. By examining those methods of concussion education most familiar to coaches, this study sought to address those concerns to help decrease liability and may help to increase efficacy of sideline assessment and management of sport-related concussion.

### Constructs and Operationalization as Variables

In order to thoroughly address the research questions posed in this study, it is imperative to provide an operational definition for all constructs.

#### Predictor Construct 1: Population Density

According to the United States Census Bureau (2010), an urban center is a population area of more than 50,000 people. An urban cluster is an area with a population between 2,500 and 50,000 people. Anything less than 2,500 people is considered a rural area. Although there will certainly be some variance, this study used the student population at the high school level and its corresponding classification to describe whether a school is considered urban or rural.

High schools in Montana are classified by the Montana High School Association (MHSA) in terms of student enrollment numbers into the following categories: AA, A, B, and C.

Classifications are defined by the following student numbers: Class AA = 826+; Class A = 340-825; Class B = 120-339; Class C = 1-119 (MHSA, 2016). For the purpose of this study, urban schools will be defined as Class AA and Class A, while rural schools will be classified as Class B and Class C. Class AA schools are located in the larger population centers in Montana such as Billings, Bozeman, Missoula, Great Falls, Helena, Butte, and Kalispell; all of which have populations greater than 20,000. Conversely, examples of Class C schools include the following:

Lincoln, Belfry, Belt, Hysham, and Plentywood. All of these towns have populations of less than 1,000 people ([https://www.montana-demographics.com/cities\\_by\\_population](https://www.montana-demographics.com/cities_by_population), 2021).

Exceptions to the urban/rural classification rule will occur if a private school with a small enrollment is located in an urban area. These schools will be excluded from the study. All other private schools that fit inclusion criteria will be used in this study with no restrictions. The independent variable for research question 1 was the population density of the location of the target schools, classified as either urban or rural.

#### Predictor Construct 2: Sport Category

The independent variable for research question 2 was the category of the primary sport with which the head coach is affiliated. Categories of sport included collision, contact, and non-contact. Football was the only sport classified as a collision sport. Basketball, soccer, volleyball, and softball were classified as contact sports. Finally, track and field, tennis, golf, and cross-country were classified as non-contact sports. Since not all schools sponsored the same sports, they were categorized by the physical nature of each sport (Benedict & Parker, 2014), such as collision, contact, or non-contact. I present the categorization of sports in the study in Table 3-1.

Table 3-1 Sports Classified According to Physical Risk

<u>Collision (56)</u>	<u>Contact (77)</u>	<u>Non-Contact (27)</u>
Football	Basketball	Tennis
	Soccer	Cross-Country
	Softball	Golf
	Volleyball	Track and Field

Note: Number of respondents for each sport type is presented in parentheses.

Dependent Construct 1: Self-perceived Familiarity with Educational Materials

The outcome measure for this study is coaches' perceived awareness of different concussion curricula. This study presented coaches with the opportunity to rate their familiarity with some of the most popular concussion education materials. By extrapolating this data, it is possible to determine which programs and documents are the most widely used in both rural and urban settings. It will also be possible to determine which programs demonstrated the highest level of awareness by sport in this population.

Mirroring the Esquivel et al. (2013) study design, this study used continuous scales from 0-100 (0 being not familiar at all, 100 being most familiar) in the survey instrument to allow coaches to report their familiarity with multiple concussion education documents and programs. The survey instrument queried coaches' awareness of the most nationally recognized concussion programs available without regard to an individual's status as a healthcare provider or lay person including: the National Athletic Trainers' Association Position Statement on Management of Sport-Related Concussion, Consensus Statement on Concussion in Sport from the Third International Conference on Concussion in Sport, Heads Up Concussion kit from the CDC, and the MHSAs protocol for implementation of National Federation of State High School Associations playing rules for concussions. Table 3-2 illustrates how coaches were asked to rate their familiarity with the various concussion curricula.

Table 3-2 Sample Questions

How familiar are you with the National Athletic Trainers’ Association Position Statement on Management of Sport-Related Concussion?

How familiar are you with the Consensus Statement on Concussion in Sport from the Third International Conference on Concussion in Sport?

How familiar are you with the Heads Up Concussion kit from the CDC?

How familiar are you with the MHSA protocol for implementation of National Federation of State High School Associations playing rules for concussions?

Table 3-3 Descriptive Statistics and Kurtosis Scores

	Familiarity with MHSA	Familiarity with CDC	Familiarity with NATA	Familiarity with Consensus
N	160	160	160	160
Mean	92.125	49.775	63.818	39.693
Median	100	50	80	30.5
Mode	100	0	100	0
Std. Deviation	20.332	38.206	36.359	36.510
Skewness	-3.722	-.102	-.756	.439
Kurtosis	13.841	-1.529	-.899	-1.252

The skewness of the MHSA category was highly skewed, the skewness of NATA was moderately skewed, and the values of CDC and Consensus were approximately symmetrical. The MHSA category showed leptokurtosis, while the CDC, NATA, and consensus showed acceptable kurtosis (between -3 and 3).

Study Sample

The target population of this study was high school head coaches from high schools in Montana. The surveys were distributed to all high school athletic directors in Montana to be disseminated to all head coaches in their schools. The study was limited to head coaches as not

every school has assistant coaches in all sports and also because it is the head coaches' responsibility to monitor his/her players for signs of concussion. Esquivel et al. (2013) used this type of design to survey the coaches in their study and it produced a 35% return rate. One anticipated problem with this type of dissemination is that there is no way to be sure how many coaches actually received the survey and therefore, it is impossible to calculate accurate response rates (Kaye and Johnson, 1999). The target population was high school head coaches in Montana during the year this study was conducted. The results herein reported the number of total responses received rather than a percentage of responses initially distributed. The demographic information for the participants in the survey is listed below in tables 3.4 and 3.5.

Table 3-4 Participants Classified by Sport

<u>Sport Type</u>	<u>Frequency</u>	<u>Percent</u>
Collision	56	35.0
Contact	77	48.1
Non-Contact	27	16.9
<u>Total</u>	<u>160</u>	

Table 3-5 Participants Classified by Urban/Rural Location

<u>Location</u>	<u>Frequency</u>	<u>Percent</u>
Urban	67	41.8
Rural	93	58.2

This study used a census sampling approach in that surveys will be distributed to all schools in each of the 4 size classifications (AA, A, B & C). This ensured that maximum representation was obtained in each demographic group. Similarly, athletic directors were

informed of the need to provide the survey to all high school head coaches, regardless of sport and associated concussion risk. Since it is an MHSA mandate that all coaches take an annual online concussion course, this survey is equally appropriate to all head coaches. The response rate of this study is calculated using parameters for an upper-bounds estimate of the number of coaches in Montana during the study year (approximately 3,276 coaches in the target population). This number is reached by assuming that every high school in Montana fielded a team for every sport sanctioned by the Montana High School Association and that no one coached more than 1 sport. Naturally, it can be assumed that those assumptions are invalid since the smaller class “C” schools do not usually complement a full slate of sports and inevitably there are coaches that coach more than one sport. The most conservative response rate can be calculated by observing that there were 160 individual respondents to this survey for approximately a 4% overall completion rate. We can also assume that this conservative estimate understates the response rate since most rural schools don’t have the student population or the facilities to field all 18 sports. In a random sample of 10 class B and C school’s athletic websites, most of these rural schools only dress 7-10 sports as an estimate of the population.

Table 3-6 Response Rate by Class Compared to Total Number of Schools by Class

<u>Location</u>	<u>#Respondents</u>	<u>#Total Schools</u>	<u>Max sport/school</u>	<u>Lower Bounds</u>
Urban	67	39	18 (702)	9.5%
Rural	93	143	18 (2574)	3.6%

### Instrumentation

For this study, a survey instrument developed by Esquivel et al (2013) was used. This instrument was piloted by the authors before being published in the article, “Concussion Management, Education, and Return-to-Play Policies in High Schools: A Survey of Athletic Directors, Athletic Trainers, and Coaches”. While Esquivel et al. utilized 3 separate surveys; the present study was only intended for head coaches. The survey took approximately 10 minutes to complete. The survey (see Appendix D) began with a section to collect demographic information on the participant such as which sport they coach, the size of their school, and how many years of experience they have in their current position. Although not a primary research question, the number of years of experience that a coach has may provide interesting feedback into whether new coaches are better trained than more experienced coaches when it comes to concussion education. The next portion of the survey gathered information on how much awareness the coach had with the different educational and training programs on sport-related concussion. Not only did this allow an aggregate view of concussion programs, it provided insight into which programs are more commonly used in certain settings and by sport. Since coaches in Montana have a mandatory annual concussion training that is conducted through the MHSA, it was reasonable to assume that most coaches would be more familiar with that particular training program. These survey findings can either validate that belief or provide information on another training program for which coaches identify greater awareness. The last part of the survey asked about individual institutional concussion plans: does the school have one, who is in charge of it, and after which guideline is it modeled. This section also provided data to see if all participating schools are in compliance with the state concussion law, the Dylan

Steigers Youth Protection Act (2013), for Montana. Coaches have the responsibility to provide concussion recognition education to their players in the absence of a healthcare provider and corresponding questions are also posed here.

Validity evidence for the survey instrument was not present in the original article (Esquivel et al., 2013). Email correspondence with one of the authors revealed that although the survey instrument was not piloted with actual subjects, it was administered to lab participants to ensure clarity and measure time demands.

A possible challenge to the external validity of the Esquivel et al. (2013) study is that it was performed in Michigan and may not necessarily reflect attitudes and trends in coaches' concussion education in more rural parts of the country. Similarly, the demographic breakdown of the coaches in Montana may not be representative of all states and therefore may not reflect concussion curricular awareness of coaches in different parts of the United States. Although the survey instrument lacked multiple validation reviews, it was chosen due to its unique formulation of questions especially appropriate to current educational trends in rural and frontier settings.

#### Data Collection

Prior to data collection, IRB approval was gained from Montana State University. Since this study was survey-based data collection, it posed limited risk in that participants were asked to describe information that they would engage in the normal course of their coaching duties. Unanticipated psychological stress could have resulted from assessing current concussion protocol. Results were compiled and kept confidential and secure by the investigator. All data were kept on a password-protected computer and on a secure network. All personal information was destroyed at the conclusion of this study.

The distribution of this survey was by email; including an invitation letter (see Appendix B) that explains the purpose of the study, and survey access to the athletic director. The email stated that all data collected would be stored on a password-protected secure server. Instructions were provided to distribute the survey to all head coaches at their school. This involved forwarding all coaches an email with instructions on how to begin the survey along with a letter that explained the purpose and significance of the study (see Appendix B). Data were collected using Survey Monkey and all data was kept secure on that website. Once the survey was completed, responses were downloaded and stored on a secure, password-protected server. The data collection was set at 3 weeks. *CustomInsight* (2010), a firm that specializes in survey research, recommends allowing a minimum of 7-10 days, recognizing that over 80% of responses are recorded in the first 8 days after a survey has been distributed. A follow-up email was then sent to the athletic directors to remind coaches that there was 1 week left to complete the survey. There was no penalty for not participating in the study. Results were compiled and examined for completeness before being analyzed.

According to Groves et al., (2009), there are several potential threats to this method of survey research. With a census-type sample, there is the possibility that some of the classes will have the opportunity for greater representation than other groups. In this example, there are only 14 Class AA schools compared to 105 Class C schools. According to the upper bounds estimates of this study, there are approximately 3276 total coaches in Montana: urban coaches' make up 21% of total coaches; rural make up approximately 79%. The response pool of this study is 160 participants; with urban comprising 42% of the response pool. This does not reflect an accurate representation of coaches in each group.

Interference with coaching schedules could also affect the survey results. In the case of this study, the survey was distributed during the fall sports seasons. Coaches who were already busy with their team may have chosen not to complete the study due to time constraints or to answer it hastily without adequate time for thought to each response. Dillman (2007) also cautions that all respondents need to have a minimal level of competence with web-based surveys. As the target population were largely school employees who are familiar with many facets of digital technology, the level of risk here was deemed acceptable.

### Limitations and Delimitations

There are several limitations that could affect the validity of this study. The first limitation could impact the face validity of this study, which describes if the study actually measures what it is supposed to measure (Gay et al., 2011). This limitation is based on the honesty of the coaches participating in this survey and if they accurately report their actual familiarity with the concussion education and training modules on the survey. One could also posit that “familiarity” does not necessarily equal competency with the subject material, therefore not providing an accurate representation of a particular coach’s concussion education. Another challenge to the internal validity is the level of educational attainment of the coach. A coach who has a background or advanced degree in an exercise science related field would most likely have vastly different pre-existing ideas and beliefs on concussions than a coach from a less specialized educational background. This could confound the data if a school that employed more coaches with advanced degrees or exercise science backgrounds came from an urban setting, or conversely a rural background. Finally, the years of coaching experience that an individual has could affect the results of this study.

Construct validity is intended to measure the intended hypothetical construct of the study (Gay et al., 2011). In this particular study of educational and training practices for concussion assessment, it is important to understand how scope of practice influences decision-making. Under the Dylan Steigers Youth Protection Act (2013), a coach does not have the responsibility for sideline diagnosis of concussion. The practice of diagnosing a condition resides with a healthcare provider trained in the assessment of that particular condition. The responsibility of the coach and other lay personnel is to recognize signs or symptoms of such an injury and remove the athlete from play until the player can be properly evaluated by a healthcare provider who is trained in the evaluation and management of concussion. To that end, a survey section that focuses on extensive content knowledge may not be appropriate for coaches as that information is outside the scope of their practice. Therefore, a line of questioning that has the participant self-evaluate their familiarity with training and educational documents is appropriate for a coach or other lay administrative person and adds to the construct validity for this instrument.

Finally, this survey instrument used by Esquivel, et al (2013) utilizes one question for each type of training to measure the respondent's familiarity of each training type. This limits the statistical power to determine significance of the dependent variables. Groves et al. (2009) describes how single item measurement can increase the likelihood of measurement error due to lack of correlating data. However, Wanous and Hudy (2001) mention that single item measurement can be effectively used if the variable being measured is familiar to the respondents, unidimensional, and sufficiently narrow in scope. The survey provides data for copious amounts of background information, but does not specifically focus on this line of investigation.

Data Analysis

The data collected were analyzed using multiple methods. Each variable was analyzed with univariate statistics using histograms, frequency counts, and measures of central tendency. For the first research question, scores for each educational program were coded in one of two categories: urban or rural based on the participant's position at a Class AA or A (urban) or Class B or C (rural). A MANOVA determined if there was any significant difference between the coaches' familiarity of NATA, CDC, and Consensus statement training programs between coaches of those two groups. This was possible due to the normality of variance for these groups. The MANOVA is used in the same situation as an ANOVA, but for several dependent variables. Similar to an ANOVA, a MANOVA can also be used when there is one independent variable or when there are multiple independent variables (Field, 2013). A Pearson's Correlation was performed on all of the dependent variables. The results of this analysis are listed below in Table 3.7.

Table 3-7 Pearson's Correlations, Means, and Standard Deviations of Concussion Curricula

	MHSA	CDC	NATA	Consensus	Mean	S.D.
MHSA	1	.223**	.261**	.159*	92.125	20.332
CDC	.223**	1	.343**	.413**	49.775	38.207
NATA	.261**	.343**	1	.471**	63.818	36.359
Consensus	.159*	.413**	.471**	1	36.693	36.510

\*\*Correlation is significant at the 0.01 level (2-tailed).

\*Correlation is significant at the 0.05 level (2-tailed).

For the MHSA outcome, the data were analyzed using a one-way ANOVA and a Kruskal-Wallis test to compare the data parametrically and non-parametrically due to the high level of skewness and kurtosis in this measure. These bivariate analyses provided information about which educational curricula coaches were most familiar by group (rural and urban), as well as those materials that were least familiar to each group. By identifying this information, it becomes possible to make recommendations on how to bolster familiarity with these materials among coaches from schools in communities of varying population density.

The second research question used a MANOVA test to determine if there was significant difference between the familiarity of the CDC, NATA, and Consensus Statement groups between coaches of different types of sports (collision, contact, and non-contact). This was done due to the normal variance in these sets of data (Field, 2013). The MHSA training method was analyzed using both parametric and non-parametric tests due to the high level of skewness and kurtosis for the data. A one-way ANOVA and a Kruskal-Wallis test were used to analyze the data by using SPSS. These bivariate analyses provided information about which educational curricula coaches were most familiar by sport type (non-contact, contact, and collision), as well as those materials that were least familiar to coaches of each sport type.

Finally, a logistic regression was performed for each research question to control for coaches' years of experience. Because of the distribution of the outcome measures, I created two categories of awareness for each of the concussion curricula: average or above awareness and below average awareness. The statistical method allows the researcher to "predict categorical outcomes from continuous or categorical predictors (Field, 2013, pg. 761)." In this study, conducting a logistic regression permits the researcher to account for the years of experience the coach has while examining the unique relationship between population density of school (urban

v rural in research question 1) or type of sport (collision, contact, and non-contact in research question 2). The years of experience is not specified in either research question, but controlling and exploring this variable provides a more accurate assessment of the relationships of interest present in the other research questions.

Table 3-8 Research Questions, and Data Analysis

Research Question	Data Analysis
Is there a significant difference in concussion education training between rural and urban high school coaches in Montana?	Descriptive Statistics One-way ANOVA between Urban and Rural Schools (MHSA training) Kruskal-Wallis between Urban and Rural Schools (MHSA training) MANOVA between Urban and Rural Schools (CDC, NATA, & Consensus)
Is there a significant difference in concussion training between head coaches of different sports?	Descriptive Statistics MANOVA between Sport Type Schools (CDC, NATA, & Consensus) One-way ANOVA between Sport Type (MHSA training) Kruskal-Wallis between Sport Type (MHSA training)

### Summary

The research goal of this survey is to gather critical data regarding the education and training of high school coaches in concussion assessment and management. By disseminating the data collected from this survey, valuable information can be collected that describes how familiarity of different concussion education curricula vary by geographic location, sport, size of school, and experience of the coach. After interpreting and reviewing the results of this study, it

may be possible to develop more accurate, affordable, accessible, and user-friendly concussion training protocols that will increase patient outcomes for athletes with head injuries across the state of Montana. This study may also open doors into where state or federal resources could be applied to improve patient care in rural and frontier medical settings.

## CHAPTER 4

## RESULTS

The goal of this study was to examine how familiar high school coaches were with different methods of concussion education. Specifically, differences based on whether the person coached in an urban or rural setting and the type of sport coached were analyzed and evaluated.

An invitation to share a survey link was sent to the athletic director at each of the 182 high schools in Montana to disseminate to the coaches at each school. A reminder email was also sent after 10 days. Responses to the electronic survey were received and recorded from 160 coaches.

The first research question sought to identify if there was a significant difference in the type of concussion education awareness based on the location of where the individual coached. A MANOVA was used to analyze the data for this research question for the CDC, NATA, and consensus statement groups. The MHSA group was analyzed with a Kruskal-Wallis test and a one-way ANOVA due to the skewness and kurtosis of the data. The MANOVA was selected to measure the differences between the CDC, NATA, and consensus statement groups because they met the assumptions of normality of distribution. Due to the high level of skewness in the MHSA group, a Kruskal-Wallis test was selected to account for the non-parametric nature of the data. One of the hypotheses of this study is that coaches in urban settings tend to have easier access to healthcare providers who are trained in the evaluation and treatment of sport-related concussion and also to concussion education provided at conferences and symposia in these urban centers. By this rationale, the urban coaches would have greater familiarity with current concussion education practices than their rural counterparts.

The second research question explored whether coaches of different types of sports (collision, contact, and non-contact) report different levels of familiarity with concussion education curricula. A MANOVA was again used to analyze the data for the CDC, NATA, and consensus statement groups for this research question because of the multivariate nature of the dependent variables, the correlation of the dependent variables, and the data meeting the assumptions of homogeneity of variance. Due to the skewness and kurtosis of the MHSA group, a Kruskal-Wallis test and one-way ANOVA was used to analyze this group. The hypothesis of the second research question is that coaches of collision sports would have a greater awareness of different types of concussion training due to the increased incidence rate of sport-related concussion in their sport compared to contact and non-contact sports. In schools without everyday access to an athletic trainer, the coach would be a primary caregiver to concussed athletes. This would also support the hypothesis that collision sport coaches would be more familiar with concussion training programs.

### Research Question Results

Research Question 1: *Is there a significant difference in familiarity of concussion education training between rural and urban high school coaches in Montana?* The results of the survey were coded and analyzed using a MANOVA for the NATA, CDC, and Consensus Statement groups to determine if there was a significant difference between Montana high school coaches based on their geographical urban vs. rural location of their school. These groups satisfied the assumptions of homogeneity of variance and were deemed parametric data. The results of the MANOVA are listed below in Table 4-1.

Table 4-1 MANOVA Results of Concussion Familiarity Based on Population Density

<u>Familiarity with Training</u>	<u>F-Value</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Significance</u>
CDC	2.378	49.775	38.206	.125
NATA	3.706	63.818	36.359	.056
Consensus Statement	4.393	36.693	36.510	.038

\* $p < .05$

A MANOVA was performed to help protect against increasing the risk of Type 1 error rate in the follow-up ANOVAs and post-hoc comparisons. Before the MANOVA was conducted, a set of Pearson correlations were performed between all of the dependent variables to ensure all the dependent variables would be correlated ([www.how2stats](http://www.how2stats.com), 2021). The correlations for all the dependent variables were between .159-.471 which constitutes an acceptable range. Box's M value of 24.459 had a  $p$ -value of 0.008 is considered below the threshold of significance ( $p < .005$ ) based on the work of Huberty and Petoskey (2000). The MANOVA was then conducted to discover if there was a significant difference in familiarity with concussion education curricula based on population density. Results from the MANOVA are listed above in Table 4.3. The multivariate effect size was .040 which indicates that the 4% of the variance in the dependent variables is accounted for by the population density location of the participant.

The homogeneity of variance assumption was tested for all concussion education curricula using Levene's Test of Equality of Error Variances. The variances were above the level of significance and do not violate the assumption of homogeneity of variance. Post hoc testing was not performed because there were fewer than 3 independent variables.

The MHSA group did not meet the standard for parametric data. This result was expected as the MHSA training is required for all high-school coaches in Montana and a normal distribution of results is unlikely in this situation. Data were analyzed using both a One-Way

ANOVA and then a Kruskal-Wallis test given the non-parametric nature of the data. The One-Way between subjects ANOVA was conducted to compare the effects of population density on coaches' familiarity with the MHSAs concussion education curriculum. There was not a significant difference in the MHSAs group as the significance level was  $p = .616$ . The non-parametric Kruskal-Wallis test also failed to achieve statistical significance with a value of  $p = .991$ . The results for these analyses are listed below in Tables 4-2 and 4-3.

Table 4-2 One-Way ANOVA Results of Concussion Familiarity Based on Location

<u>Familiarity with Training</u>	<u>F-Value</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Significance</u>
MHSA	.884	92.125	20.332	.616

*\*p < .05*

Table 4-3 Kruskal- Wallis Test Results of Concussion Familiarity Based on Location

<u>Familiarity with Training</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Significance</u>
MHSA	92.125	20.332	.991

*\*p < .05*

Based on these findings, the only significance between groups was found with the coaches' familiarity with the consensus statement, while the coaches' familiarity with the NATA training approached statistical significance. It should also be noted that the mean score for the MHSAs group was much higher than the rest of the groups. This is likely attributable to all high school coaches in Montana being required to take this type of training. Although not reaching statistical significance, it was of clinical significance to mention that the urban group of coaches

rated their familiarity higher on all 4 dependent variables than did the rural cohort. This gives some support to the hypothesis that urban coaches have greater familiarity with concussion education programs than their rural counterparts.

Table 4-4 Means and Standard Deviation by Population Density

	N	NATA		CDC		Consensus		MHSA	
		Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
Rural	67	59.161	38.151	45.838	38.287	31.612	33.747	90.301	23.687
Urban	93	70.283	32.907	55.239	37.698	43.746	39.203	94.656	14.233

Research Question 2: *Is there a significant difference in concussion training between head coaches of different sports?* A MANOVA was conducted to analyze the data for the second research question due to having multiple dependent variables. The data were coded to include the coaches into three categories: collision, contact, and non-contact. Football was the only sport classified as a collision sport. Basketball, soccer, volleyball, and softball were classified as contact sports. Finally, track and field, tennis, golf, and cross-country were classified as non-contact sports. The research hypothesis was that coaches of collision and contact sports would have the most familiarity with concussion education due to the higher incidence rates in those sports versus non-contact sports. The results of MANOVA are listed below in Table 4-5.

Table 4-5 MANOVA Results of Concussion Education Familiarity by Sport Type

<u>Familiarity with Training</u>	<u>F-Value</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Significance</u>
CDC	9.243	49.775	38.206	.000
NATA	.686	63.818	36.359	.505
Consensus	.687	36.693	36.510	.505

\* $p < .05$

A second MANOVA was performed to help protect against increasing the risk of Type 1 error rate in the follow-up ANOVAs and post-hoc comparisons. Before the MANOVA was conducted, a set of Pearson correlations were performed between all of the dependent variables to ensure all the dependent variables would be correlated ([www.how2stats](http://www.how2stats.com), 2021). The correlations for all the dependent variables were between .159-.471 which constitutes an acceptable range. Box's M value of 16.836 had a  $p$ -value of 0.713 is considered non-significant ( $p < .005$ ) based on the aforementioned work of Huberty and Petoskey (2000). The MANOVA was then conducted to discover if there was a significant difference in familiarity with concussion education curricula based on sport type (non-contact, contact, or collision). Results from the MANOVA are listed above in Table 4-7. The Wilk's Lambda had a value of 0.882 with a significance of  $p = .012$  and a partial eta squared of .061, indicating that 6.1% of the variance in concussion education curricula familiarity can be explained by the type of sport coached by each participant.

The homogeneity of variance assumption was tested for all concussion education curricula using Levene's Test of Equality of Error Variances. The variances were above the level of significance and do not violate the assumption of homogeneity of variance. Post hoc testing was performed using Bonferroni, Tukey HSD, and Fisher's LSD tests. The only

significance for all post-hoc tests was found in the CDC group. All other group did not reach statistical significance in post-hoc tests.

The MHSA group did not meet the standard for parametric data. Data were analyzed using both a One-Way ANOVA and then a Kruskal-Wallis test given the non-parametric nature of the data. The One-Way between subjects ANOVA was conducted to compare the effects of sport type on coaches' familiarity with the MHSA concussion education curriculum. There was not a significant difference in the MHSA group as the significance level was  $p = .945$ . The non-parametric Kruskal-Wallis test also failed to achieve statistical significance with a value of  $p=.061$ , although this could be considered clinical significance. The results for these analyses are listed below in Tables 4-6 and 4-7.

Table 4-6 One-Way ANOVA Results of Concussion Familiarity by Sport Type

<u>Familiarity with Training</u>	<u>F-Value</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Significance</u>
MHSA	.324	92.125	20.332	.945

*\*p<.05*

Table 4-7 Kruskal- Wallis Test Results of Concussion Familiarity Based on Sport Type

<u>Familiarity with Training</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Significance</u>
MHSA	92.125	20.332	.061

*\*p<.05*

The result of this analysis was that the only significance was demonstrated between the 3 types of coaches in the CDC concussion training. None of the other types of training achieved statistical significance with respect to the type of sport coached. These findings generally do not

support the hypothesis that coaches of contact and collision sports would be more familiar with concussion education than non-contact coaches. The means plots are listed below to demonstrate these results.

### Logistic Regression Results

The logistical regression analysis was performed in order to account for any confounding relationship that years of experience has with the predictor variables of interest (population density as defined by urban vs. rural school settings and type of sport and the four measures of familiarity with concussion. While this was not a primary research question, the data were available from the survey results and serve as an important control variable for better understanding Montana high school coaches' familiarity with different types of concussion education curricula.

The  $R^2$  is defined as the coefficient of determination and “summarizes the proportion of variance in the dependent variable associated with the predictor (independent) variables, with larger  $R^2$  values indicating that more of the variation is explained by the model, to a maximum of 1 (IBM.com, 2021). The Nagelkerke statistic is a Pseudo  $R^2$  that represents the value of the square of the correlation between the model's predicted values and the actual values (UCLA, 2021). This statistic provides the percent of variance in the dichotomous dependent outcome (average or greater familiarity with concussion curricula vs. lower than average familiarity) explained by the model (Field, 2013).

The next value that is of critical importance is the odds ratio. The odds ratio describes the change in odds that results from a change in the predictor variable (Field, 2013). Finally, the

standard error describes represents the average distance that the observed values fall from the regression line (Frost, 2021). This value can also be used in calculating the confidence intervals.

Research Question 1: Population Density and Familiarity, controlling for years of coaching experience

Table 4-8 displays that controlling for years of experience; coaches in urban school districts do not statistically significantly differ in the odds of reporting average or above familiarity with the NATA curriculum than their coach peers in rural school districts. However, the odds that a coach has average or above familiarity with the NATA curriculum is lower among coaches who have coached 1-5 and 6-10 years compared to their peers who have coached more than 10 years, controlling for school size.

Table 4-8 Relationship between School Size and Coaches’ Odds of High Awareness of NATA Curriculum

	Odds ratio	SE	Conf Interval	<i>p</i>
Urban (vs Rural)	1.485	.351	(.747-2.952)	.260
1-5 years of experience	.350	.419	(.154-.797)	.012
6-10 years of experience	.386	.436	(.164-.907)	.029

Nagelkerke R<sup>2</sup>= .094

Note: Geographic population density is informed by school size. Schools designated as class B and C by the Montana High School Association are coded as rural; those designated class A or AA are coded as urban. Years of experience variables are compared to coaches with more than 10 years of experience and serve as statistical controls in the model.

Table 4-9 displays that controlling for years of experience; coaches in urban school districts do not statistically significantly differ in the odds of reporting average or above familiarity with the MHSA curriculum than their coach peers in rural school districts. However, the odds that a coach has average or above familiarity with the MHSA curriculum is lower

among coaches who have coached 1-5 and 6-10 years compared to their peers who have coached more than 10 years, controlling for school size.

Table 4-9 Relationship between School Size and Coaches' Odds of High Awareness of MHSA Curriculum

	Odds ratio	SE	Conf Interval	<i>p</i>
Urban (vs Rural)	1.079	.427	(.467-2.492)	.858
1-5 years of experience	.205	.476	(.081-.523)	.001
6-10 years of experience	.373	.518	(.135-1.029)	.057

Nagelkerke R<sup>2</sup>= .119

Note: Geographic population density is informed by school size. Schools designated as class B and C by the Montana High School Association are coded as rural; those designated class A or AA are coded as urban. Years of experience variables are compared to coaches with more than 10 years of experience and serve as statistical controls in the model.

Table 4-10 displays that controlling for years of experience; coaches in urban school districts do not statistically significantly differ in the odds of reporting average or above familiarity with the CDC curriculum than their coach peers in rural school districts. Also, the odds that a coach has average or above familiarity with the MHSA curriculum are non-significant compared to coaches who have coached 1-5 and 6-10 years compared to their peers who have coached more than 10 years, controlling for school size.

Table 4.10 Relationship between School Size and Coaches’ Odds of High Awareness of CDC Curriculum

	Odds ratio	SE	Conf Interval	<i>p</i>
Urban (vs Rural)	1.589	.336	(.822-3.073)	.169
1-5 years of experience	.913	.413	(.406-2.052)	.826
6-10 years of experience	.617	.429	(.266-1.430)	.260

Nagelkerke R<sup>2</sup>= .028

Note: Geographic population density is informed by school size. Schools designated as class B and C by the Montana High School Association are coded as rural; those designated class A or AA are coded as urban. Years of experience variables are compared to coaches with more than 10 years of experience and serve as statistical controls in the model.

Table 4.11 Relationship between School Size and Coaches’ Odds of High Awareness of Consensus Statement Curriculum

	Odds ratio	SE	Conf Interval	<i>p</i>
Urban (vs Rural)	1.472	.329	(.772-2.804)	.240
1-5 years of experience	.753	.412	(.336-1.691)	.492
6-10 years of experience	.816	.427	(.353-1.887)	.635

Nagelkerke R<sup>2</sup>= .020

Note: Geographic population density is informed by school size. Schools designated as class B and C by the Montana High School Association are coded as rural; those designated class A or AA are coded as urban. Years of experience variables are compared to coaches with more than 10 years of experience and serve as statistical controls in the model.

In practice, the 95% CI is often used as a proxy for the presence of statistical significance if it does not overlap the null value, where Odds Ratio=1. The concussion curricula that did show statistical significance between coaches with varying amounts of experience were the NATA and MHSA. The odds ratios on both of these curricula were <1 indicating that experience levels of 1-5 years and 6-10 year decreased the odds that the coach would be familiar

with those specific concussion curricula when compared to coaches who had 11 or more years of experience.

In all groups, the odds of a coach being familiar with the various concussion education curricula were higher with coaches having the most experience (11+ years). The Consensus group was statistically significant in the MANOVA, but when years of experience were taken into account, there was no significant difference between the groups of urban vs. rural coaches.

Research Question 2: Type of Sport and Familiarity, controlling for years of coaching experience

In Table 4-12 below, the odds that a coach has average or above familiarity with the NATA curriculum is lower among coaches who have coached 1-5 and 6-10 years compared to their peers who have coached more than 10 years, controlling for type of sport coached.

Table 4-12 Relationship between Type of Sport and Coaches’ Odds of High Awareness of NATA Curriculum

	Odds ratio	SE	Conf Interval	<i>p</i>
Non-contact	.913	.505	(.339-2.457)	.857
Contact	.831	.484	(.322-2.146)	.703
1-5 years of experience	.328	.419	(.144-.746)	.008
6-10 years of experience	.372	.438	(.158-.878)	.024

Nagelkerke R<sup>2</sup>=.085

Note: Type of sport (non-contact and contact) is compared to collision sports. Years of experience variables are compared to coaches with more than 10 years of experience and serve as statistical controls in the model.

In Table 4-13 below, the odds that a coach has average or above familiarity with the MHSA curriculum is lower among coaches who have coached 1-5 compared to their peers who have coached more than 6 years, controlling for type of sport coached.

Table 4-13 Relationship between Type of Sport and Coaches' Odds of High Awareness of MHSA Curriculum

	Odds ratio	SE	Conf Interval	<i>p</i>
Non-contact	2.714	.605	(.828—8.889)	.099
Contact	1.481	.532	(.522-4.205)	.460
1-5 years of experience	.215	.477	(.084-.546)	.001
6-10 years of experience	.396	.527	(.141-1.112)	.079

Nagelkerke R<sup>2</sup>= .144

Note: Type of sport (non-contact and contact) is compared to collision sports. Years of experience variables are compared to coaches with more than 10 years of experience and serve as statistical controls in the model.

In Table 4-14 below, there is no significant difference in the odds that a coach has average or above familiarity with the CDC curriculum when comparing coaches who have coached 1-5 and 6-10 years to their peers who have coached more than 10 years, controlling for type of sport coached. However, non-contact coaches have greater than 5 times the familiarity of the CDC curriculum when compared to contact and collision sport coaches.

Table 4-14 Relationship between Type of Sport and Coaches' Odds of High Awareness of CDC Curriculum

	Odds ratio	SE	Conf Interval	<i>p</i>
Non-contact	5.777	.514	(2.108-15.833)	.001
Contact	2.173	.475	(.857-5.513)	.102
1-5 years of experience	.940	.424	(.410-2.156)	.883
6-10 years of experience	.667	.451	(.275-1.614)	.369

Nagelkerke R<sup>2</sup>= .122

Note: Type of sport (non-contact and contact) is compared to collision sports. Years of experience variables are compared to coaches with more than 10 years of experience and serve as statistical controls in the model.

Table 4-15 Relationship between Type of Sport and Coaches' Odds of High Awareness of Consensus Curriculum

	Odds ratio	SE	Conf Interval	<i>p</i>
Non-contact	1.618	.476	(.637-4.11)	.311
Contact	.895	.459	(.364-2.197)	.808
1-5 years of experience	.770	.413	(.343-1.730)	.527
6-10 years of experience	.809	.432	(.347-1.887)	.624

Nagelkerke R<sup>2</sup>= .031

Note: Type of sport (non-contact and contact) is compared to collision sports. Years of experience variables are compared to coaches with more than 10 years of experience and serve as statistical controls in the model.

Table 4-16 Descriptive Statistics- Mean and Standard Deviations

	Sport	Mean	Std. Dev.	N
Familiarity with MHSA	Collision	93.893	19.765	56
	Contact	91.13	20.853	77
	Non-Contact	91.296	20.501	27
	Total	92.125	20.332	160
Familiarity with CDC	Collision	63.5	33.945	56
	Contact	47.649	38.746	77
	Non-Contact	27.370	34.070	27
	Total	49.775	38.206	160
Familiarity with NATA	Collision	68.410	34.134	56
	Contact	61.220	36.731	77
	Non-Contact	61.703	40.072	27
	Total	63.818	36.359	160
Familiarity with Consensus	Collision	41.250	35.255	56
	Contact	33.831	37.204	77
	Non-Contact	35.407	37.493	27
	Total	36.693	36.510	160

The data here showed that familiarity of all 4 concussion education curricula was highest within the collision group compared to the others. The MHSA curriculum was significantly more familiar to all three sport groups when compared to the other curricula.

Table 4-17 Descriptive Statistics and Kurtosis Scores

	Familiarity with MHSA	Familiarity with CDC	Familiarity with NATA	Familiarity with Consensus
N	160	160	160	160
Mean	92.125	49.775	63.818	39.693
Median	100	50	80	30.5
Mode	100	0	100	0
Std. Deviation	20.332	38.206	36.359	36.510
Skewness	-3.722	-.102	-.756	.439
Kurtosis	13.841	-1.529	-.899	-1.252

The skewness of the MHSA category was highly skewed, the skewness of NATA was moderately skewed, and the values of CDC and Consensus were approximately symmetrical. The MHSA category showed leptokurtosis, while the CDC, NATA, and consensus showed acceptable kurtosis (between -3 and 3).

## CHAPTER 5

## DISCUSSION

Summary of Findings

This study examined the familiarity of different concussion education curricula with high school coaches in Montana in different population density classifications (urban and rural) and types of sports (non-contact, contact, and collision). Data were also analyzed to control for years of experience by the coaches. Results for each research question are presented below.

Research Question 1

Research Question 1 sought to discover if there were significant differences in familiarity of concussion education programs between coaches in urban and rural settings. A MANOVA was conducted to analyze the data for this research question for the CDC, NATA, and consensus statement curricula. The MHSA group was analyzed with a Kruskal-Wallis test and a one-way ANOVA due to the skewness and kurtosis of the data. Logistic regressions were also performed to analyze for differences in familiarity while controlling for years of coaching experience.

Statistically significant differences were found in the Urban/Rural MANOVA with the Consensus Statement curriculum with a value of  $p = .038$ . This indicates that urban coaches were significantly more familiar with the Consensus Statement than were rural coaches. Although not reaching statistical significance, it was worthy to note that the urban group of coaches rated their familiarity higher on all 4 dependent variables than did the rural cohort. This gives some clinical significance to the hypothesis that urban coaches have greater familiarity

with concussion education programs than their rural counterparts. Kraemer et al. (2003) describes clinical significance as having a result that is large enough to be practically meaningful or useful in its context. The results of the logistic regression analyses performed on the urban/rural groups showed that there were significant differences based on the years of experience of the coach. The odds ratios on both of these curricula were  $<1$  indicating that experience levels of 1-5 years and 6-10 year decreased the odds that the coach would be familiar with those specific concussion curricula when compared to coaches who had 11 or more years of experience.

### Research Question 2

The purpose of research question 2 was to determine if there were significant differences in familiarity of concussion education programs between coaches of different types of sports (non-contact, contact, and collision). A MANOVA was conducted to analyze the data for this research question for the CDC, NATA, and consensus statement curricula. The MHSA curriculum was analyzed with a Kruskal-Wallis test and a one-way ANOVA due to the skewness and kurtosis of the data. Logistic regressions were also performed to analyze for differences in familiarity while controlling for years of coaching experience.

In the MANOVA analyzing familiarity by type of sport coached, the CDC curriculum was statistically significant at  $p = .000$ . The results showed coaches of collision sports had significantly more familiarity with this curriculum than coaches from other sport types. The MHSA curriculum was analyzed using an ANOVA and a Kruskal-Wallis test due to the non-parametric nature of the data. Leptokurtosis was observed in this group on a histogram. This can be explained due to the required nature of this type of education for every high school coach

in Montana on an annual basis. No statistically significant differences were found on either the ANOVA or the Kruskal-Wallis test.

Logistic regression analyses were performed to determine the presence of differences in familiarity of concussion education curricula based on type of sport coached when accounting for years of coaching experience. The only curriculum that displayed a statistically significant difference in the MANOVA test was the CDC. However, when controlling for years of coaching experience, the change in results was impressive. The results of the logistic regression tests displayed significant differences in the odds that a coach with 10 years or less experience would be as familiar with the NATA curriculum as one who has coached for 11 or more years. Similarly with the MHS A curriculum, a coach who has between 1-5 years of experience would have significantly lower odds of being as familiar with coaches who have coached 6 years or more. Lastly, and perhaps most unexpected, non-contact coaches had over 5 times greater odds of being more familiar with the CDC curriculum when compared to collision coaches while accounting for years of experience. More research will need to be done to determine if these phenomena are consistent across other states or regions of the country.

#### Comparisons to Empirical Data

Findings from this study support the work done by Esquivel et al. (2013) in which coaches expressed the greatest familiarity with curricula that was required by their state athletic association. Esquivel et al. (2013) found that only 31% of coaches expressed some familiarity with the Consensus Statement on Concussion in Sport. That is compared to 57% of respondents in this study who responded that had at least some familiarity. While that is a notable increase to the data reported by Esquivel et al. (2013), that still means that 43% of all coaches in Montana

have no familiarity with this document. This study also supports Esquivel et al. (2013) by showing that, after the state athletic association training (MHSA), coaches' familiarity with different concussion education decreased greatly (CDC, NATA, and Consensus curricula). The Esquivel et al. (2013) found similar results in that coaches rated their familiarity at over 95% in the "somewhat familiar" or "very familiar" categories with their state athletic association policy. However, the "somewhat familiar" or "very familiar" ratings of coaches with the CDC, Consensus, and NATA curricula were below 31%. What this could indicate is that these modes of concussion education, while they present relevant and clinically significant information, are not among the most popular resources used by coaches. Mrazik et al. (2015) describe the importance of recognizing a "standard" for coaches to establish a baseline level of competence. The results of this study echo that fact in that coaches displayed different awareness of the various curricula that could be influenced by the population density of their location, the sport they coach, and how many years of experience they have in coaching. By establishing a standard curriculum that could be used for all states, it would eliminate confusion and streamline the process of providing appropriate concussion assessment techniques for high school coaches, regardless of school size or setting. This could be used in combination with periodic assessments to facilitate retention.

### Relationships to Theoretical Framework

The results of this study reinforce that coaches' behaviors can be explained by Knowles' principles of adult learners. He describes this process of andragogy as the science of adult learning (Knowles, 1984). This principle directly relates to my study because Knowles posits that individuals who understand the importance of a task or issue are more compelled and

motivated to pursue the knowledge and understanding that are associated with it. Findings from this study support that coaches will feel adequate motivation (either intrinsic or extrinsic) to pursue appropriate forms of concussion education and will scaffold this knowledge on their base of previous experience and expertise. This is evidenced by the significantly higher familiarity scores with the mandatory MHSA curriculum compared to the other elective options. As coaches become more familiar with the assessment techniques, management practice, and long-term sequelae associated with sport-related concussion, they are more likely to seek a deeper level of comprehension on the topic as it pertains to them. The correlation of familiarity between dependent variables as shown in Chapter 4 supports that coaches who report a high level of familiarity on one dependent variable often reported familiarity with other curricula. Hence, coaches who see the easy access to the MHSA education program are more likely to engage in that manner of educational pursuit compared to others. Knowles' (1984) third principle of andragogy states that previous experience of the individual is correlated to their level of attainment. This principle is displayed in the logistic regression results of this study in which coaches who have 11 or more years of experience rated their familiarity higher on each of the 4 concussion education curricula when compared to their peers with 1-5 and 6-10 years of coaching experience.

Supplemental data on my survey instrument (Question 38) gathered data on coaches preferred method of concussion education delivery. Although this question was not one of the primary research questions of the study, 80% (129/160) of respondents reported that online/internet education was their preferred method of delivery. These results support the work of Lajoie et al. (2013) who describe how online delivery methods are an effective form of self-regulated learning that allow motivated individuals to perform the training on their own schedule

and pace. This fits with our model as coaches tend to be busy with the demands of their sport and need the flexibility to complete training modules when their schedule allows. Cox et al. (2014) also supported the online method of concussion education as they discussed how coaches are motivated by clear expectations and task-specific goals. Since the MHSAA requires their online concussion training module to be completed before an individual can begin coaching each year, it is clearly a motivator for coaches to complete the training. This follows Knowles' 6<sup>th</sup> Principle of Andragogy; Motivation. In this instance, since the training is a pre-requisite for being allowed to begin coaching, the motivation is extrinsic. The coaches who chose to expand their knowledge with other forms of concussion education demonstrate Knowles' 5<sup>th</sup> Principle; Problem Orientation. By reinforcing their baseline level of knowledge with further training, the coach is able to focus not only on the content of the information, but on the practical application in real-world scenarios.

Mezirow's theory of transformative learning (1997) is also supported by my study. Mezirow stated that an individual's learning is directly affected by their frame of reference. A rural coach who has limited access to sports medicine conferences, symposia, and sports medicine professionals, may not have the same frame of reference when understanding the need for additional training in concussion management as urban coaches do. This is supported by the results of this study that showed higher mean familiarity scores of urban coaches in all 4 concussion curricula. The familiarity was significantly higher for urban coaches on the Consensus Statement ( $p = .038$ ) and clinically significant for urban coaches with the NATA curricula ( $p = .056$ ) when compared to their rural peers. To shift the frame of reference for these rural coaches, a shift in paradigm may be required. Instead of the annual online concussion training that is required, school districts and athletic departments should increase the focus

placed on developing greater competency in the evaluation and management of sport-related concussions. This could include encouraging coaches to participate in the annual coaches' clinic in Great Falls to learn about concussions from current sports medicine providers, facilitating virtual training seminars, and providing other resources that maximize the learning potential of each coach.

### Current Implications in Clinical Practice

Understanding which concussion curricula have the greatest familiarity with coaches is a step towards understanding which curricula are most commonly used. This can be the result of several factors: state mandated training requirements, time commitment, ease of access, type of delivery, cost, and individual preferences by the coaches. In this study, the data clearly showed coaches were more familiar with the MHSA concussion education curricula than any of the other concussion curricula. This is largely due to this being the state mandated training program required of all coaches in Montana. While the results of this study support that most coaches are compliant with the MHSA mandated concussion training with 92% familiarity among all coaches, the breadth of their concussion education still has room for improvement. If the expectation is that all coaches will be familiar with a concussion education curriculum, then careful consideration should be placed on making sure that this required curriculum is up-to-date, clear in its objectives, thorough, and accurately assesses the coaches' knowledge of sport-related concussion assessment and management. As mentioned in Chapter 2, this required training should incorporate a learning-over-time component to ensure that coaches' learning is reinforced over several times during the year. This facilitates better comprehension and allows for easier recall of training materials in the event a concussion occurs during their season. This also

correlates to Knowles' Principles of Adult Learners (1984) by supporting the idea that coaches will become involved in their own education pursuits. By establishing current, evidence-based standards that are required to be completed before an individual can begin coaching, the coach will likely display the motivation to complete the training in a timely manner. Policymakers may also leverage Knowles' 6th principle which supports that the intrinsic motivation of the coach is a major factor in educational attainment.

The results from the logistic regressions in this study suggest that new coaches do not feel as familiar with various concussion education curricula as their more experienced peers. Knowles' 2<sup>nd</sup> Principle (1984) acknowledges that adult learners draw on their past experiences to assist their learning objectives. Since new coaches may not possess a vast repository of experience, additional resources such as online training modules, podcasts, seminars, and other remedial concussion training options should be offered to coaches who do not display a minimum level of understanding of concussion assessment materials.

In schools with athletic trainers, there may be times when the athletic trainer is not available due to being with another sport. This suggests that even if a school employs or provides an athletic trainer, all coaches still need to be trained in concussion assessment and management at the same level as coaches who do not have access to an athletic trainer. Continued efforts should be made to promote access to qualified healthcare providers, including athletic trainers, at all sanctioned practices and games. Unfortunately, this is unlikely in the near future as many schools struggle with sources of funding (Mazerolle, et al., 2015).

While not statistically significant, histograms show coaches in rural populations tended to rate their familiarity lower than their urban counterparts. Similarly, coaches in collision sports tended to rate their familiarity higher than coaches in contact and non-contact sports. While

many factors can be attributed to these trends, schools should continue to encourage coaches in rural settings and in non-contact and contact sports to increase their familiarity by providing more opportunities and resources to increase their knowledge and competency in recognizing and managing sport-related concussions in their own individual situations. School districts, especially in rural locations, can look to facilitate better educational opportunities by improving and increasing online training options that includes live video conferencing options (Zoom, WebEx, etc), providing continuing education for coaches who attend conferences dealing with sport-related concussion, and keeping their institutional concussion protocols current with approved standards.

### Barriers to Implementation

As with any comprehensive educational plan, there may be barriers to implementation. While some of the barriers to providing timely, evidence-based concussion education may be limited by resource and budgetary constraints, others such as policy-making could prove more difficult to overcome. Understanding the critical nature of how sport-related concussions can impact the health and well-being of our young athletes is a crucial first step in taking action to improve safety considerations in youth sports.

The first barrier to discuss is policy. Without requirements that specify the type, frequency, and rigor of concussion education, it is likely that many coaches will continue to follow the status quo. The most familiar concussion curriculum in this study was the MHSA curriculum that is mandated. Without this requirement, it is possible there would have been more variance in the familiarity between urban/rural coaches and coaches of different types of sports. However, one of the strengths of the MHSA protocol is accessibility. The training

program is located directly under the sports medicine link on the MHSA website

(<https://www.mhsa.org/sportsmed>). This allows coaches to find the training easily and quickly.

As this training is asynchronous, coaches are able to complete the module at their convenience and at a location of their choice. Accessibility can be a challenge to other modes of educational delivery other than online. Many coaches in remote locations are not able to travel long distances to attend conferences or seminars on sport-related concussion. An alternative to this would be to have school district(s) bring in speakers or sports medicine professionals to their sites to provide the training at the remote sites. While this may be a preferred method of delivery, it presents other challenges as well. Most importantly with this option is cost. Many school districts may have budgetary challenges that limit them from allocating funding specifically to concussion education. As a result, school districts may choose to stick with curricula that are widely available online and free. Attending virtual conferences or concussion seminars that are live streamed are another option that have become increasingly popular, especially in the COVID-era of limited large gatherings.

#### Implications for Policy and Practice Change

The goal of concussion legislative efforts across the country is to ensure that coaches exhibit a minimum level of competency related to concussion in sport. In order to achieve this, efforts must be made to ensure that coaches in rural locations and coaches of all sports, not just high-risk sports, receive ongoing and current training to achieve and maintain proficiency. The results of this study support that the greatest number of coaches display familiarity with a concussion curriculum that is mandated (MHSA). All state high school associations are able to evaluate and discern which concussion education program they implement for their coaching

education curricula. Thus, it is reasonable to assume there is much variability in how coaches are trained across the country. A required standardized educational curriculum that is endorsed by the National Federation of High School Associations (NFHS) could help eliminate disparities and ensure a minimal established level of care. In order to better achieve this goal, the NFHS should officially adopt a position statement on the evaluation and management of sport-related concussions. Currently, the NFHS issues a document titled “Suggested Guidelines for Management of Concussion in Sport” (<https://www.nfhs.org/sports-resource-content/nfhs-sports-medicine-position-statements-and-guidelines/>, 2019), but a guideline is not an actual requirement, it is merely a suggestion. This leaves the ultimate authority on which curricula to follow up to the individual state association. While some autonomy is acceptable, a minimum standard to establish a baseline level of competency would be beneficial to ensure optimal outcomes nationwide.

The NFHS also publishes a Code of Ethics for coaches (<https://www.nfhs.org/nfhs-for-you/coaches/coaches-code-of-ethics/>) that describes how coaches shall conduct themselves. This policy does not currently mention the ethics involved in maintaining student-athlete safety as a priority. In situations where qualified medical care is absent, the role of first-aid provider falls to the coach. This can sometimes create a conflict of interest when an athlete who may be suspected of sustaining a concussion is also a critical part of the team’s success. Coaches must be reminded of this ethical and moral standard to always make the health and well-being of the injured student-athlete their first priority.

In addition to the emphasis on increasing knowledge and competence of coaches, policy changes at the school district level would help ensure that best practices that involve concussions are standard protocol at all schools. According to data collected on this survey instrument

(question 15), 13 out of the 160 (8%) respondents in this study reported that their school did not have a concussion policy in place. It is unclear if this number is representative of the rest of the schools in Montana, but this is an issue that can be readily addressed and corrected by adopting policies established by organizations, such as the CDC, to help eliminate confusion regarding roles of coaches, medical policies and procedures for dealing with an athlete who has sustained a concussion, and return-to-learn plans to incorporate the student back into the classroom following a concussion.

Finally, the Dylan Steigers Protection of Youth Athletes Act needs to be periodically revisited to address evolving changes in the standard of care for coaches and to include any pertinent changes in concussion assessment and management. Advances in technology can potentially have a major impact in how concussions are evaluated through telemedicine and virtual doctor visits. Coaches may someday have virtual real-time access to qualified healthcare providers while on the sideline. All of these developments could alter the way the current statute affects coaching responsibilities in relation to concussions.

#### Directions for Future Research

The field of concussion education is a very dynamic area of study that requires constant attention to stay current with emerging practices and trends. The data collection for this study was completed in 2016. The timeliness of the data could be a limitation especially because concussion education is a dynamic field where changes occur rapidly and regularly. While the concussion education curricula in this study are still valid instruments that are commonly used in high school concussion training, other education methodologies have been developed since the data in this study were collected. Current monitoring of new and emerging concussion education

practices should be monitored and evaluated for coach familiarity, efficacy, ease of use, access, and affordability. A periodic follow-up to this study could determine the effect of evolving education practices, governmental involvement, and institutional changes in concussion education for coaches. Additionally, research that would study challenges and barriers to best practices and evidence-based strategies could help eliminate problems faced by schools, especially in rural and under-served communities where resources are scarce. This could also factor into ways of providing access to better medical coverage, such as athletic trainers, for schools in these same communities.

As previously discussed in Chapter 3, this study utilizes a single item measurement to quantify familiarity with each concussion curricula. Grove et al. (2009) describes how multiple item measures allow for a more accurate method of analyzing data when compared to single item measures. To increase validity, more questions assessing familiarity should be used in subsequent research. External validity could also be improved by implementing follow-up studies in different states or regions of the country with different demographic densities, distances between urban areas, percentages of schools with athletic trainers, and varying requirements for concussion education training which could all affect the variables in this study.

While it is critical to make accurate and effective decisions regarding removal from play for athletes suspected of sustaining a concussion, it is equally important to make prudent decisions when introducing them back into competition and also re-integration into the classroom. Further research is necessary to determine effective strategies for schools to incorporate “return-to-learn” protocols into their plans for managing athletes who have suffered concussions. These plans should include methods to educate teachers and administrators so they

understand the necessity of making reasonable academic accommodations while these athletes continue to recover from the symptoms of concussions.

In addition to making sports safer for high school athletes, a logical next step is to investigate methods to increase concussion education in all forms of youth sports, including club and youth leagues. Organizations such as Little League, Pop Warner football, YMCA, and other popular sporting groups should be afforded the opportunity to provide concussion training to their coaches and volunteers. Physical educators at all levels of K-12 could also benefit from this training. By providing training to additional stakeholders involved in youth sports, correlational studies could be performed to determine if there is a relationship with increased rates of concussion training and number of concussions diagnosed annually.

Finally, studies designed to evaluate coaches' knowledge, attitudes, and self-efficacy regarding concussion evaluation and management could continue to provide valuable data to inform policy, assist in resource allocation, and improve risk-management strategies. A holistic team approach that includes the medical community, coaches, parent groups, and school administrators is needed to collaborate to implement policies that are scientifically sound, fiscally responsible, and accessible enough to provide the highest level of concussion education with the fewest possible barriers.

### Conclusion

This purpose of this paper was to explore the familiarity of concussion education curricula among high school coaches in Montana and to gain understanding if there were differences in this familiarity based on the population density of the coaches' location and whether the sport coached was non-contact, contact, or collision. The experience of the coach

was also examined as a possible factor in concussion curricula familiarity. The future direction of this research is to take the information gained on concussion education curricula awareness and apply it using appropriate educational methodology so that all coaches, regardless of location or sport coached, can receive adequate training in the prevention, evaluation, and management of sport-related concussion. By continuing to improve concussion education for coaches, it may be possible to make sport participation safer for youth and high school athletes.

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APPENDICES

APPENDIX A

INFORMED CONSENT STATEMENT

Study: Concussion Survey

Principal Investigator: Patrick Hughes

Faculty Advisor: Dr. Tricia Seifert

You are invited to voluntarily participate in a research project examining familiarity with different concussion education materials and concussion policies at your high school. This will involve answering questions regarding concussion practices that should take approximately 10 minutes of your time.

Your responses will be kept strictly confidential. The only information that will be kept that could be linked to you is your school classification, sport that you coach, and how many years of experience you have in your current position. All data will be kept on a secure, password-protected server. There are no foreseen risks with this study. You may benefit from this study by examining current concussion practices at your school and becoming exposed to alternate methods of concussion education.

If you have any questions regarding this study or your rights as a research participant, please contact Patrick Hughes at 406-896-5941 or at [phughes@msubillings.edu](mailto:phughes@msubillings.edu).

You may also contact the Institutional Review Board at the Montana State University at 406-994-6783 if you have questions about your rights as a research subject.

Your answer below will serve as your electronic signature.

- Yes, I consent to taking this survey.
- No, I do not consent to taking this survey.

APPENDIX B

LETTER TO COACHES

Dear Head Coach:

According to a report by the American Academy of Pediatrics, approximately 1 in 5 high school athletes will sustain a concussion during a given sport season. As a person responsible for the health and safety of your athletes, your participation is requested to participate in a survey to learn about concussion training and management in your high school. Sideline concussion assessment is a topic of major importance for coaches, trainers, athletes, and fans of all sports. There are currently many different training techniques used to provide coaches with information on sideline assessment, treatment, and return to play decisions. This study will provide critical information to determine how concussions are managed at high schools in Montana.

This survey is conducted as part of a doctoral dissertation at Montana State University. Your participation is completely voluntary and you may choose to discontinue the survey at any time. This survey will take approximately 10 minutes to complete. Your response can help improve concussion education and management throughout Montana. Results will be kept confidential and you will not be connected to your answers in any way. Results will be made available to participants upon request at the conclusion of the study.

[https://www.surveymonkey.com/create/?sm=QwfTOIVOhXZggzOF5zZEPiAtx8LesQwCDNe41oI33qU\\_3D](https://www.surveymonkey.com/create/?sm=QwfTOIVOhXZggzOF5zZEPiAtx8LesQwCDNe41oI33qU_3D) Thank you for your assistance in this important research. If you have any questions or concerns about this study, I would be very happy to talk with you. You can contact me at (406) 896-5826 or [phughes@msubillings.edu](mailto:phughes@msubillings.edu). Thank you very much for your participation in this very important study.

Best regards,

Patrick Hughes, MS, ATC

Doctoral student at Montana State University

APPENDIX C

LETTER TO ATHLETIC DIRECTOR

Subject: Montana Concussion Education Survey

Dear Athletic Director,

I am a doctoral student at Montana State University conducting my doctoral dissertation research on concussion education and training for athletic personnel at Montana high schools. Your high school has been selected to participate in a short survey regarding concussion education and management in each sport you sponsor. Your assistance is requested to distribute the link to this survey to all of your head coaches and encourage their participation. Results will be made available upon request at the conclusion of the study.

This study is critical to determine how best to educate our coaches and provide the safest outcomes for our high school athletes. All responses will be kept confidential and no identifying information will be linked to participants. If you have any questions or comments regarding this study, I would be happy to discuss it with you. My contact information is (406) 896-5826 or [phughes@msubillings.edu](mailto:phughes@msubillings.edu).

Thank you very much for your cooperation with this very important study.

Best regards,

Patrick Hughes, MS, ATC

Doctoral Student, Montana State University

APPENDIX D

FOLLOW-UP REMINDER TO COACHES

Dear Head Coach:

This is a friendly reminder to consider participating in a survey regarding concussion training and education techniques in Montana. Your participation is vital to ensure that high school athletes in Montana continue to receive the best care possible after suffering a sport-related concussion. This survey is conducted as part of a doctoral dissertation at Montana State University. Your participation is completely voluntary and you may choose to discontinue the survey at any time. This survey will take less than 10 minutes to complete. Your response can help improve concussion education and management throughout Montana. Results will be kept confidential and you will not be connected to your answers in any way. Results will be made available to participants upon request at the conclusion of the study.

Survey Link: <https://www.surveymonkey.com/r/PRJDM95>

Thank you for your assistance in this important research. If you have any questions or concerns about this study, I would be very happy to talk with you. You can contact me at (406) 896-5826 or [phughes@msubillings.edu](mailto:phughes@msubillings.edu). Thank you very much for your participation in this very important study.

Best regards,

Patrick Hughes, MS, ATC

Doctoral student at Montana State University

APPENDIX E

SURVEY QUESTIONS

1. What is your MHS A classification for your school? AA A B C
2. What is your role in coaching? Head Coach Assistant Coach
3. In your current high school athletics role, are you part-time or full-time? Full-time Part-time
4. What type of sport do you currently coach? Collision (football) Contact (basketball, soccer, volleyball, wrestling, cheerleading, softball) Non-contact (tennis, swimming, golf, cross-country, track and field)
5. How many years coaching do you have? 1-5 6-10 11+
6. How many sports do you coach?
7. Do you currently have athletic training coverage for your sport? Yes No
8. Is an athletic trainer routinely at your games? Yes No
9. Does your team have access to a neuropsychologist? Yes No
10. Does your team perform any baseline neurocognitive testing (ImPACT, Braincheck, etc.) at the beginning of the season? Yes No
11. How familiar are you with the National Athletic Trainer's Association Position Statement on Management of Sport-Related Concussions? 0-100
12. How familiar are you with the Heads Up Concussion kit from the Centers for Disease Control (CDC)? 0-100

13. How familiar are you with the MHSA protocol for implementation of National Federation of High School Sports playing rules for concussions? 0-100

14. How familiar are you with the Consensus Statement on Concussion in Sport from the Third International Conference on Concussion in Sport? 0-100

15. Does your high school currently have a written policy in place to manage sport-related concussion? Yes No

16. If yes, is this policy based on one of the documents listed above? Yes No

17. If so, which one?

18. Do you use sideline assessment tools (SCAT3, King-Devick, SAC, etc)

19. In your opinion, what is the single most important indicator that an athlete has sustained a concussion? Open-ended

20. Please list the signs and symptoms you use to make a diagnosis of concussion. Open-ended

21. Who has the final determination that an athlete has sustained a concussion during practice?

Coach Athletic Trainer Physician Athletic Director Other (please specify)

22. Who has the final determination that an athlete has sustained a concussion during a game?

Coach Athletic Trainer Physician Athletic Director Other (please specify)

23. Once the diagnosis of concussion has been made, can a player return to play that same day? Yes No

24. If No, when are they allowed to return to play? Open-ended

25. When a concussion is diagnosed, is the high school (administration, faculty, nurses) made aware of the injury and the precautions required? Yes No

26. When a concussion is diagnosed, are the parents/guardians made aware of the injury?

Yes No

27. Once the diagnosis of concussion has been made, is a player referred to a physician?

Yes No

28. Who decides that a player may return to play after exhibiting concussion symptoms? Open-ended

29. Do you require written authorization from a physician (MD/DO) before an athlete may return to play after exhibiting concussion symptoms? Yes No

30. Does the school have informational materials on concussion prevention and management (posters/wallet-cards) available or on display? Yes No

31. Are players educated on concussion prevention and management before the season? Yes No

32. How frequently do players self-report a concussion? 1-Never 2-Rarely 3-Sometimes

33. How frequently do players report a possible concussion of a teammate? 1-Never 2-Rarely 3-Sometimes

34. Do you feel pressure to avoid removing a player with a suspected concussion from play due to family members of players, school administrators or fans? Yes No

35. In the past year, have you received training in concussion assessment/management? Yes

No

36. If you answered "Yes" to the previous question, please describe all the methods by which you received training. Select all that apply. Online/Internet Seminar/Conference In-service with Peers Journal or Printed Material Other(please specify)

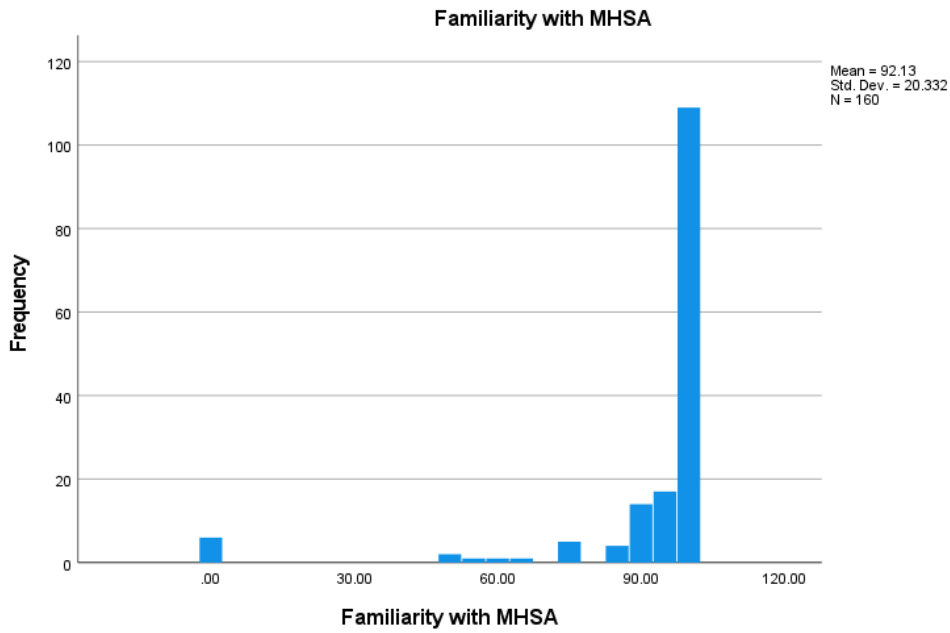
37. In the past year, how often have you participated in each form of concussion training? Open ended

38. Please select your preferred method of concussion training. Online/Internet Seminar/Conference In-service with Peers Journal or Printed Material Other(please specify)

39. Why is the method you selected your preferred concussion training method? Open-ended

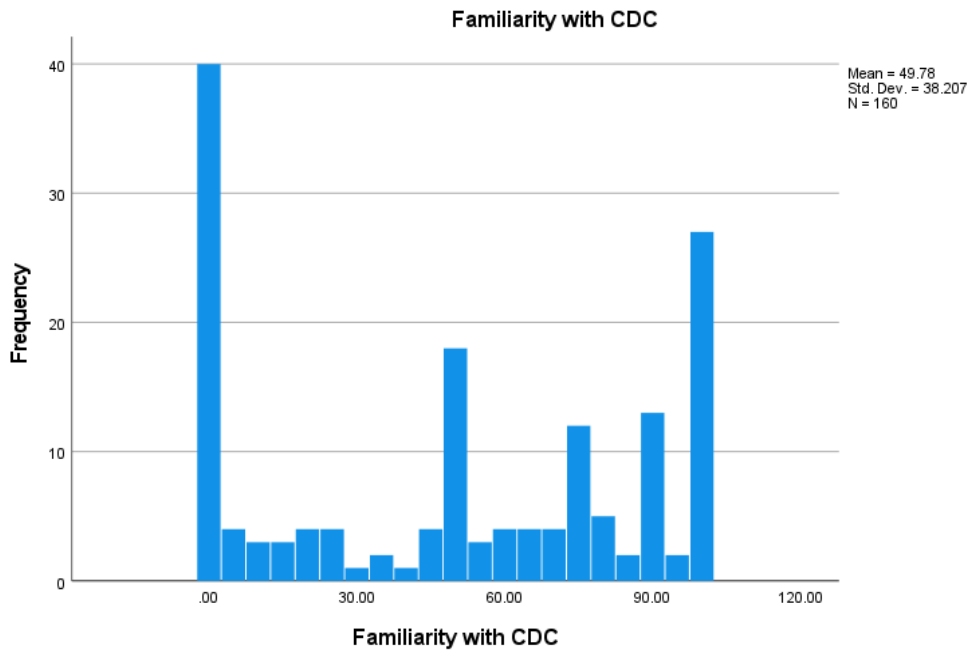
APPENDIX F

HISTOGRAMS

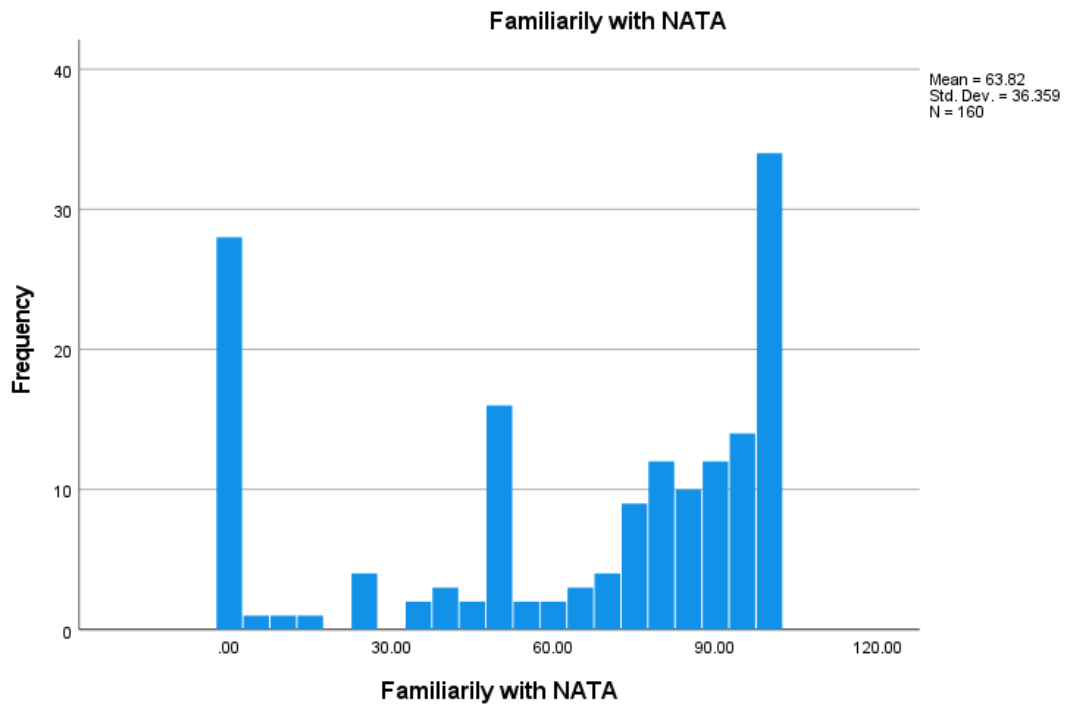


Frequency Table for Familiarity with MHSa

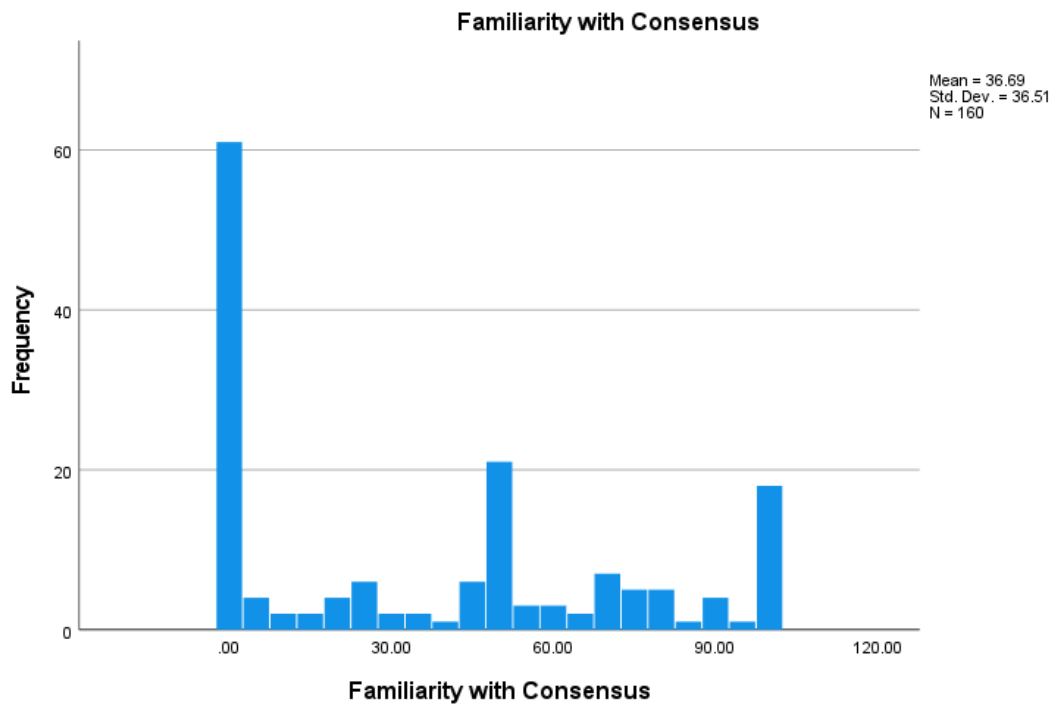
Scores for the MHSa are very negatively skewed. It would also be classified as leptokurtic due to the sharp spike and rapid peak. This is to be expected because all coaches are required to undergo this type of concussion training annually.



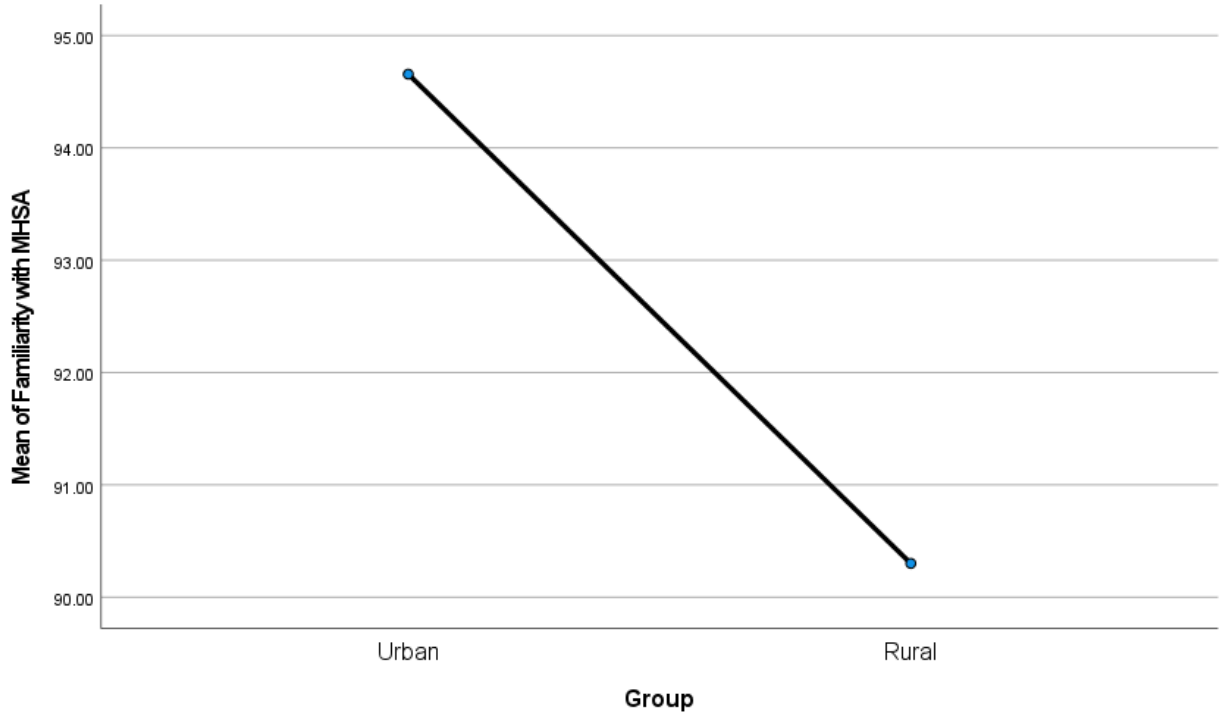
Frequency Table for Familiarity with CDC



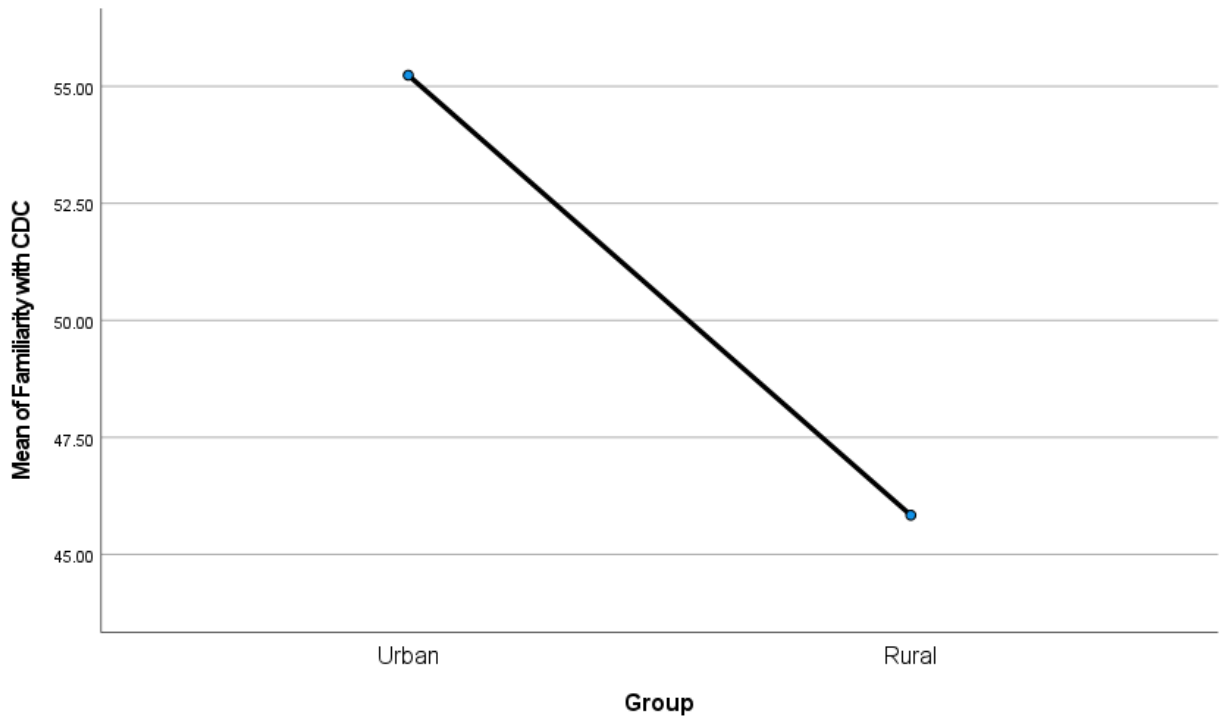
Frequency Table for Familiarity with NATA



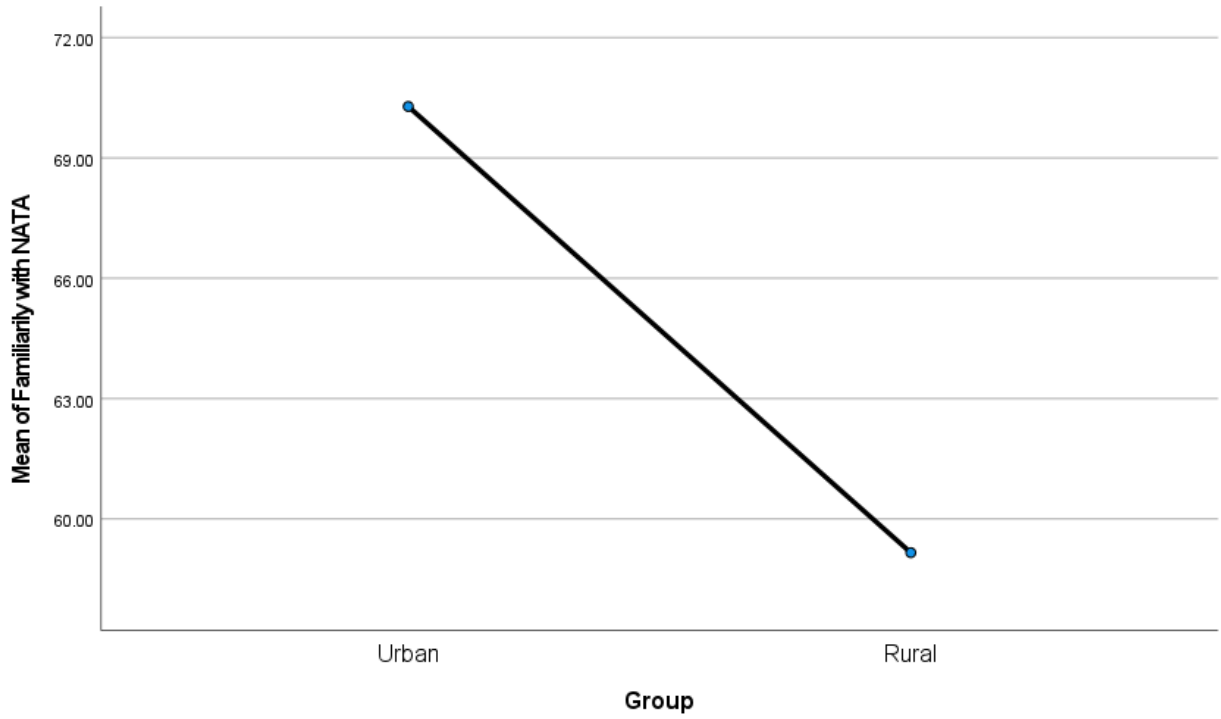
Frequency Table for Familiarity with Consensus Statement



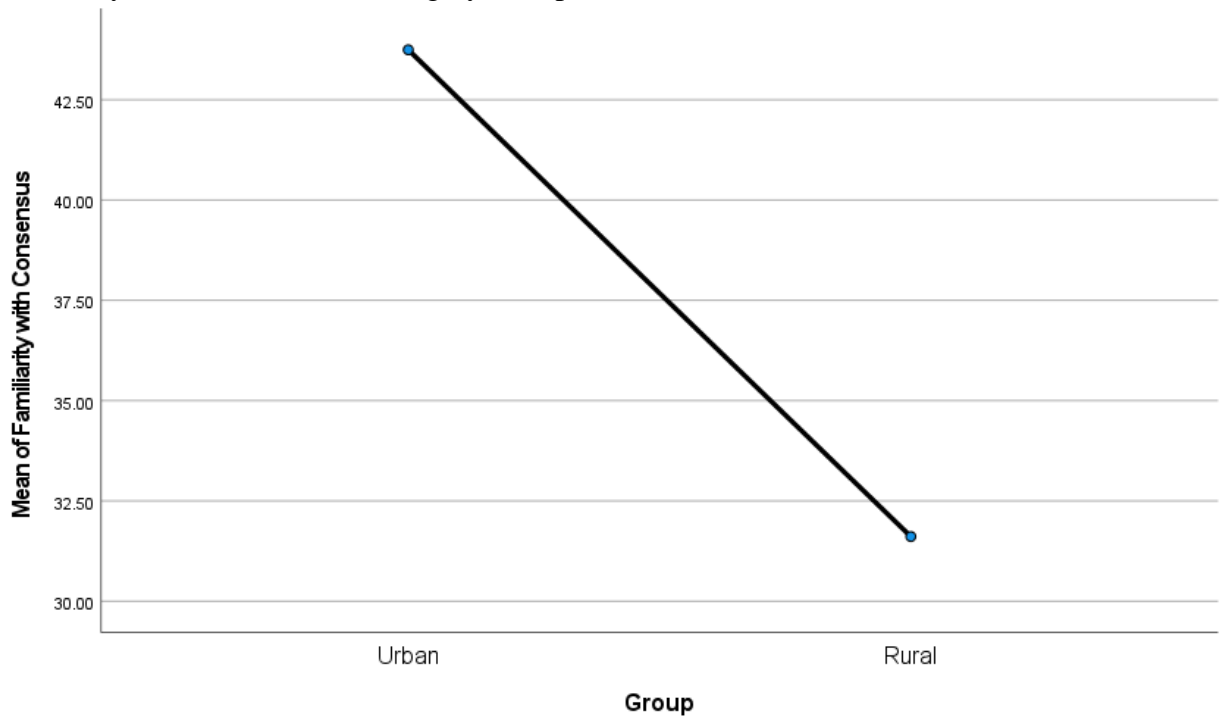
Familiarity with the MHSA training by Group



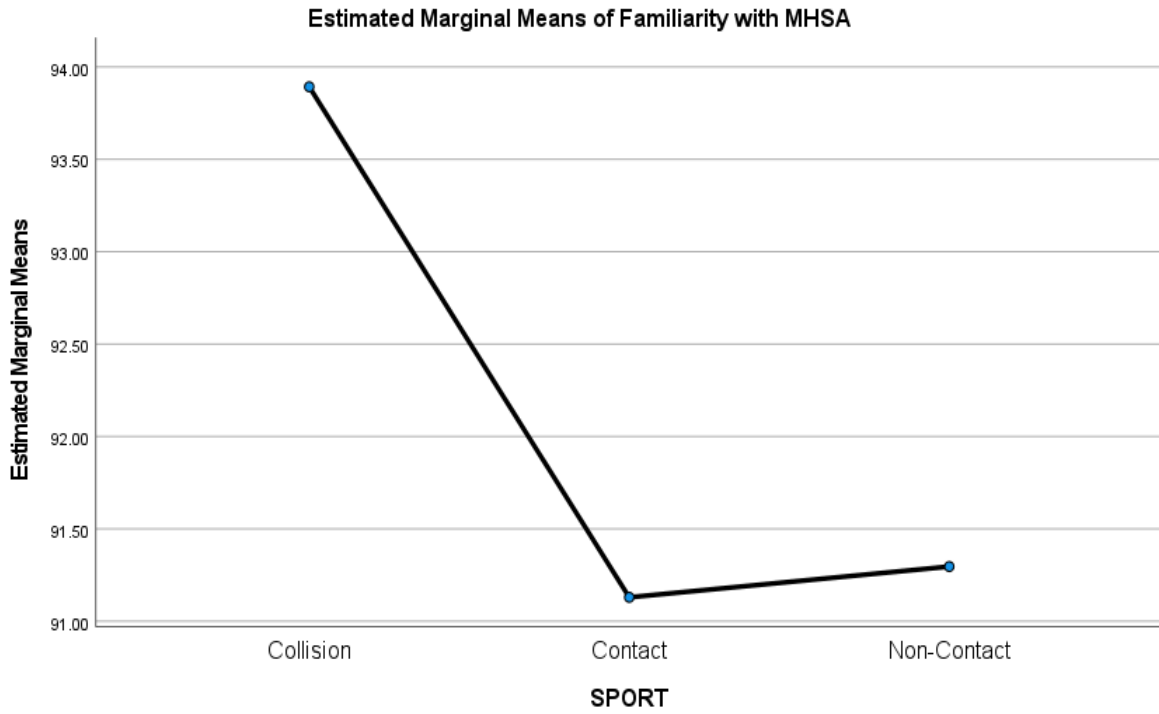
Familiarity with the CDC training by Group



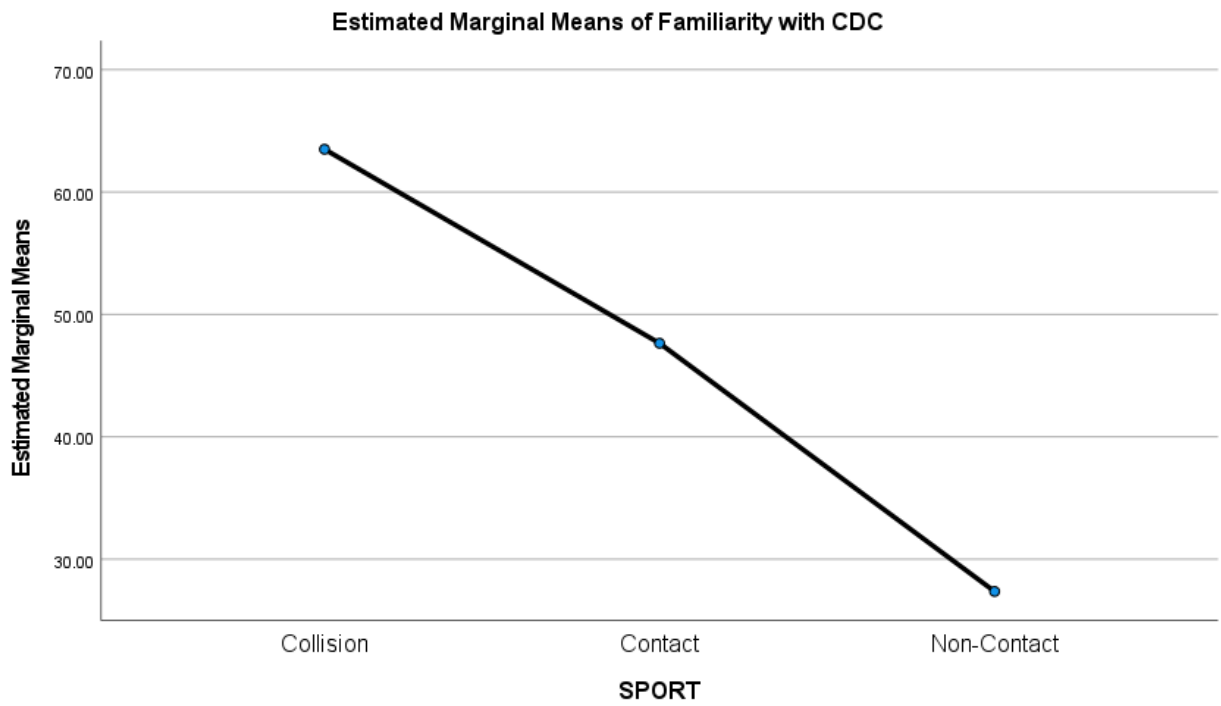
Familiarity with the NATA training by Group



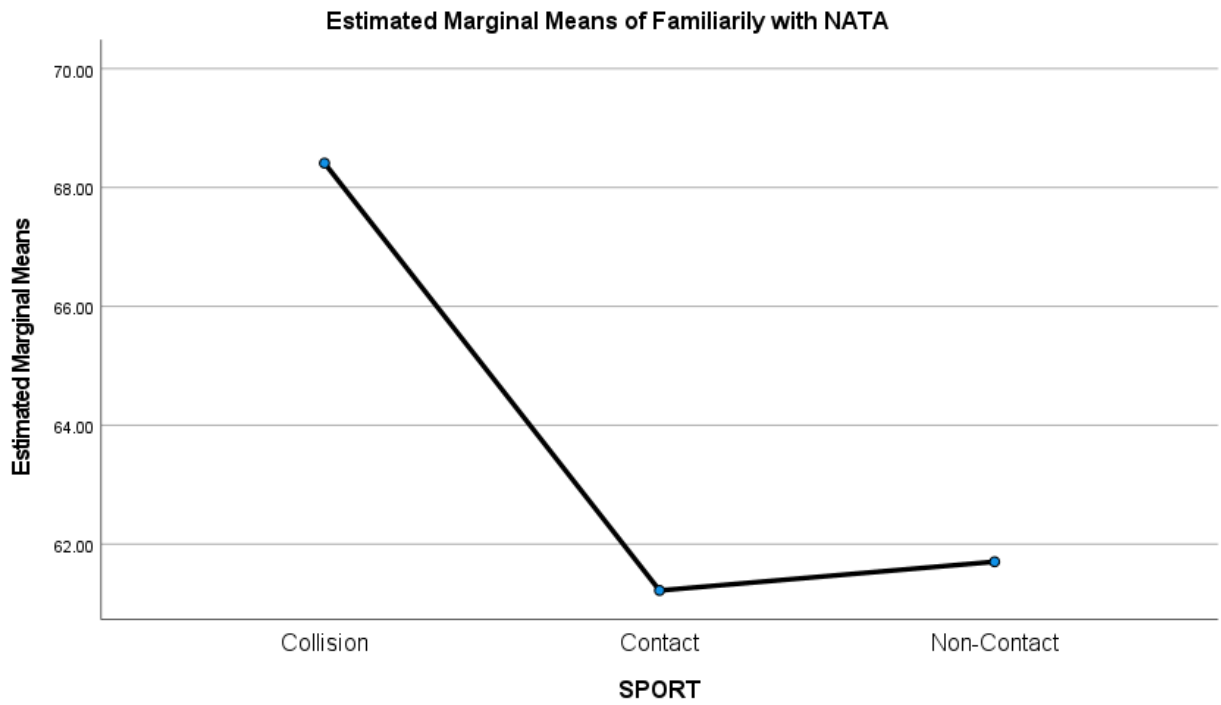
Familiarity with the Consensus Statement by Group



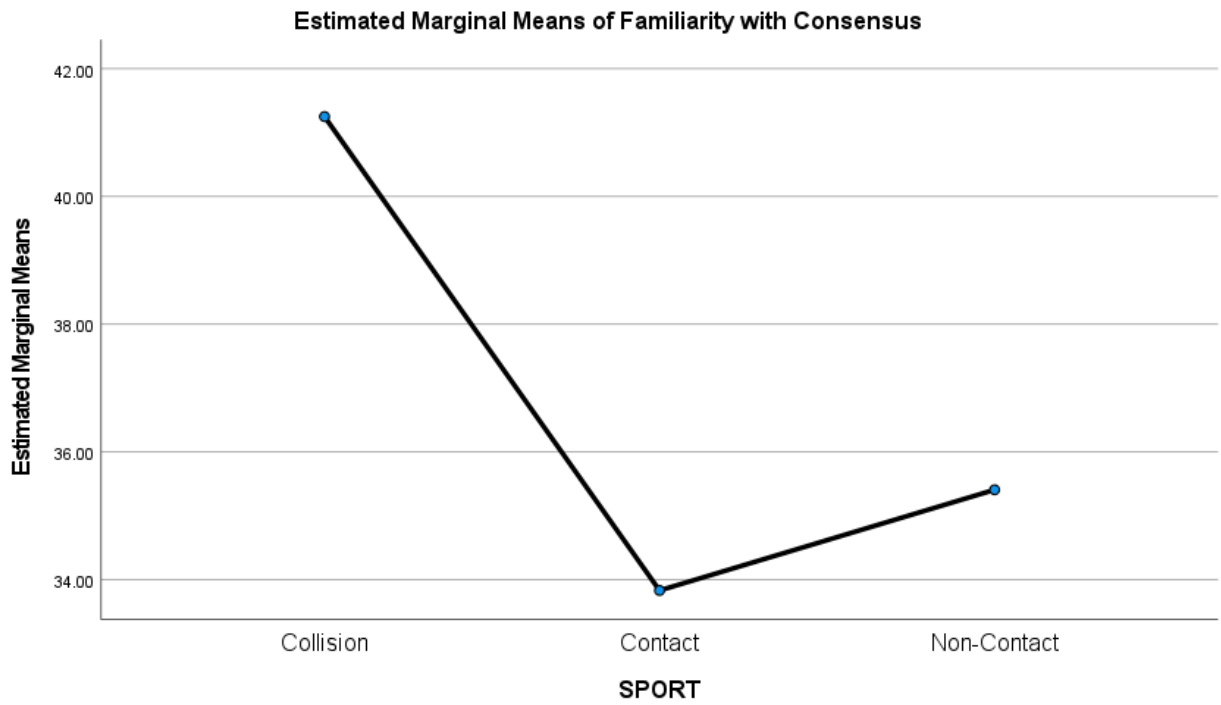
Familiarity with MHSa by Sport



Familiarity with the CDC by Sport



Familiarity with the NATA by Sport



Familiarity with the Consensus Statement by Sport