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COACHING AND CONCUSSIONS: PREVENTION, EDUCATION, AND PERSPECTIVE

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PREVENTION, EDUCATION, AND PERSPECTIVE

by

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ABSTRACT

Coaching and Concussions: Prevention, Education, and Perspective

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The large participation of players and coaches in football has made it one of the most popular sports in America. Concussions have specifically gained national attention in football due to frequent, high impact collisions. A concussion injury poses a unique threat in high school football because of the developing adolescent brain and high participation numbers. Additionally, lack of medical personnel to diagnose concussions at the high school level imposes a legal duty on the coaches. The thesis develops a recommended plan of action for directors of Iowa high school football to assist in preserving the future of the sport. A survey of Iowa high school football coaches in 2014 served as the foundation for the recommendation. An analysis of the physiology of concussions and prevention methods are also discussed, because regardless of one's love for a sport, no victory is worth a young athlete's life.

KEYWORDS: Concussion, Football, High School, Iowa Survey, Coaching

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DEDICATION

For:

Those alive and deceased who have been impacted by head injuries from football.

CHAPTER ONE

Introduction

Concussions possess the potential to eliminate football, one of the most popular sports in the United States. While this may seem a bold overstatement, the harsh reality presents a type of medical injury much different than the typical sports injury. As with any contact sport, physically debilitating medical injuries are inevitable. A concussion is unique that it affects a player's mental functioning, which can alter physical abilities (Edwards & Bodle, 2014). The injury is particularly significant to football, because it is the sport with the highest concussion frequency rate per athletic exposure (Marar, McIlvain, Fields, & Comstock, 2012). The elevated concussion frequency can be correlated with the physical, swift, and violent nature of the game when compared to other sports. However, those same factors are what attract many players, coaches, and spectators to the sport.

Although the collegiate and professional football leagues garner the most media attention, over one million individuals play high school football each year (Martini, Eckner, Kutcher, & Broglio, 2013). The large participation numbers create additional challenges associated with concussion prevention, detection, and education, unique to the high school level. It is justifiable for parents to be concerned about their child participating in the sport with the highest concussion frequency when sports are the second leading cause for traumatic brain injuries (TBIs) for those 15-24 years old (Gessel, Fields, Collins, Dick, & Comstock, 2007). In order to address these concerns, actions associated with concussion are analyzed to increase the safety of the game as

much as possible, while still maintaining the sport many enjoy. However, increasing concussion safety is not a one answer solution; it involves multiple factors such as prevention, detection, and education. While dramatic advances may not be currently possible in any one area, a combination of smaller improvements in multiple areas may help lead to the desired result.

According to Iowa High School Athletic Association (IHSAA) website, the first high school football games in Iowa began around 1890. However, the formalized high school athletic union called the IHSAA was not created until 1904. Upon formation, they banned the sport of football at the high school level due to the dangerous nature of the game. Following widespread nationwide rule changes to the sport, high school football was re-instated for the 1909 season. Recognizing early potential dangers, the IHSAA was one of the first pioneers in requiring mouth pieces in 1960 and eliminating illegal helmet contact including spearing in 1968. Prior to the 1989 season, the IHSAA began distribution information to schools regarding heat indexes and preventing dehydration (IHSSA, 2015).

In 2002, a video named "keeping the head out of football" was jointly created by the IHSAA and the Iowa Football Coaches Association and distributed to all schools. With increasing information related to concussions, the Iowa Medical Society and IHSAA in 2006 sent out reminders to participating schools on "concussion management". For the 2010 season, schools were provided with brain trauma/concussion protocols; these were incorporated into state legislation in 2011. In 2013, a variety of changes were introduced related to heat acclimation, a safety video, hydration, pre-season practice times, and course work for coaches on minimizing brain injuries. Recently in the spring

of 2015, new rules were integrated limiting the amount of contact teams are allowed each week during practice (IHSSA, 2015).

The development of a recommended plan of action for the IHSAA is built upon the consideration of multiple areas of influence. A survey of Iowa high school football coaches following the 2014 season serves as the primary resource for the recommendation. While the survey only encompassed one state, it provides a foundational study which can be improved upon for distribution in other states. The survey provides critical information toward increasing concussion safety, as coaches are an important resource for concussion prevention and education at the high school level. Information regarding medical personnel availability, concussion statistics, and ethical dilemmas is also included in the survey.

Six primary areas are discussed to formulate the suggested recommendation of ways to improve concussion safety for high school football in the state of Iowa. First, the physiology of a concussion is explained. Second, the materials and methods for the 2014 survey of Iowa high school football coaches in 2014 are mentioned. Third, the results of the survey are analyzed. Fourth, a discussion is conducted. Fifth, the plan of action is proposed. Finally, a perspective on coaching and playing football is discussed. To preserve the long-term future of football at the high school level while minimizing adverse long-term effects of concussions, a purposeful and direct plan of action is presented to assist in increasing concussion prevention, education, and detection to the highest levels possible.

CHAPTER TWO

Physiology of a Concussion

Traditionally called a “bell ringer” or a “dinger,” concussions were poorly understood for many years. Recent research has significantly increased the knowledge in the topic area in association to physiology, symptoms, diagnosis, management, and prevention (Guskiewicz et al., 2003). Comprehension of the physiology of a concussion allows for an understanding of the severity of this injury. Although the skull serves as adequate protection for the delicate brain in many situations, specific impacts and rotational forces can result in acute brain damage termed a traumatic brain injury (TBI) (McKinley, O’Loughlin, Pennefather-O’Brien, & Harris, 2015). Outside of classifying the severity of TBIs, there is not a universally accepted grading system defining the different levels of severity (Cook & Hawley, 2014). This ambiguity makes classifying concussions, the mildest form of a TBI, extremely difficult. Edwards and Bodle defined concussions as a, “trauma affecting the head or body resulting in transient neurologic deficits or symptoms” while noting 75% of TBIs are diagnosed as concussions (2014, p. 128). This elevated frequency helps to explain the concern surrounding concussions, despite the potentially more debilitating and lethal consequences of severe TBIs. For example, severe TBIs resulting from extremely strong forces can result in the rupture of the brain’s blood vessels. Bleeding of the brain (intracerebral hematoma) increases the pressure within the skull causing potentially fatal consequences (Post & Hoshizaki, 2012). To further explain TBIs, the anatomy of the brain and surrounding structures must be examined.

The brain is enclosed by a tightly fused, bony capsule called the skull or cranium. Holes in the cranium provide small openings into the cranial vault for blood vessels and nerves to pass through. A small intracranial space, primarily composed of connective tissue termed cranial meninges, exists between the cranial bones and brain. The area between two of the meninges is called the subarachnoid space, which contains cerebrospinal fluid (CSF) (McKinley et al., 2015). A one centimeter thick gel-like substance when combined with proteins and connective tissue, CSF provides a protective function to the brain by providing buoyancy as well as absorbing and decelerating forces acting on the brain (Babbs, 2005). McKinley et al. (2015) explain this mechanism as, "When you try to walk quickly in a swimming pool, your movements are slowed as the water acts as a 'movement buffer'. CSF likewise helps slow movements of the brain if the skull and/or body move suddenly and forcefully" (p. 448).

The brain is a massive interconnected network of nerves which are composed of individual nerve cells called neurons (McKinley et al., 2015). The neurons communicate signals with each other via electrical movements called action potentials. Sodium-potassium exchange pumps change the voltage at the individual neuron cell membranes which "carries" the signal down the nerve. At the junctions between neurons called a synaptic cleft, the message is communicated to the next neuron with chemicals called neurotransmitters. The next neuron can continue "carrying" the signal or the signal can be blocked based on the different types of neurotransmitters released and the type of receptor activated. Because of the delicate and complex nature of the brain, there must be tightly regulated transport between blood vessels and brain tissue to assist in maintaining optimal performance. A selectively permeable membrane called the "blood-

brain barrier" is responsible for regulation. This barrier allows the proper nutrients in the bloodstream to reach brain cells but prevents harmful substances from entering brain tissue (McKinley et al., 2015). With an understanding of the anatomy of the brain and surrounding structures, the mechanism of a concussion can be analyzed.

The general mechanism of a concussion can be described as changes in acceleration to the brain, which result in damage to the neurons (Edwards & Bodle, 2014). Despite extensive research, determining the exact mechanism and the forces involved in a concussion is extremely difficult. One challenge is trying to replicate a brain surrounded by CSF in a closed skull and another is that the impact of a concussion only lasts around 2-20 milliseconds or faster than the blink of an eye (Babbs, 2005). Post and Hoshizaki (2012) suggested the most common mechanisms for brain injuries are, "(i) contusions resulting from skull deformation and brain motion; (ii) intracranial pressure gradients produced from impacts; (iii) rotation causing skull/brain relative motion and (iv) combined linear and rotational acceleration from impact" (p. 328). For example, the liner acceleration and deceleration of the brain within the skull during a concussion can be compared to slamming on the brakes in a rapidly moving vehicle. Even though the vehicle (skull) is quickly decreasing speed, the driver's (brain) inertia is still traveling in a forward direction resulting in the driver (brain) being thrown forward and contacting the vehicle (skull). The contact between the skull and brain causes an area of high pressure at the point of contact and an area of low pressure behind the brain (Post and Hoshizaki, 2012). The pressure differential causes a shearing force which damages the delicate nervous tissue of the brain. Despite understanding the individual forces associated with a concussion, "theories [suggest] that brain injuries occur through a

combination of elastic deformation of the skull, positive and negative pressures and inertial brain lag from linear and rotational acceleration" (p. 332). Thus, it is difficult to accurately replicate such conditions with scientific research.

Neuronal changes induced by concussive forces are an evolving area of study. The Committee on Sports-Related Concussions in Youth (2013) reported that, "the biology responses [in nerve tissue] may be structural or functional" (p. 59). After the damage has occurred, the injury "results in an adverse 'neurometabolic cascade' of altered cerebral metabolism and blood flow, and impaired [nerve] function that can last for weeks" (Johnson, 2012, p. 181). The "neurometabolic cascade" includes a variety of functions associated with electrical movement at cellular membranes and neurotransmitter release. Cellular membranes in neurons are maintained at a specific voltage through careful electrical charge movement. Following a concussive impact, changes in normal electrical movement have been detected, and the degree of movement has been associated with the severity of the concussion. Additionally, concussive impacts have been associated with the incidental release of specific neurotransmitters. This subsequently upsets the normal cellular membrane balance requiring extra energy (ATP) to restore normal concentrations. However, decreased cerebral blood flow decreases the ability to create extra energy (Committee on Sports-Related, 2013). In addition, blood-brain barrier disruption with both concussive and sub-concussive impacts also results in irregular deposits of protein in the blood stream (Marchi et al., 2013).

By better understanding the forces associated with concussions and microscopic changes within neurons, better prevention methods can be developed (Post & Hoshizaki, 2012). Brain damage similar to concussions can occur even when the individuals have

experienced sub-concussive level forces; the damage occurs without concussion symptoms and is dependent on the frequency of the impacts (Breedlove et al., 2012; Talavage et al., 2014). In particular, the accumulation of sub-concussive level forces increases the permeability of the blood-brain barrier. This has been linked to increased incidences of, "seizures, Alzheimer's disease, stroke, and traumatic brain injury" (Marchi et al., 2013, p. 1). Despite understanding some of the physiological changes that occur in response to concussions, correlating specific results with predicted side effects is an area of continuing research.

In general, the signs and symptoms of concussions are much easier to evaluate than the mechanism behind the injury. Concussions are analyzed based upon three categories: immediate, short term, and long term side effects. Immediate side effects appear in the seconds or minutes following the injury. Edwards and Bodle (2014) listed these potential symptoms as, "vacant stare, delayed verbal and motor responses, confusion or inability to focus attention, slurred or incoherent speech, gross incoordination, emotions out of proportion to the situation, memory deficits, repeating questions, nausea, vomiting, dizziness, and sometimes loss of consciousness" (p. 128). One of the critical developments in concussion education is the recognition that a concussion can occur without the loss of consciousness. In fact, more than 90% of individuals do not lose consciousness during a concussion injury (Cobb & Battin, 2004).

Many grading systems, which evaluate the severity of concussions, base their ranking on how quickly the immediate effects of a concussion subside (Hodge Jr. & Kadoo, 2014). Although the initial impact of a concussion is harmful, continuing to play after experiencing a concussion can be lethal due to a phenomenon termed second impact

syndrome (SIS). Following an initial concussion, the brain is in a vulnerable state; receiving a second concussion before the appropriate recovery time can result in the inability of the brain to auto-regulate the amount of fluid in the intracranial space. When such an event occurs, fluid, often blood, accumulates in the skull, increasing cranial pressure (Johnson, 2012). The second impact does not need to be a direct blow to the head. Instead, it can be any type of contact which results in a "jerking" motion of the head (Cobb & Battin, 2004). As fluid accumulates in the cranium, the increased fluid pressure compresses the brain. Because of the rigid skull it is encapsulated within, the increased pressure results in brain herniation out of the skull leading to death (Edwards & Bodle, 2014). In these situations, the structure that is supposed to help protect an individual's brain, actually results in their death. The mortality of the injury is almost 100% and death usually occurs within five minutes of the second impact (Johnson, 2012). Additionally, "there is agreement that children and adolescents are uniquely susceptible to SIS, with all confirmable cases having been observed in adolescents 18 and younger" (p. 181). The young athlete's vulnerability is attributed to, "the difference in blood volume, blood-brain barrier, the brain's water content, amount of myelination, cerebral metabolic rate of glucose, and other metabolic factors" (Hodge Jr. & Kadoo, 2014, p. 162). The lethal consequences of SIS emphasize the importance of diagnosing concussions and removing players from action immediately after they occur.

The short term effects of a concussion appear hours to days following the impact. The symptoms typically disappear in 7-14 days, but they can persist for weeks, months, or even an entire-life time following the injury (Edwards &Bodle, 2014). Edwards and Bodle described potential short term symptoms as, "persistent headache, sleep

disturbance, hypersomnia, poor attention and concentration, difficulty with memory, [and] irritability" (p.128). Concussions show a cumulative effect. In fact, a prior concussion doubles the risk of prolonged symptoms in football players (Committee on Sports-Related, 2013). Football players with a previous concussion have a higher likelihood to experience another concussion than players with no concussion history (Guskiewicz et al., 2003) thus, the more concussions an individual experiences, the higher the probability of additional concussions becomes. For example, individuals with three previous concussions are three times as likely to experience another concussion when compared to individuals with no concussion history.

A potential long term effect of concussions and sub-concussive forces is chronic traumatic encephalopathy (CTE). Edwards and Bodle (2014) described the disease as:

> Gross anatomic changes seen in CTE include decreased brain weight, thinning of the corpus callosum, enlargement of the ventricles, and atrophy most pronounced in the frontal and temporal lobes. Symptoms associated with CTE include difficulty with memory and cognition, depression, suicidal behavior, poor impulse control, aggressiveness, parkinsonism, and dementia. (p. 130)

These changes are a result of repetitive sub-concussive head impacts and/or concussions (Committee on Sports-Related, 2013). The problem is that the development of the disease occurs years before the symptoms are finally expressed later in life (Hodge Jr. & Kadoo, 2014). Accumulation in the brain of a specific protein called a Tau protein is indicative of CTE. However, diagnosis can only occur during a post-mortem autopsy. The primary evidence of CTE is from former professional football players, but it has also been discovered in deceased former high school football players (Johnson, 2012).

Although detecting CTE is important, it does not help an individual if they have already died. However, examination of brain tissue in which CTE is evident provides a great research tool to assist in finding a preventive solution.

Diagnosing a concussion is difficult. There is no commonly accepted method of neuroimaging (CAT scans, MRIs) used to detect the injury. While recent technology has made improvements in the area, the current detection images are mainly investigative (Cook & Hawley, 2014). Instead, the diagnosis is dependent on signs and symptoms from the impacted individual. Players understand that if they show concussion symptoms, they cannot resume contact until they have cleared return to play (RTP) guidelines. To avoid missing playing time, players may try to hide concussion symptoms, further adding to the challenge of detection (Edwards & Bodle, 2014). The current treatment of concussions is defined as, "physical and cognitive rest until the athlete is asymptomatic, with a stepwise approach to rehabilitation prior to return[ing] to play" (Johnson, 2012, p. 181). The IHSAA (2015) has a specific concussion management protocol developed which includes RTP guidelines for individuals diagnosed with a concussion. Despite the immense concern surrounding concussion frequency, there does not appear to be a widely accepted limit for the number of concussions a player can experience before participation is prohibited by medical professionals.

CHAPTER THREE

Materials and Methods

A survey of Iowa high school football coaches during the 2014 season was developed to provide a primary resource for the research. The purpose of the study was to determine the frequency, management, and education of concussion related injuries for one high school football season from the perspective of Iowa high school head football coaches. Information garnered from the study, along with additional literary resources, was used to generate a recommendation for the Iowa High School Athletic Association (IHSAA) to assist in increasing the prevention, education, and management of concussions in Iowa high school football.

The survey of Iowa high school football coaches consisted of 26 questions. A variety of options for the questions were used including a five point Likert scale, fill in the blank, multiple choice, and ranking. Questions were associated with demographic information, concussion frequency, medical personnel availability, and concussion education. At the end of the survey, two questions associated with ethical decisions were also included. The survey was developed by the student investigator with the assistance of three other investigators to create the final product. After initial creation by the student investigator, comments and suggestions about the survey were presented and the final adjustments were made.

As an incentive to complete the survey, coaches were offered the opportunity to enter a drawing for a twenty dollar Amazon gift card upon completion of the survey. The

responses of the coaches remained anonymous. In total, twenty Amazon gift cards were given to the winning coaches. The gift cards were funded by the Council for Undergraduate Research and Creative Scholarship (CURCS) Mini-Grant funding through the Center for Academic & Global Engagement (CAGE) at the University of South Dakota. Receiving these funds increased the probability of obtaining a strong rate of response due to a potential monetary reward for participating coaches (Singer & Couper, 2008). At the beginning of the survey, a cover letter was presented in which the participant was told why they were chosen, the procedure, confidentiality, risks, and biography of the student investigator. Following successful completion of the survey, coaches were presented with an optional link where they could access and complete an entry for the gift card drawing.

The primary contact for the distribution of the survey was Mr. Todd Tharp. Mr. Tharp is the Assistant Executive Director of the IHSAA and primary contact for high school football in the state of Iowa. The board of executive directors of the IHSAA examined the survey and approved the study. Mr. Tharp agreed to send a script to the coaches regarding the survey. This procedure was employed so that Mr. Tharp could protect the confidentiality of the head football coaches' e-mail addresses. The survey was sent via e-mail to all 340 head high school football coaches in the state of Iowa. Because coaches would be notified of the survey three times, six scripts were prepared for the distribution. Three of the scripts were directed towards Mr. Tharp detailing explicit instructions on what should be included in the distribution e-mail and when they should be sent. The final three scripts included the material Mr. Tharp e-mailed to the football coaches. The coaches' scripts included information on why they were invited,

how long the survey would take, and if the individual would be paid for participating, as well as an embedded link allowing access to the survey. Additionally, it was explained that the survey was completely voluntary and the coach could withdraw from the study at any time.

Following construction of the entire survey including scripts, cover letter, links, and survey questions, an exempt request was submitted to the University of South Dakota's Institutional Review Board (IRB), which approved the project. Instructions were sent to Mr. Tharp to distribute the initial survey e-mail inviting all 340 high school football coaches in the state of Iowa to participate in the survey following the first round of the Iowa state playoffs on October 31. Reminder e-mails were sent to the coaches on November 24 and December 8. Coaches were notified in the final e-mail that the survey would close on December 19. Following completion of the survey, results were extracted on an excel sheet through PsychData for analysis. Gift card winners were randomly chosen and the prizes were distributed.

CHAPTER FOUR

Results

Demographics

Two hundred and forty-six coaches submitted fully completed surveys and an additional 13 coaches submitted partially completed surveys. Using 246 completed surveys, there was a 72.4% response rate. One hundred and nineteen of the 246 (48.4%) coaches who fully completed the survey entered the gift card drawing. The results of the survey were compiled using means, percentages, and ratios.

Coaches were asked to list their team's level of classification (8-Man - smallest, 4A - largest) for the 2014 football season in the state of Iowa (Table 1).

Table 1 *Response Rates by Classification**

	8-Man	A	1A	2A	3A	4A
Responses	36/64 (56.3%)	42/62 (67.7%)	43/56 (76.8%)	46/56 (82.1%)	51/56 (91.7%)	28/46 (60.9%)
Overall %	14.6	17.1	17.5	18.7	20.7	11.4

*N = 246

Football coaching experience (N = 246) was relatively evenly distributed. One hundred and thirteen (45.9%) coaches answered that they had been coaching for fifteen years or less while 133 (54.1%) responded they had over sixteen years of experience.

Coaches were asked to list their team size during the 2014 season (Table 2). Combined, these coaches were responsible for 14,722 players.

Table 2 *Team Size Combining Varsity, Junior Varsity, and Freshman Teams**

	8-Man	A	1A	2A	3A	4A	Overall
Average	29	39	48	59	82	119	60
Range	15-45	19-63	29-72	38-117	45-150	60-200	15-200

*N = 246

Concussion Frequency

Coaches were asked to record how many medically diagnosed concussions their team experienced during the 2014 football season (Table 3). Although concussion frequency is a critical statistic, it does not compare the frequency to the number of individuals on the team. Using a concussion percentage statistic, the number of concussions experienced was divided by the number of players on the team to produce a statistic which is comparable throughout all classifications and team sizes.

Table 3 *Medically Diagnosed Concussions in the 2014 Iowa HS Football Season**

	8-Man	A	1A	2A	3A	4A	Total
Average	1.3	1.9	2.6	2.6	5.1	4.8	3.1
Range	0-6	0-8	0-12	0-10	0-14	0-20	0-20
Concussion #	48	78	111	124	261	134	757
# of Players	1,014	1,624	2,048	2,660	4,166	3,210	14,722
Concussion %	4.73	4.80	5.42	4.66	6.27	4.21	5.15
Highest%	26.7	21.5	18.5	13.9	16.0	14.7	
Highest Ratio	4 in 15	8 in 38	12 in 65	10 in 72	12 in 75	14 in 95	

*N = 246

Coaches were also asked to estimate their teams' average concussion frequency in previous seasons as a coach at that school (Table 4).

Table 4 *Average Concussion Frequency in Previous Iowa HS Football Seasons**

	8-Man	A	1A	2A	3A	4A	Total
Average	2.1	2.4	2.7	3.2	4.3	4.7	3.2
Range	0-9	0-8	1-10	0-10	1-12	0-20	0-20
Total #	77	102.5	116	146	219	132	792.5
# of Players	1,014	1,624	2,048	2,660	4,166	3,210	14,722
Concussion %	7.6	6.3	5.7	5.5	5.3	4.1	5.4

*N = 246

Coaches (*N* = 246) were asked to select which grade level(s) experienced the most concussions. Because multiple grade levels could be selected, 346 overall answers were given by the 246 respondents to the question. Underclassmen (freshman and sophomores) were the most common response with 192 (55.5%) selections. Seniors garnered the least number of selections with 63 (18.2%).

Prevention

In relation to concussion prevention, coaches were asked to list their teams' most commonly used football helmet during the 2014 season (Tables 5-7). Some coaches responded with only the brand name while other answered with the specific model. Riddell and Schutt were overwhelming the most popular brands with 239 (97.2%) of the 246 answers. A concussion percentage was calculated based upon the reported type of

helmet using the number of concussions experienced by users of a helmet divided by the total number of users of that particular helmet brand.

Table 5 *Most Common Helmet by Team in the 2014 Season**

	Riddell	Schutt	Xenith	SG
Teams	177 (72.0%)	62 (25.2%)	6 (2.4%)	1 (0.4%)
Concussions	578	157	22	0
Players	11,153	3,290	249	30
Concussion %	5.2%	4.8%	8.8%	0%

*N = 246

Of the 239 coaches who selected either Riddell or Schutt, only 118 (49.4%) coaches listed the specific model of helmet the team predominantly wore. The coaches who did not specific the model were categorized as unspecified for that brand.

Table 6 *Types of Riddell Helmets Worn by Team in the 2014 Season**

	Unspecified	Revo.*	Revo.* Speed	360	IQ
Teams	68 (27.8%)	26 (10.6%)	69 (28.0%)	11 (4.5%)	3 (1.2%)
Concussions	236	94	210	31	7
Players	4,275	1,872	4,162	617	227
Concussion %	5.5%	5.0%	5.0%	5.0%	3.1%

*N = 177, Revo, = Revolution

Table 7 *Types of Schutt Helmets Worn by Team in the 2014 Season**

	Unspecified	DNA	Air Adv.	Ion	Veng.*	XP Pro
Teams	53 (21.6%)	5 (2.0%)	1 (.4%)	1 (.4%)	1 (.4%)	1 (.4%)
Concussions	145	8	3	0	0	1
Players	2,913	203	31	55	55	33
Concussion %	5.0%	3.9%	9.7%	0.0%	0.0%	3.0%

*N = 62, Veng. = Vengeance

Qualified Medical Personnel

For questions associated with medical personnel, the survey defined "qualified medical personnel" as: Physicians (MD/DO), Physician Assistants (PA), Nurse Practitioners (NP), Physical Therapists (PT), Chiropractors, Athletic Trainers (ATC or LAT), Nurses, or EMTs. Coaches were asked whether qualified medical personnel was available at all home varsity, junior varsity, and freshman games as well as at all practices (Tables 8 & 9).

Table 8 *Qualified Medical Personnel Availability Part I**

	All Home Varsity Games			All Home Junior Varsity Games		
	Yes	No	N/A	Yes	No	N/A
Overall	96.7% (237)	3.3% (8)	1	68.6% (164)	31.4% (75)	7
8-Man	97.2% (35)	2.8% (1)	0	45.5% (15)	54.5% (18)	3
A	92.7% (38)	7.3% (3)	1	50.0% (20)	50.0% (20)	2
1A	95.3% (41)	4.7% (2)	0	60.5% (26)	39.5% (17)	0
2A	95.7% (44)	4.3% (2)	0	67.4% (31)	32.6% (15)	0
3A	100.0% (51)	0.0% (0)	0	90.0% (45)	10.0% (5)	1
4A	100.0% (28)	0.0% (0)	0	100.0% (27)	0.0% (0)	1

*N = 246

Table 9 *Qualified Medical Personnel Availability Part II**

	All Home Freshman Games			All Home Practices		
	Yes	No	N/A	Yes	No	N/A
Overall	71.4% (137)	28.6% (55)	54	33.8% (81)	66.2% (159)	6
8-Man	36.8% (7)	63.2% (12)	17	8.6% (3)	91.4% (32)	1
A	42.1% (8)	57.9% (11)	23	17.5% (7)	82.5% (33)	3
1A	58.8% (20)	41.2% (14)	9	14.3 % (6)	85.7% (36)	1
2A	68.3% (28)	31.7% (13)	5	31.8% (14)	68.2% (30)	2
3A	92.2% (47)	7.8% (4)	0	49.0% (25)	51.0% (26)	0
4A	96.4% (27)	3.6% (1)	0	92.9% (26)	7.1% (2)	0

*N = 246

If coaches selected “no” for any answer, they were asked to provide the reason(s) for the response. Five possible explanations were provided and multiple responses were allowed. These explanations included “lack of medical personnel”, “lack of funding”, “unnecessary to have”, “do not know”, or “other”. For those that selected “no” to varsity, junior varsity, or freshman games, the two most common responses (75.6%) were “lack of medical personnel” (79 responses, 43.9%) and “lack of funding” (57 responses, 31.7%).

When comparing practice availability to game availability, practices (33.8%) had noticeably less qualified medical personnel available when compared to games (79.6%). However, the primary explanation for “no” responses were largely the same as the “no” responses for games. “Lack of funding” (80 responses, 38.1%) was the primary reasoning while “lack of medical personnel” (71 responses, 33.8%) also represented a large share. However, the choices of “unnecessary to have” (23, 11.0%) and “do not know” (24, 11.4%) were also frequently selected.

Next, the coaches were asked about which types of medical personnel were used for games and practices (Table 10). Coaches were allowed to select more than one answer as the type of medical personnel may change throughout the season.

Table 10 *Types of Medical Personnel**

	Home Games	Practices
Physician	19.4% (104)	0.4% (1)
Athletic Trainer	36.0% (194)	37.8% (99)
Physical Therapist	9.1% (49)	4.2% (11)
Physician Assistant	2.4% (13)	0.4% (1)
Nurse Practitioner	1.3% (7)	0.0% (0)
EMT	22.3% (120)	3.0% (8)
Nurse	1.7% (9)	0.4% (1)
Chiropractor	6.9% (37)	0.8% (2)
None	0.6% (3)	47.3% (124)
Other	0.6% (3)	5.7% (15)

*N = 246

For games, the three primary types of personnel were physicians, athletic trainers, and EMTs. Across all classifications, athletic trainers were the most popular type of "qualified medical personnel" with average selections ranging from 31.0 percent to 40.0 percent. In the three largest classifications (2A, 3A, and 4A), physicians were represented 74 (71.1%) times compared to only 30 (28.9%) times in the smallest three classifications (8-man, A, and 1A). EMTs showed a similar trend in the opposite direction. They were represented 69 (57.5%) times at the three smallest classifications compared to 51 (42.5%) times in the largest three classifications.

Concussion Education

To assist in determining coaches' concussion educational levels, the coaches (*N* = 246) rated themselves (*1 = Minimal, 2 = Below Average, 3 = Moderate, 4 = Above Average, 5 = Excellent*). The respondents felt they had above average (*M* = 3.99) education levels in association to concussions. These results were fairly consistent over all classifications. Individuals who had coached for less than 16 years rated themselves slightly lower (*M* = 3.88) than coaches with over 16 or more years of experience (*M* = 4.09). Next, the coaches (*N* = 246) rated their confidence in determining if a player was experiencing concussion symptoms (*1 = No Confidence, 2 = Minimal, 3 = Moderate, 4 = High, 5 = Complete*). Again, the respondents answered with high confidence (*M* = 3.81) in determining these symptoms. Coaches in the 4A classification had the greatest confidence (*M* = 4.18) while 1A coaches showed moderately high confidence (*M* = 3.56). The results were fairly similar over all levels of coaching experience. Of the respondents, 99.6% (*N* = 246) knew about the concussion information available on the Iowa High School Athletic Association website. If the coach answered "yes", they were asked to rate the helpfulness of the resources. One coach who selected "yes" did not rate the resources. The coaches (*N* = 245) agreed (*M* = 3.92) that the resources were extremely helpful (*1= Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree*).

Coaches were asked how many times they or a member of their staff had to determine if a player had experienced concussion symptoms during the 2014 season. To account for differing team sizes, an incident percentage statistic was used for equal

comparisons. The statistic is calculated by taking the total number of evaluations divided by the total number of players (Table 11).

Table 11 *Frequency of Concussion Symptom Evaluations by Coaches**

	8-Man	A	1A	2A	3A	4A	Total
Average	3.5	2.7	4.2	6.4	6.4	4.9	4.8
Range	0-15	0-11	0-15	0-110	0-All Plays	0-50	0-All Plays
Total #	126	112	181	293	327	138	1,177
# of Players	1,014	1,624	2,048	2,660	4,166	3,210	14,722
Incident %	12.4	6.9	8.8	11.0	7.8	4.3	8.0

*N = 259

In smaller classifications (8-man to 2A), coaches on average evaluated for symptoms at a higher rate per player than the largest two classifications.

Two hundred and four (82.9%) coaches (*N* = 246) disagreed (*M* = 1.68) that players on their team experienced additional concussions which were not properly diagnosed (*1= Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree*). Coaches (*N* =246) only slightly disagreed (*M* = 2.59) that players try to hide concussion symptoms to avoid loss of playing time (*1= Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree*). Sixty-seven (27.2%) coaches agreed that players do try to hide concussions symptoms to avoid missing playing time. When asked to rate positions on their risk of concussions, coaches (*N* = 246) rated fullbacks and linebackers highest (*M* = 3.95) to experience a concussion with running backs (*M* = 3.93).rated third (*1 = No Possibility, 2 = Very Unlikely, 3 = Unlikely, 4 = Likely, 5 =*

Extremely Likely). Offensive lineman (*M* = 3.27) and defensive lineman (*M* = 3.31) were rated unlikely to receive concussions. All other positions received results between unlikely and likely (*M* = 3.49-3.83).

When asked about specific contact leading to concussions, coaches (*N* = 246) stated that most concussions are a result of a single, large incident (*M* = 3.75) instead of repeated, smaller contact (*1 = All due to Smaller, Repeated Contact, 2 = Majority due to Smaller, Repeated Contact, 3 = Equal Causation, 4 = Majority due to Big Hits, 5 = All due to Big Hits*). The majority (70.7%) of coaches associated concussions with single, large incidents while 27.7% answered with equal causation. Coaches (*N* = 246) were asked to determine if concussions are being diagnosed more frequently because of bigger, faster players or greater information (*1 = All due to bigger, faster players, 2 = Majority due to bigger, faster players, 3 = Equal agreement, 4 = Majority due to greater information, 5 = All due to greater information*). The majority of coaches (60.2%) selected that the increase was due to greater information. Approximately, one-third (34.1%) of the respondents stated the increase was due to equal causation between bigger, faster players and greater information.

Suggestions

Coaches (N=246) were asked to rank six potential options for their ability to help increase concussion prevention and education on a scale from one (*most effective*) to six (*least effective*). The use of all six possible ranking slots was required. The potential solutions included: additional tackling technique training, improved helmet quality, mandatory player concussion training, concussion clinics for coaches, mandatory parent concussion training, and rule changes. The respondents suggested additional tackling

technique training as the most effective solution (*M* = 2.69), while improved helmet quality (*M* = 2.98) and mandatory player concussion training (*M* = 3.02) were ranked second and third respectively. Concussion clinics for coaches were selected as less helpful (*M* = 3.67). In general, coaches strongly rated mandatory parent concussion training (*M* = 4.12) and rules changes (*M* = 4.51) as the least effective solutions.

Participants in the survey were given an opportunity to provide additional suggestions to improve concussion prevention and education. Twenty-two suggestions were given with a wide variety of responses. Four (18.2%) respondents indicated that the proper rules are in place, but enforcement is an area where improvement is needed. Another four (18.2%) participants indicated concerns over reduced practice time and an expanded playoff system.

Ethics

Coaches (*N* = 246) strongly disagreed (*M* = 1.48) that they had been tempted to re-enter a player into a game who they suspected of experiencing concussions symptoms (*1= Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)*. Only 11 (4.5%) coaches agreed with this statement. The coaches (*N* = 246) disagreed (*M* = 1.87) that parents had pressured them to re-enter their child when the individual was suspected of having concussion symptoms. One hundred and eighty-nine (76.9%) coaches either disagreed or strongly disagreed with the statement. However, a moderate number of coaches (37, 15%) agreed that they had received parental pressure to re-enter a player.

CHAPTER FIVE

Discussion

Demographics

Several factors potentially contributed to the high (72.4%) response rate (Nulty, 2008). First, the survey was distributed by a well-known and credible individual who directs all of high school football in the state of Iowa. Second, the survey was distributed to coaches on three separate occasions. Third, there was chance for a monetary reward at the end of the survey. Fourth, the student investigator was a previous high school football coach and player in the state of Iowa providing a connection to the participants. Fifth, coaches recognized the importance of the research being conducted (Jin, 2011).

Because a head football coach is typically not an entry-level coaching position, the relatively similar distribution in experience among the coaches is surprising. Twenty-four (9.7%) coaches had less than six years of experience which is remarkable considering the experience typically needed to become a head coach. A potential explanation is that the online format of the survey is better suited toward younger coaches with greater technology expertise (Szolnoki & Hoffmann, 2013). The range of team sizes varied significantly as there is often substantial overlap between the biggest and smallest teams in subsequent classifications. In almost every classification, the largest team had three times as many players as the smallest team. The discrepancy poses health concerns toward the smallest teams at the class A and 8-man levels. The players on these teams often experience more playing time per player in comparison to larger teams, increasing those athletes' risk for concussions (Gessel et al., 2007).

The 8-man classification provides an opportunity for smaller membered teams to be more competitive and safe, while still maintaining the game of football. However, there is the difficulty in determining which schools should be eligible for this classification. Classification designations are determined on Basic Education Data Survey (BEDS) numbers (freshman, sophomore, and juniors in the school semi-annually). These statistics are used to collected data on staff and student sizes for the state of Iowa's Education department. The IHSAA uses these numbers to determine classifications for sports based upon school size. While the reason for conducting the research semi-annually is not entirely clear, it works well for the IHSAA as teams are reclassified every two years based on the new BEDS numbers. However, these numbers are not always indicative of the number of participants on the football team. From a safety perspective, the class A team with only 19 players appears to be much better fit for 8-man classification. By eliminating three individuals from the field, the players will experience less contact exposure thus increasing safety. To assist smaller 11-man teams, raising the BEDS limit number for the 8-man level would allow such schools the opportunity to play 8-man. However, such a decision may alter the yearly competitiveness level between the largest and smallest teams in 8-man, as well as affecting district sizes and schedules across the state. It must be noted that schools have the option to play a class higher than their BEDS numbers indicate, which could potentially explain the smallest team sizes at the class A level.

Concussion Frequency

Between all classes, the concussion percentage is relatively stable around 5% or 1 in 20 players. However, the single team maximum percentages are much higher in the

smaller classifications with 4 in 15 (26.7%) being the largest ratio. When determining the estimated concussion frequency in previous seasons, coaches were not asked to list the number of players on their football team in previous seasons at the school they are current at. For comparative analysis in determining the results, the number of players on a team was estimated to remain consistent from season to season. The accuracy of such calculations is variable due to class size fluctuation from year to year. In comparison to the 2014 season data, the overall concussion percentage is fairly similar.

To quantify the concussion statistics from the state of Iowa to national data, the frequencies were converted to a ratio against athletic exposures (AEs). A countable athletic exposure is an organized practice or game during the season (Gessel et al., 2007). Without knowing each team's practice and game schedule, it is impossible to accurately determine the number of athletic exposures experienced through the season. However, estimates can be generated based upon the number of available practices. An aggressive practice approach assumes that the coach is using every potential practice day throughout the season. A conservative approach gives players one day off each week. During the pre-season, there are 12 potential athletic exposures over two weeks. The aggressive approach assumes a coach uses all 12 practices while the conservative approach assumes they use only ten. During the season, the aggressive approach assumes a coach is practicing four days a week along with a game. The conservative approach assumes three days of practice a week in addition to a game. While the conservative approach is potentially the more realistic approach, coaches still possess the ability to practice at the more aggressive rate.

Using an aggressive practice approach, the concussion rate in Iowa for the 2014 season is 8.36 concussions/10,000 AEs. Using a conservative practice approach, the concussion rate in Iowa for the 2014 season is 10.21 concussions/10,000 AEs. The entire statistical calculations and explanations are listed in the Appendix B. These two numbers provide a strong estimate of the true concussion frequency range (8.36-10.21 concussion/10,000 AEs). In Table 4, coaches reported slightly elevated concussion frequencies in previous high school football seasons while they have been at their current school. Using this statistic, the actual concussion rate for the 2014 high school football season can be reasonably estimated around 9-10 concussions/10,000 AEs. For reporting purposes, 8.36 concussions/10,000 AEs is the research result, because determining the exact rate cannot be done without additional research on teams' practice schedules and how far they advanced in the playoffs. For comparison, 2014 Iowa high school football concussion frequency is examined against previous high school football concussion rates as well as collegiate rates (Table 12).

Table 12 lists previously conducted research on concussion frequency in high school and collegiate football. All of the research projects were conducted on a range of 25 to 100 high schools or colleges (Committee on Sports-Related, 2013, p. 34-35; Gessel et al., 2007, p. 497; Guskiewicz et al, 2003, p. 2551; Marar et al., 2012, p.4).

Table 12 *Comparison of Football Concussion Frequencies per 10,000 Athletic Exposures*

	1999-2001 Guskiewicz et al.	2005 Gessel et al.	2008-09 Marar et al.	2010-11 CSRCY	2014 Felts
High School	-	4.7	6.4	11.2	8.36
Collegiate	8.1	6.1	-	6.3 (2009-12)	-

Several differences exist between the information gathered in the Table 12 and the survey of Iowa high school football coaches. All four of the previous studies used athletic trainers to record concussion data as the injuries occurred. While the Guskiewicz et al. (2003) study recorded a concussion as any brain injury showing at least one symptom, the other three studies required the individual to miss an athletic exposure to count as a concussion (Committee on Sports-Related, 2013; Gessel et al., 2007; Marar et al., 2012). A limitation of the 2014 Iowa high school football study is that coaches were asked at the end of the season to quantify the number of concussions. Without direct information from the medical personnel that diagnosed the concussion, the parameters of what defined a concussion reported by the coaches are not entirely clear.

In comparison to previous studies (Committee on Sports-Related 2013; Gessel et al., 2007; Guskiewicz et al, 2003; Marar et al., 2012), concussion frequency in Iowa during the 2014 high school football season appears to contradict the trend of continually increasing concussion rates at the high school football level. While the difference may be due to reporting error between coaches and athletic trainers, it may also suggest Iowa football players are experiencing concussions less frequently than the most recent national averages. Despite being limited to one state, the Iowa survey examined

significantly more high schools than any of the other listed studies. For example, the Gessel et al. (2007) and Marar et al. (2012) studies examined only 100 high schools, while Guskiewicz et al. (2000) researched 117 high schools. Even considering an estimated "true" frequency of 9-10 concussions/10,000 AEs, the concussion frequency rate is still slightly below current expected averages.

The information about concussions has grown exponentially in recent years. The increased concussion education can be partially attributed to the growth in football concussion frequency at the high school level (Edwards & Bodle, 2014). Gessel et al. (2007) discuss this phenomenon when they reported, "Educational campaigns, such as the…'Heads Up: Concussion in High School Sports' tool kit by the Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, have increased awareness of concussion symptoms among coaches, athletes, and parents" (p. 501). However, increasing education and better diagnostic techniques does not always mean injuries are occurring more frequently; instead, it can simply mean that they are being identified more often.

A rise in disease frequency without an actual incidence increase is called an artificial increase. Riegelman and Kirkwood (2014) stated criteria for such an increase should include, "1) Differences or changes in the interest in identifying the disease. 2) Differences or changes in the ability to identify the disease. 3) Differences or changes in the definition of the disease" (p. 25). Evaluating players during games can be difficult because of players' tendencies to hide or down play symptoms. The Committee on Sports-Related Concussions in Youth, (2013) reported, "66 percent [of players] said they did not report their symptoms because they did not think their injury was serious enough

to warrant medical attention" (p. 101). Until better detection techniques can be developed, fluctuations in concussion frequency cannot accurately determine whether the actual concussion rate is increasing. As consistent and more accurate reporting standards become established, fluctuations in concussion frequency can begin to be used for in-depth comparison of concussions rates. Current preventative measures may be lowering the actual frequency of concussion; however, as the ability to detect the injury increases, the preventive effects on the concussion rate will be difficult to establish.

In a comparison between high school and collegiate football concussion rates, research varies on which level has the higher reported rate (Committee on Sports-Related 2013; Gessel et al., 2007; Guskiewicz et al, 2003; Marar et al., 2012). Research which has determined that high school athletes have a higher frequency often associate such findings to poor preventative equipment and more playing time (Guskiewicz, Weaver, Padua, & Garrett, 2000). However, research suggesting higher rates in college attributes such findings to the more talented, bigger, and faster players at the collegiate level (Covassin, Swanik, & Sachs, 2003). Such inconsistent results may infer an incidence somewhere in the middle. While concussions at the high school level may be more prominent compared to other injuries, the speed of play at the collegiate level may increase other athletic injuries thus lowering the percentage of injuries that are concussions (Gessel et al., 2007). Until there are equal levels of diagnostic testing in both collegiate and high school football, the value of comparing frequencies will be limited.

Reported concussion frequencies widely vary between practice and game athletic exposures. Various studies have indicated that concussions generally occur at a

frequency of eight times greater during games than they do during practices. The college football studies in 1999, 2000, and 2001 by Guskiewicz et al. (2003) noted a practice frequency of only 4.7 concussions/10,000 AEs, while games were 38.1 concussions/10,000 AEs. The 2005 survey by Gessel et al. (2007) reported a rate of 2.1 concussions/10,000 AEs during practice, while the rate was 15.5 concussions/10,000 AEs during games. The 2008, 2009 studies by Marar et al. (2012) reported a practice frequency of 3.1 concussion/10,000 AEs, while games reported 22.9 concussions/10,000 AEs. Even though the conclusions between similar situation concussion rates are limited, the consistent relationship between practice and game rates is a viable statistic. One potential explanation of the difference is the speed and duration of the athletic exposures. Practices are typically conducted at a slower tempo with shorter contact periods than games (Guskiewicz et al., 2003). One limitation of the current survey of Iowa high school football coaches was the inability to gather separate concussion data between practices and games. To do so would require consistent reporting by coaches or medical personnel over the course of a season. Such investment in a research project might decrease the likelihood of receiving a high response rate. However, such an investment may yield results valuable enough to outweigh the potential of a decreased response rate.

Prevention

In terms of concussion prevention, helmets are an extremely important factor. The Committee on Sports-Related Concussions in Youth (2013) described the purpose of a helmet as, "designed to mitigate the likelihood of head injuries from an impact to the head by dissipating and distributing the energy of impact and protecting the head from penetration" (p. 239-240). While helmets cannot truly prevent a concussion, they can

assist in reducing the risk. Although the effectiveness of helmets in reducing concussions is an area of debate, helmets cannot function properly if they are not fitted correctly. The IHSAA website includes a list of proper helmet fitting techniques for coaches. All helmets used for play must meet the National Operating Committee on Standards for Athletic Equipment (NOCSAE) (IHSAA, 2015).

Research conducted on football helmet quality by Virginia Tech University through their biomedical engineering department is extremely well known. The department has developed Summation of Tests for the Analysis of Risk (STAR) ratings for 26 helmets which rate the number of concussions an individual should experience through one season wearing that helmet. The STAR rating is separated into categories labeling a helmet as 5 star (*best available*) to NR (*not recommend*) (Virginia Tech University, 2014). Creation of the rating involves concussion risk, distribution of head impacts, and the ability of the helmet to decrease linear acceleration. However, there are some limitations to these ratings. Concussions do not typically result solely from linear acceleration. Instead, it is a combination of linear and rotational acceleration in association with pressure gradients that create a concussion injury. Additionally, the risk is determined on a full season of impact at the collegiate football level limiting the significance at the high school level (Committee on Sports-Related, 2013). All helmets certified by NOCSAE assist in preventing concussions; the STAR rating only suggests which ones are better at doing so.

Respondents of the current Iowa coaches' survey indicated that Riddell, Schutt, Xenith, and SG helmets were all used as the primary helmet on a football team in the state of Iowa during the past season. An examination of helmets based on concussion

percentage yields no findings showing increased concussion frequency in a specific helmet. Outlier percentages must be discounted due to small sample size. When examining concussion percentage by helmet, it is critical to note that the coaches only listed the predominant helmet type used during the season. They did not indicate what type of helmet the individual was wearing when the concussion was sustained. For more accurate information, future studies could include documentation of the helmet brand and specific type worn during the injury.

Teams in Iowa during the 2014 football season predominately (72%) used a version of Riddell as their primary helmet. Virginia Tech's STAR ranking system lists six Riddell helmets with an average ranking of 4 stars. Schutt was the second most common helmet percentage (25.2%) used during the 2014 Iowa high school football season. Eight Schutt helmets earned an overall ranking of 3.625 stars in the Virginia Tech STAR ranking. Only six teams (2.4%) reported wearing primarily Xenith helmets for the 2014 season while one team (.4%) stated SG helmets were their primary choice. Four types of Xenith helmets were examined using the Virginia Tech STAR ranking with an average rating of 4.75 stars. Three SG helmets received an average rating of 4.67 stars in the Virginia Tech STAR ranking. While SG helmets are relatively new, they were also the most expensive helmet studied (Virginia Tech University, 2014). The Virginia Tech study notes three interesting points about SG helmets:

> 1) Permanent cracks were observed in the helmet padding for all tested SG helmets. 2) The lifespan of these helmets is slated as 2 years, which differs from the more common 10 year lifespan of most other helmets. 3) Sizing of this helmet is unique. (Virginia Tech University, 2014)

It is difficult to infer potential conclusions from helmets worn in the 2014 Iowa high school football season when a significant portion of coaches using Riddell's (38.4%) and

Schutt's (85.5%) did not identify the specific type. Although the STAR ranking system provides general helmet suggestions, further research should be conducted before a true recommendation on the best helmet types can be applied to high school teams.

Qualified Medical Personnel

In the 3A and 4A classifications, qualified medical personnel were available at almost all game contact exposures (95.7%). Additionally, the high percentage of medical personnel at 4A practices (92.9%) relieved medical responsibility from coaches and provides the players on-site evaluation. However, lack of qualified medical personnel at all contact exposures becomes a pressing concern as the size of the school decreases. This is to be expected based upon the typical location and funding of these school districts. There are two locations associated with the lack of medical personnel: practices and games. For smaller schools, having medical personnel at all practices is extremely difficult. From a funding perspective, it is justifiable to pay medical personnel once or twice every other week for a home football game. However, it is much more difficult budget medical personnel for practice every day in addition to the games. Because many smaller school districts are located in smaller towns, the medical professional may have to travel to attend practice. As many coaches indicated, medical personnel availability is also a major hurdle for not having these individuals at practice.

Some coaches indicated that having these individuals at practice was unnecessary (23, 11.0%). In absence of qualified medical personnel, coaches are entrusted with the responsibility to detect concussion symptoms if they occur and remove the individual from play (Committee on Sports-Related, 2013). Concussions occur at a significantly less frequent rate during practices in comparison to games. When funding is limited, it

may be hard to justify spending money on medical personnel at practice when coaches have proven they are capable of detecting the few concussions which have occurred during practice. As long as a school district feels that adequate detection of symptoms is occurring, they may feel the money can be better utilized in other areas.

The lack of medical personnel at games is more concerning than lack of medical personnel at practices largely since concussions occur more frequently during games. However, the reasons for not having these individuals available at games appear to be the same reasons they aren't available during practices: availability of medical personnel and funding. With 170 football games every Friday night during the regular season, schools are asking 170 medical personnel to work extra hours in addition to a normal work week. For schools in large cities, finding medical personnel may not be as much of a problem considering the short travel distance and the possibility the individual may attend the game anyhow. For schools in small towns, the medical personnel may have to travel farther which increases the time commitment. This is noticeable when examining the types of medical personnel used at contact exposures. In large towns where physicians are more common, the physicians are more frequently used as medical personnel during contact exposures. However in small towns, EMTs may be the only medical personnel in the entire town. If an emergency arises or an individual is sick, there is no longer anyone available for the game.

With a small school district, limited funding can place constraints on hiring individuals as medical personnel during all games. Schools appear to be doing an excellent job with medical personnel availability at home varsity games (237, 96.7%). However, this percentage should be 100% considering these are the longest, most

important, and highest concussion frequency athletic exposures on a team's schedule. If schools are having trouble finding medical personnel or funding for varsity games, it seems even less likely they will be able to hire these individuals for junior varsity, freshman, and even junior high games.

Lack of medical personnel at games places an enormous burden on coaches. Coaching football is a fast paced and emotional roller coaster. This challenge becomes even greater as the school size decreases, because the number of coaches decreases with size. It can be difficult for coaches to recognize concussion symptoms during the busy game atmosphere. However, coaches are told "when in doubt, sit them out" (Committee on Sports-Related, 2013). These precautions are particularly important because of the threat of SIS. The dilemma is that any player who is suspected of having concussion symptoms must be cleared by qualified medical personnel before they can re-enter the game. If no medical personnel are available, the player must sit out until they can visit one (Committee on Sports-Related, 2013). To avoid withholding non-concussed players from games, a coach must be extremely well educated in concussion symptoms. While trained professionals can struggle to determine concussion symptoms, coaches have to do so while also trying to coach a football game. Available qualified medical personnel at all games essentially eliminate this difficult challenge for a coach. If a coach has any suspicions, the player can easily be directed to the available medical personnel for evaluation, and the coach can continue to focus on their coaching responsibilities

Concussion Education

While qualified medical personnel should ideally be available at all athletic exposures, the feasibility of doing so seems limited. Coaches are entrusted with detecting

signs of concussions in these situations. Due to differences in medical personnel availability, coaches in smaller classifications have to detect concussion signs more frequently than coaches in the larger classifications. Based upon survey results, coaches feel that they are well educated on the topic area (*M* = 3.99, *4 = Above Average)*. However, a study of athletic trainers associated football teams in Texas reported that the trainers believe coaches could not recognize concussion symptoms (Miller & Ammon, 2014).While this is an area of subjective opinion, future research could evaluate the ability of football coaches to detect signs of a concussion.

Beginning in the 2014 season, all Iowa high school football coaches were required to complete the National Federation of State High School Associations (NFHS) course, "Concussions in Sports" (IHSAA, 2015). This educational opportunity may have contributed to the confidence Iowa football coaches have in their knowledge regarding concussions. The IHSAA website contains a variety of different documents regarding concussions. Possessing easily accessible and important information on the topic can make the challenging decisions easier which is the entire goal. However, the large quantity of different documents on the webpage make finding the desired relevant information challenging.

It was surprising that coaches feel that their team did not experience undiagnosed concussions in the 2014 season (*M* =1.68, *1 = Strongly Disagree*, *2 = Disagree)*. Although giving players more information on concussions can make them more likely to identify concussion symptoms, it may also contribute to them trying to hide concussion symptoms. A player who knows the symptoms of a concussion may be able to infer they have experienced a concussion and understands they will be forced to sit out the rest of

the game if someone notices. Instead of reporting the symptoms as they should, the players may try to hide the symptoms and avoid coaches/medical personnel so that they can continue playing. This makes it extremely difficult to predict the actual concussion rates, because players aren't always completely honest when the topic relates to a potential concussion injury. Gessel et al. (2007) reported a study in which only 47.3% of football players who experienced a concussion actually reported the symptoms. Additionally, it is perhaps even more shocking that the majority of Iowa high school football coaches disagreed (*M = 2.59, 2 = Disagree, 3 = Neutral)* that players would hide concussion symptoms because they knew they could miss playing time. Current research in this area indicates extremely different results. The Committee on Sports-Related Concussions in Youth, (2013) notes a study where, "41 percent of subjects reported not wanting to leave the game as their reason for not reporting a possible concussion" (p. 101).

The majority of coaches associated concussions with single, large impacts (174, 70.7%). This may help to explain the selections of offensive and defensive lineman as the least likely positions (*M = 3.27 & 3.31)* to receive concussions. Current research suggests that offensive and defensive lineman actually experience head impacts more frequently than any other position group (Martini et al., 2013). Concussion rates between position groups are an area of debate. Some research indicates that running backs and linebackers are the most likely positions to receive a concussion (Gessel et al., 2007). Other research indicates only a weak association between position played and frequency of concussions (Guskiewicz et al., 2003). Further research is necessary to examine the types of forces experience by different positions and the frequency in which they occur.

Recommendations

In 2012, the state of Iowa adopted a variety of changes regarding the two weeks of pre-season practice. These changes eliminated "two-a-day" practices and changed the dates for full contact practices. Teams are given two weeks of pre-season practices before the first game week (assuming week one start). Previously, teams were allowed "two-a-day" practices for the first pre-season practice week from Monday through Friday. Full contact practices could start on Thursday of the first week, and practice was not allowed on Saturday. The following week, teams were allowed one practice a day and could practice from Monday through Saturday at full contact.

Currently, teams are only allowed 12 pre-season practice dates with a maximum of three hours of physical activity. The first two days are helmets only while days three through five include helmets and shoulder pads with form tackling contact. Full contact practices can start on the first Saturday and continue from Monday through Saturday on the next week. Teams are now allowed to scrimmage another team on the Friday of the second week. The changes eliminated three days of full contact practice, eliminated four total days of practice, and added a potential scrimmage date against another team. In the spring of 2015, the IHSAA instituted changes to the amount of contact during a week of practice excluding the second week of the pre-season. Teams are allowed only 90 minutes of "engagement" per week with a maximum of 30 minutes per day. "Engagement" is classified as "thud" or "live action" per definitions by USA Football (IHSAA, 2015).

To assist in increasing concussion prevention and education, coaches recommended additional tackling technique training as the number one suggestion (73,

29.7%). With the new changes to pre-season practice scheduling, more practices were allotted with a non-live "form tackling" emphasis. However, it appears some coaches desire more full contact practice time with three coaches who gave additional suggestions requesting additional practice time (13.6%). The dilemma with increased full contact practices is the increased concussion risk. Particularly with individuals who have learned poor technique, it can take significant practice time to correct the form before it is translated to games. Like many activities, correct form is possible when consciously acknowledging the technique; the difficulty is making such a process automatic during game action. If teams were allowed more contact practices, there would be more full speed teaching opportunities on tackling technique. These teachings would ideally carry-over to games and decreases concussion frequency during games. However, such correlations are only an assumption and research should be conducted to study such associations. Although coaches want increased practice time, it is not entirely clear if this is truly for additional tackling technique training or simply an opportunity for extra contact repetitions.

One coach expressed concern over the expanded playoff system. Despite reducing the number of contact practices during the pre-season, adding another playoff game has eliminated the benefit gained in terms of concussion rate. Because concussions occur during games almost eight times more frequently than during practice, eight practices would need to be eliminated to equal an extra game in relation to concussion rate. With another playoff game, there are additional practices and shorter player recovery times between games.

There was a strong opposition from coaches toward rule changes in relationship to concussion prevention (98, 39.8%). The coaches felt the correct rules are in place, but the enforcement of the rules is where the system is lacking. They believed by enforcing the rules correctly, players would be forced to use the proper tackling technique they are taught during practice. Even if the players are not being taught the proper technique during practice, properly enforcing the rules would require these coaches to teach the correct tackling form.

CHAPTER SIX

Recommended Plan of Action

Based upon the survey results and additional literary research, a recommended plan of action for the IHSAA was created. The goal of the plan of action is to assist in making the game of football safer by increasing concussion prevention, education, and detection. In relationship to class sizes, the IHSAA should explore the possibility of expanding the BEDS limit for the 8-man classification. Doing so may put smaller class A schools into a type of play more adequately suited for their team size. Studies on BEDS number to team size ratio research should be conducted for additional information regarding this decision.

In regard to increasing pre-season practices, "two-a-days" should be reinstated for the first week of pre-season. Only helmets would be allowed on Monday and Tuesday, shoulder pads would be allowed starting Wednesday morning, and full contact may be held in the afternoon on Thursday and Friday. Saturday would be an off day. Doing so would provide more practice time for teams prior to their first game and fulfill some coaches' request for additional practice time (3, 13.6%). Coaches should be encouraged to hold practices in the early morning and late afternoon to avoid the heat of the day. As always, the heat index chart should be referenced when in doubt. Additionally, the ability to scrimmage another school in the pre-season should be eliminated since high concussion rates are associated with games. Instead, teams should have the ability to hold a joint practice with another school where both fundamental

instruction and full contact sessions could be utilized. It is unnecessary to add another "game" to the schedule considering the concussion frequency associated with games.

The first round of the state playoff system should be eliminated. With over 50% of teams in each class qualifying, the majority of the state is experiencing another game worth of head exposures in addition to the extra practices and shortened rest periods between games. An alternative option to eliminating the first round of the state playoffs is to eliminate a non-district football game. Doing so would restore "normal" game weeks throughout the duration of the playoffs.

Although there are a variety of rating systems for football helmet quality, all have been certified by NOCSAE. More important than the subjective quality rating of the helmet is the proper fitting of the helmet. It is recommended that the state of Iowa create a short video for football coaches properly explaining the correct way to fit a player for a helmet. The video should be short enough to keep coaches' attention, but long enough to explain all of the proper steps in a clear and concise manner. Additionally, coaches should be sent yearly reminders to continually incorporate neck muscle exercises in their weight lifting regime.

A major concern for coaches was the enforcement of rules associated with head injury including targeting, helmet-to-helmet contact, spearing, ramming, and butting. Although this has been a point of emphasis in past seasons, coaches still do not feel that it is being enforced properly (6, 27.2%). Communication needs to take place with officials and the head of officiating to ensure the penalties are being called correctly. Additionally, all coaches should be surveyed every year on potential rule changes or

suggestions for implementation. No process is every perfect; receiving additional feedback can only enhance the experience for administrators, coaches, players, and fans.

To assist in increasing player education on concussion, the Centers for Disease Control and Prevention fact sheet on concussion from the IHSAA website should be printed and placed in locker rooms used by the football team as a constant reminder. Lack of medical personnel is resulting in coaches having to determine if players are experiencing concussion symptoms. Despite the difficult position, the objective is to simplify the process for the coaches as much as possible. While the IHSAA website contains a wide variety of information, it is dispersed in a variety of documents. A simplified coach's guide to concussions should be created as an easy, single point access resource for all high school coaches. This document should be easy to follow and simplified to remove ambiguity. It should include the most pertinent information on concussion prevention, detection, and management that coaches will be working with most frequently. While a coach's guide already exists on the IHSAA, it is not user-friendly and lacks important information available in other documents on the website.

Finally, the IHSAA should develop and initiate a long-term study with qualified medical personnel and coaches detailing concussion frequency, concussion location (practice/game), and team practice formats for season. This study can be used to help more accurately determine the concussion frequency for the state of Iowa as well as determining when concussions are happening most frequently. Additionally, use of practice time by coaches can be analyzed to assist in developing the best pre-season practice strategy for preparation and safety of the players. Although convincing individuals to maintain participation in the survey will be challenging, the results

obtained can only assist in helping to make football in the state of Iowa safer and better. Development of this survey can also be shared with other state athletic associations to address the study in high school football over various states in the United States. The study will allow for a comparison of what the IHSAA is currently doing well and also areas of improvement.

CHAPTER SEVEN

Perspective

Despite the competitive nature of football, it is important for the coaches, players, fans, and administrators to all remember that it is just a game. For the majority of high school football players, their playing career will not continue at the collegiate level (Martini et al., 2013). No victory is worth sacrificing the future of a young athlete. Generally speaking, coaches denied (M = 1.48) being tempted to re-enter a player into a game who shown signs of a concussion (*1= Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).* While many coaches also denied (M = 1.87) being pressured by parents to re-enter an individual back into the game, 15% of coaches felt they had been pressured by parents. Although some parents and coaches can get caught up in the "heat of the moment," no individual should ever return to the game that is experiencing concussion symptoms. While victory in that particular game may seem like the most important thing in the world, there are always going to be things more important than a football game.

Many parents debate whether to allow their child to participate in football because of the potential risks involved. This is reasonable concern with the increasing amount of information available on the risks associated with football. Even though injuries will always be involved in the sport, the game of football is more than wins and losses; it is about developing these young individuals into better members of society. Coaches are in a position of enormous influence. They have the ability to teach attributes such as discipline, work ethic, and commitment. While those may seem important

characteristics on the football field, they are even more important in life. Everyone who has played football enjoys something different about the experience. Some individuals enjoy the comradery among teammates. Others enjoy the thrill of excelling underneath the lights on a Friday night. Despite individual differences, there is something special about the bond built between teammates over the course of a football season.

Even though the risk of another concussion may seem worth the price of victory, it is up to the coaches to protect their athletes. Teammates help each other and protect others from harm. While the player may not agree with the decision, they will appreciate others being concerned about their health. It can be difficult as a coach knowing that the "star" player potentially has a concussion, particularly in a big game. However if the player is not removed from the game, one additional head impact could have a lethal ending. This is one of the primary reasons why so much effort and energy has been invested into concussion prevention, education, and management. Most individuals who are trying to assist with changes to football love the sport. The reason they are doing what they are doing is because they want to protect the future of the sport. Regardless of the excitement and thrills a sport brings, it cannot be continued if the medical risks are too great.

CHAPTER EIGHT

Conclusion

In conclusion, a purposeful and direct plan of action has been developed to assist in increasing concussion prevention, education, and detection to the highest levels possible. After initially establishing the physiology of a concussion, the materials and methods of the survey of Iowa high school football coaches in 2014 were discussed. Following the introduction to the survey, the results were analyzed. Next, a discussion resulted from the areas of focus during the survey. First, the demographics of the survey were examined. Second, concussion frequency was analyzed. Third, concussion prevention by helmets was investigated. Fourth, the availability of medical personnel during all contact exposures was explored. Fifth, concussion education of players and coaches was pondered. Finally, a perspective on the game of football was discussed.

Despite the challenges of decreasing concussion frequency in high school football players, it can be accomplished. However, there is not a one-step magic solution. Small improvements in a variety of areas can have a large impact over time. By starting the initial process, the IHSAA can become a leading state association for increasing concussion prevention, education, and management. Despite the frequent contact in the game of football, concussions in the sport can be lowered to levels similar to those in other sports. Initial progress in lowering the frequency is promising; however, better rates can always be accomplished. Expansive research and publications regarding concussions in football show that individuals truly do care about the future of the sport. The game of football has provided individuals from all demographics something truly

special. By continuing to work towards greater safety while still maintaining the game individuals love, the future of the sport can be preserved for all future generations.

APPENDICES

APPENDIX A

Full Survey Results

1. In which football classification did your team compete in the 2014 season?

*Response Rates by Classification**

	8-Man	A	1A	2A	3A	4A
Responses	36/64 (56.3%)	42/62 (67.7%)	43/56 (76.8%)	46/56 (82.1%)	51/56 (91.7%)	28/46 (60.9%)
Overall %	14.6	17.1	17.5	18.7	20.7	11.4

*N = 246

2. How many players were on your team in the 2014 season? (Combine varsity, junior varsity, and freshman teams)

*Team Size Combining Varsity, Junior Varsity, and Freshman Teams**

	8-Man	A	1A	2A	3A	4A	Overall
Average	29	39	48	59	82	119	60
Range	15-45	19-63	29-72	38-117	45-150	60-200	15-200

*N = 246

3. How many years have you coached football as either an assistant or head coach?

*Coaching Experience in Years**

	0-5	6-10	11-15	16-20	21-25	26+
Responses	24 (9.7%)	40 (16.3%)	49 (19.9%)	32 (13.0%)	44 (17.9%)	57 (23.2%)

*N = 246

4. What kind of helmet does your team use most frequently?

*Most Common Helmet by Team in the 2014 Season**

	Riddell	Schutt	Xenith	SG
Teams	177 (72.0%)	62 (25.2%)	6 (2.4%)	1 (0.4%)
Concussions	578	157	22	0
Players	11,153	3,290	249	30
Concussion %	5.2%	4.8%	8.8%	0%

*N = 246

*Types of Riddell Helmets Worn by Team in the 2014 Season**

	Unspecified	Revo.*	Revo.* Speed	360	IQ
Teams	68 (27.8%)	26 (10.6%)	69 (28.0%)	11 (4.5%)	3 (1.2%)
Concussions	236	94	210	31	7
Players	4,275	1,872	4,162	617	227
Concussion %	5.5%	5.0%	5.0%	5.0%	3.1%

*N = 177, Revo. = Revolution

*Types of Schutt Helmets Worn by Team in the 2014 Season**

	Unspecified	DNA	Air Adv.	Ion	Veng.*	XP Pro
Teams	53 (21.6%)	5 (2.0%)	1 (.4%)	1 (.4%)	1 (.4%)	1 (.4%)
Concussions	145	8	3	0	0	1
Players	2,913	203	31	55	55	33
Concussion %	5.0%	3.9%	9.7%	0.0%	0.0%	3.0%

*N = 62, Veng. = Vengeance

Note: For questions 5-15, qualified medical personnel are considered as: Physicians (MD/DO), Physician Assistants (PA), Nurse Practitioners (NP), Physical Therapists (PT), Chiropractors, Athletic Trainers (ATC or LAT), Nurses, or EMTs.

5. How many of your players were medically diagnosed with a concussion by qualified medical personnel in the 2014 season?

Medically Diagnosed Concussions in the 2014 Iowa HS Football Season

	8-Man	A	1A	2A	3A	4A	Total
Average	1.3	1.9	2.6	2.6	5.1	4.8	3.1
Range	0-6	0-8	0-12	0-10	0-14	0-20	0-20
Concussion #	48	78	111	124	261	134	757
# of Players	1,014	1,624	2,048	2,660	4,166	3,210	14,722
Concussion %	4.73	4.80	5.42	4.66	6.27	4.21	5.15
Highest %	26.7	21.5	18.5	13.9	16.0	14.7	
Highest Ratio	4 in 15	8 in 38	12 in 65	10 in 72	12 in 75	14 in 95	

*N = 246

6. How many times did you or a member of your coaching staff try to determine if a player was experiencing concussion symptoms this past season during games or practices?

*Frequency of Concussion Symptom Evaluations by Coaches**

	8-Man	A	1A	2A	3A	4A	Total
Average	3.5	2.7	4.2	6.4	6.4	4.9	4.8
Range	0-15	0-11	0-15	0-110	0-All Plays	0-50	0-All Plays
Total #	126	112	181	293	327	138	1,177
# of Players	1,014	1,624	2,048	2,660	4,166	3,210	14,722
Incident %	12.4	6.9	8.8	11.0	7.8	4.3	8.0

*N = 246

7. To the best of your knowledge, how many concussions on average has your team experienced in past seasons?

*Average Concussion Frequency in Previous Iowa HS Football Seasons**

	8-Man	A	1A	2A	3A	4A	Total
Average	2.1	2.4	2.7	3.2	4.3	4.7	3.2
Range	0-9	0-8	1-10	0-10	1-12	0-20	0-20
Total #	77	102.5	116	146	219	132	792.5
# of Players	1,014	1,624	2,048	2,660	4,166	3,210	14,722
Concussion %	7.6	6.3	5.7	5.5	5.3	4.1	5.4

*N = 246

8. In which grade level range(s) did your team experience the most concussions? Check all that apply.

*Grade Levels Experiencing the Most Concussions**

	Freshman	Sophomore	Junior	Senior	Overall
Responses	26.6% (92)	28.9% (100)	26.3% (91)	18.2% (63)	346

*N = 246

9. State your agreement with the following statement: My team experienced additional concussions this past season which were not properly diagnosed.

*Improper Concussion Diagnosis – Coaches' Opinion**

	Rating Average	Strongly Disagree = 1	Disagree = 2	Neutral = 3	Agree = 4	Strongly Agree = 5
Overall	1.68	55.3% (136)	27.6% (68)	12.2% (30)	3.7% (9)	1.2% (3)
8-Man	1.53	61.1% (22)	25.0% (9)	13.9% (5)	0.0% (0)	0.0% (0)
A	1.57	61.9% (26)	21.4% (9)	14.3% (6)	2.4% (1)	0.0% (0)
1A	1.74	51.2% (22)	32.5% (14)	9.3% (4)	4.7% (2)	2.3% (1)
2A	1.57	56.5% (26)	32.6% (15)	8.7% (4)	2.2% (1)	0.0% (0)
3A	1.71	56.9% (29)	23.5% (12)	13.7% (7)	3.9% (2)	2.0% (1)
4A	2.07	39.3% (11)	32.1% (9)	14.3% (4)	10.7% (3)	3.6% (1)

*N = 246

10. State your agreement with the following statement: Players try to hide concussion symptoms to avoid missing time on the field.

*Hiding Concussion Symptoms – Coaches' Opinion**

	Rating Average	Strongly Disagree = 1	Disagree = 2	Neutral = 3	Agree = 4	Strongly Agree = 5
Overall	2.59	18.7% (46)	32.5% (80)	21.6% (53)	25.6% (63)	1.6% (4)
8-Man	2.86	13.9% (5)	27.8% (10)	19.4% (7)	36.1% (13)	2.8% (1)
A	2.29	28.6% (12)	33.4% (14)	19.0% (8)	19.0% (8)	0.0% (0)
1A	2.60	13.9% (6)	41.9% (18)	16.3% (7)	25.6% (11)	2.3% (1)
2A	2.61	17.4% (8)	28.3% (13)	30.4% (14)	23.9% (11)	0.0% (0)
3A	2.63	15.7% (8)	35.3% (18)	21.6% (11)	25.4% (13)	2.0% (1)
4A	2.57	25.0% (7)	25.0% (7)	21.4% (6)	25.0% (7)	3.6% (1)

*N = 246

11. For the following locations, are qualified medical personnel available who can medically diagnose a concussion?

*Medical Personnel Availability at All Home Varsity Games**

	Yes	No	N/A
Overall	96.7% (237)	3.3% (8)	1
8-Man	97.2% (35)	2.8% (1)	0
A	92.7% (38)	7.3% (3)	1
1A	95.3% (41)	4.7% (2)	0
2A	95.7% (44)	4.3% (2)	0
3A	100.0% (51)	0.0% (0)	0
4A	100.0% (28)	0.0% (0)	0

*N = 246

*Medical Personnel Availability at All Home Junior Varsity Games**

	Yes	No	N/A
Overall	68.6% (164)	31.4% (75)	7
8-Man	45.5% (15)	54.5% (18)	3
A	50.0% (20)	50.0% (20)	2
1A	60.5% (26)	39.5% (17)	0
2A	67.4% (31)	32.6% (15)	0
3A	90.0% (45)	10.0% (5)	1
4A	100.0% (27)	0.0% (0)	1

*N = 246

*Medical Personnel Availability at All Home Freshman Games**

	Yes	No	N/A
Overall	71.4% (137)	28.6% (55)	54
8-Man	36.8% (7)	63.2% (12)	17
A	42.1% (8)	57.9% (11)	23
1A	58.8% (20)	41.2% (14)	9
2A	68.3% (28)	31.7% (13)	5
3A	92.2% (47)	7.8% (4)	0
4A	96.4% (27)	3.6% (1)	0

*N = 246

*Medical Personnel Availability at All Practices**

	Yes	No	N/A
Overall	33.8% (81)	66.2% (159)	6
8-Man	8.6% (3)	91.4% (32)	1
A	17.5% (7)	82.5% (33)	3
1A	14.3 % (6)	85.7% (36)	1
2A	31.8% (14)	68.2% (30)	2
3A	49.0% (25)	51.0% (26)	0
4A	92.9% (26)	7.1% (2)	0

*N = 246

12. If you answered "no" to any of the four locations in question 11, please select a reason(s) why. Check all that apply.

(MP = Lack of Medical Personnel. F = Lack of Funds. U = Unnecessary to have. D = Do not know. O= Other)

*Lack of Medical Personnel at All Home Varsity Games Explanation**

	MP	F	U	D	O
Overall	41.6% (5)	16.7% (2)	8.3% (1)	16.7% (2)	16.7% (2)
8-Man	0.0% (0)	0.0% (0)	100.0% (1)	0.0% (0)	0.0% (0)
A	40.0% (2)	0.0% (0)	0.0% (0)	40.0% (2)	20.0% (1)
1A	50.0% (1)	50.0% (1)	0.0% (0)	0.0% (0)	0.0% (0)
2A	50.0% (2)	25.0% (1)	0.0% (0)	0.0% (0)	25.0% (1)
3A	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)
4A	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)

*N = 8

*Lack of Medical Personnel at All Home Junior Varsity Games Explanation**

	MP	F	U	D	O
Overall	43.4% (40)	37.0% (34)	2.2% (2)	12.0% (11)	5.4% (5)
8-Man	45.9% (11)	33.3% (8)	4.2% (1)	8.3% (2)	8.3% (2)
A	37.0% (10)	37.0% (10)	0.0% (0)	18.6% (5)	7.4% (2)
1A	50.0% (8)	31.3% (5)	0.0% (0)	18.7% (3)	0.0% (0)
2A	55.0% (11)	40.0% (8)	0.0% (0)	0.0% (0)	5.0% (1)
3A	0.0% (0)	60.0% (3)	20.0% (1)	20.0% (1)	0.0% (0)
4A	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)

*N = 75

*Lack of Medical Personnel at All Home Freshmen Games Explanation**

	MP	F	U	D	O
Overall	44.8% (34)	27.6% (21)	3.9% (3)	9.2% (7)	14.5% (11)
8-Man	50.0% (8)	25.0% (4)	6.3% (1)	0.0% (0)	18.7% (3)
A	33.3% (7)	23.8% (5)	4.8% (1)	14.3% (3)	23.8% (5)
1A	46.7% (7)	20.0% (3)	0.0% (0)	20.0% (3)	13.3% (2)
2A	57.9% (11)	36.8% (7)	0.0% (0)	0.0% (0)	5.3% (1)
3A	0.0% (0)	50.0% (2)	25.0% (1)	25.0% (1)	0.0% (0)
4A	100.0% (1)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)

*N = 55

*Lack of Medical Personnel at All Practices Explanation**

	MP	F	U	D	O
Overall	33.8% (71)	38.1% (80)	11.0% (23)	11.4% (24)	5.7% (12)
8-Man	39.5% (17)	34.9% (15)	16.3% (7)	7.0% (3)	2.3% (1)
A	39.0% (16)	31.7% (13)	12.2% (5)	9.8% (4)	7.3% (3)
1A	25.0% (10)	17.5% (17)	10.0% (4)	12.5% (5)	10.0% (4)
2A	38.8% (19)	40.9% (20)	12.2% (6)	6.1% (3)	2.0% (1)
3A	25.7% (9)	40.0% (14)	2.9% (1)	22.9% (8)	8.5% (3)
4A	0.0% (0)	50.0% (1)	0.0% (0)	50.0% (1)	0.0% (0)

*N = 159

13. If you selected "other" for any of the responses in question 12, please explain your response for each "other".

Some “Other” answers were used for more than one situation (game/practice)

a. “Trainers can’t make all practices.”
b. “I have inquired with administration about having it required to have a medical personnel at each home game for football, no matter the level including junior high.”
c. “Our administration has failed to contact a hospital or clinic for a person to be on our sidelines during games. We [have] EMT's at the games, but no athletic trainer.”
d. “We share a trainer with another school and she splits her time between the 2.”
e. “A trainer comes every Wednesday and is available whenever I need to call him.”
f. “Coaches have phones to call medical personnel.”
g. “One varsity coach is a doctor”
h. “I do not know the specific contract details between the school and hospital.”
i. “Trainer is at the beginning of practice in training room for athletes of all sports, then come to practice but does not stay for the whole practice, coaches will refer any athletes the next day to trainer to be [assessed] for last practice if any signs of concussion during practice after they left.”

14. Which types of qualified medical personnel are available at your home games? Choose all that apply.

*Types of Medical Personnel at Home Games**

	Overall	8-Man	A	1A	2A	3A	4A
Physician	19.4% (104)	7.3% (4)	13.9% (13)	15.1% (13)	21.0% (21)	21.7% (28)	33.3% (25)
Athletic Trainer	36.0% (194)	31.0% (17)	38.3% (36)	36.1% (31)	40.0% (40)	33.3% (43)	36.0% (27)
Physical Therapist	9.1% (49)	3.6% (2)	3.2% (3)	12.8% (11)	7.0% (7)	14.7% (19)	9.4% (7)
Physician Assistant	2.4% (13)	1.8% (1)	2.1% (2)	2.3% (2)	1.0% (1)	4.7% (6)	1.3% (1)
Nurse Practitioner	1.3% (7)	3.6% (2)	2.1% (2)	0.0% (0)	2.0% (2)	0.8% (1)	0.0% (0)
EMT	22.3% (120)	40.0% (22)	28.7% (27)	23.3% (20)	16.0% (16)	17.1% (22)	17.3% (13)
Nurse	1.7% (9)	0.0% (0)	3.2% (3)	2.3% (2)	2.0% (2)	1.5% (2)	0.0% (0)
Chiropractor	6.9% (37)	5.5% (3)	8.5% (8)	8.1% (7)	9.0% (9)	6.2% (8)	2.7% (2)
None	0.6% (3)	3.6% (2)	0.0% (0)	0.0% (0)	1.0% (1)	0.0% (0)	0.0% (0)
Other	0.6% (3)	3.6% (2)	0.0% (0)	0.0% (0)	1.0% (1)	0.0% (0)	0.0% (0)

*N = 246

15. Which types of qualified personnel are available at your practices? Choose all that apply.

*Types of Medical Personnel at Practices**

	Overall	8-Man	A	1A	2A	3A	4A
Physician	0.4% (1)	0.0% (0)	0.0% (0)	0.0% (0)	2.0% (1)	0.0% (0)	0.0% (0)
Athletic Trainer	37.8% (99)	2.7% (1)	25.5% (12)	18.2% (8)	47.0% (24)	52.8% (28)	86.6% (26)
Physical Therapist	4.2% (11)	2.7% (1)	0.0% (0)	4.5% (2)	3.9% (2)	7.5% (4)	6.7% (2)
Physician Assistant	0.4% (1)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	1.9% (1)	0.0% (0)
Nurse Practitioner	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)
EMT	3.0% (8)	8.1% (3)	4.3% (2)	0.0% (0)	3.9% (2)	1.9% (1)	0.0% (0)
Nurse	0.4% (1)	0.0% (0)	0.0% (0)	2.3% (1)	0.0% (0)	0.0% (0)	0.0% (0)
Chiropractor	0.8% (2)	0.0% (0)	2.1% (1)	0.0% (0)	2.0% (1)	0.0% (0)	0.0% (0)
None	47.3% (124)	81.1% (30)	57.4% (27)	70.5% (31)	31.4% (16)	34.0% (18)	6.7% (2)
Other	5.7% (15)	5.4% (2)	10.7% (5)	4.5% (2)	9.8% (5)	1.9% (1)	0.0% (0)

*N = 246

Game Other

a. 8-Man Other - “We have parents that are nurses that can come look if need be.”
b. A Other - “Physicians & PA attend as dad/fan, but are willing to help if requested”
c. 2A Other - “Some parents work in medical field and assume the position” “We have EMT at our games, but they don't come to the sideline to diagnose the concussions.” “In the crowd or on the sidelines we usually have one or more of the above.”

Practice Other

a. 8-Man Other - “All Coaches”; “The EMT is occasionally at practice.”
b. A Others - “We have a chiropractor and ATC on call if needed and they are available.”; “Coach is science/PE.”; “Athletic trainer for first half of practice”; “ATC comes once a week to practice”; “Our trainer is not able to make it to every practice. They are present for 50% of our practices.”
c. 1A Other - “once a week”; “Coaches have phones to call medical personnel”
d. 2A Other - “1 coach”; “ATC not all the time, He splits his time at multiple schools”; “We have a Trainer 2 days a week at practice.”; “Athletic Trainer is available for pre-practice and available by phone during practice.”; “Athletic Trainer is available if coaches contact him but is not at every practice”
e. 3A Other - “ATC - visits us at the start of practices two times a week for us to check on injury or follow up as needed.”

16. How would you rate your education level on concussions?

*Coaches' Concussion Education Level by Class**

	Rating Average	Minimal = 1	Below Average = 2	Moderate = 3	Above Average = 4	Excellent = 5
Overall	3.99	0.0% (0)	0.8% (2)	18.3% (45)	61.8% (152)	19.1% (47)
8-Man	3.89	0.0% (0)	0.0% (0)	27.8% (10)	55.6% (20)	16.6% (6)
A	4.14	0.0% (0)	2.4% (1)	7.1% (3)	64.3% (27)	26.2% (11
1A	3.84	0.0% (0)	2.3% (1)	18.6% (8)	72.1% (31)	7.0% (3)
2A	3.91	0.0% (0)	0.0% (0)	21.7% (10)	65.2% (30)	13.1% (6)
3A	3.98	0.0% (0)	0.0% (0)	23.5% (12)	54.9% (28)	21.6% (11)
4A	4.29	0.0% (0)	0.0% (0)	7.2% (2)	57.1% (16)	25.7% (10)

*N = 246

*Coaches' Concussion Education Level by Experience**

	Rating Average	Minimal = 1	Below Average = 2	Moderate = 3	Above Average = 4	Excellent = 5
Overall	3.99	0.0% (0)	0.8% (2)	18.3% (45)	61.8% (152)	19.1% (47)
1-5	3.88	0.0% (0)	0.0% (0)	33.3% (8)	45.9% (11)	20.8% (5)
6-10	3.83	0.0% (0)	2.5% (1)	22.5% (9)	65.0% (26)	10.0% (4)
11-15	3.92	0.0% (0)	0.0% (0)	24.0% (12)	60.0% (30)	16.0% (8)
16-20	4.10	0.0% (0)	0.0% (0)	12.9% (4)	64.5% (20)	22.6% (7)
21-25	4.11	0.0% (0)	0.0% (0)	6.8% (3)	75.0% (33)	18.2% (8)
26+	4.07	0.0% (0)	1.8% (1)	15.8% (9)	56.1% (32)	26.3% (15)

*N = 246

17. How confident are you trying to determine whether a player is experiencing concussion symptoms?

*Coaches' Confidence by Class in Determining Concussion Symptoms**

	Rating Average	No Confidence =1	Minimal = 2	Moderate = 3	High = 4	Complete Confidence = 5
Overall	3.81	0.0% (0)	3.3% (8)	27.8% (68)	54.3% (133)	15.1% (37)
8-Man	3.89	0.0% (0)	0.0% (0)	25% (9)	61.1% (22)	13.9% (5)
A	3.79	0.0% (0)	2.4% (1)	35.7% (15)	42.9% (18)	19.0% (8)
1A	3.56	0.0% (0)	9.3% (4)	32.6% (14)	51.1% (22)	7.0% (3)
2A	3.67	0.0% (0)	2.2% (1)	37.0% (17)	52.1% (24)	8.7% (4)
3A	3.90	0.0% (0)	3.9% (2)	17.6% (9)	62.7% (32)	15.7% (8)
4A	4.18	0.0% (0)	0.0% (0)	14.3% (4)	53.6% (15)	32.1% (9)

*N = 246

Coaches' Confidence by Experience in Determining Concussion Symptoms

	Rating Average	No Confidence =1	Minimal = 2	Moderate = 3	High = 4	Complete Confidence = 5
Overall	3.81	0.0% (0)	3.3% (8)	27.7% (68)	54.1% (133)	15.0% (37)
1-5	3.79	0.0% (0)	0.0% (0)	37.5% (9)	45.8% (11)	16.7% (4)
6-10	3.73	0.0% (0)	2.5% (1)	30.0% (12)	60.0% (24)	7.5% (3)
11-15	3.80	0.0% (0)	4.0% (2)	30.0% (15)	48.0% (24)	18.0% (9)
16-20	3.76	0.0% (0)	3.3% (1)	25.8% (8)	54.8% (17)	16.1% (5)
21-25	3.91	0.0% (0)	4.6% (2)	15.9% (2)	63.6% (28)	15.9% (7)
26+	3.79	0.0% (0)	3.5% (2)	29.8% (17)	50.9% (29)	15.8% (9)

*N = 246

18. Did you know about the concussion education resources on the IHSAA website?

*Coaches' Knowledge of Concussion Education Resources on IHSAA Website**

	Yes	No
Responses	99.6% (245)	0.4% (1)

* N = 246

19. If yes, state your agreement with the following statement: The concussion education resources on the IHSAA website were extremely helpful.

*Rating on IHSAA's Concussion Education Resources**

	Rating Average	Strongly Disagree = 1	Disagree = 2	Neutral = 3	Agree = 4	Strongly Agree = 5
Overall	3.92	2.4% (6)	2.4% (6)	15.1% (37)	60.9% (149)	19.2% (47)
8-Man	3.94	5.6% (2)	2.8% (1)	8.3% (3)	58.3% (21)	25.0% (9)
A	3.93	2.4% (1)	4.7% (2)	16.7% (7)	50.0% (21)	26.2% (11)
1A	3.83	0.0% (0)	4.8% (2)	19.0% (8)	64.3% (27)	11.9% (5)
2A	3.85	2.2% (1)	0.0% (0)	21.8% (10)	63.0% (29)	13.0% (6)
3A	3.98	0.0% (0)	2.0% (1)	11.8% (6)	72.5% (37)	13.7% (7)
4A	4.00	7.2% (2)	0.0% (0)	10.7% (3)	50.0% (14)	32.1% (9)

*N = 245

20. Rank the following choices from the best (1) to least beneficial (6) as ways to improve concussion prevention and education.

Option #1 = Additional Tackling Technique Training
Option #2 = Improved Helmet Quality
Option #3 = Mandatory Player Concussion Training
Option #4 = Concussion Clinics for Coaches
Option #5 = Mandatory Parent Concussion Training
Option #6 = Rule Change

*Ratings for Solutions to Improve Concussion Prevention & Education**

	Rating Average	Best = 1	= 2	= 3	= 4	= 5	Least = 6
Option #1	2.69	29.7% (73)	23.2% (57)	15.9% (39)	14.2% (35)	14.2% (35)	2.8% (7)
Option #2	2.98	24.0% (59)	23.6% (58)	14.2% (35)	17.5% (43)	10.1% (25)	10.6% (26)
Option #3	3.02	23.6% (58)	18.7% (46)	17.5% (43)	18.7% (46)	15.0% (37)	6.5% (16)
Option #4	3.67	10.6% (26)	14.2% (35)	21.1% (52)	21.5% (53)	16.3% (40)	16.3% (40)
Option #5	4.12	6.9% (17)	11.4% (28)	17.5% (43)	15.0% (37)	25.2% (62)	24.0% (59)
Option #6	4.51	5.3% (13)	9.0% (22)	13.8% (34)	13.0% (32)	19.1% (47)	39.8% (98)

*N = 246

21. If you have any additional suggestions for question 22, please explain and denote where they would rank on your list.

a. “The rules are only as effective as the enforcement of them. When special attention is given to new rules for the safety of players and officials do not enforce them, they add to the problem.”
b. “Honestly, we should address players hiding this injury because of them being scared they won't be able to play in athletics anymore. We have a couple players who have 2 concussions and have been heard saying that they will hide the injury or even refuse to go to the doctor for this reason. I think it is an important rule, but am scared that this will lead to more players hiding symptoms and not getting the proper medical attention.”
c. “Educated kids but they still have the choice to make on the field. Helmet quality is a great thought but unsure what can be done.”
d. “State could provide a crew for "on sight" concussion education during ALL pre-season team camps throughout the state.”
e. “I think that the rules are fine as they currently are, as long as they are taught and enforced correctly.”
f. “SG helmets will solve most of the concussion problem”
g. “More time to teach proper tackling is the most important aspect of preventing concussions in my opinion and having coaches teach that.”
h. “Officials need to enforce the rules properly. I know this sounds like a typical coach complaining about officiating, but I NEVER have coached a game in which helmet-to-helmet/targeting has been called. Not once.”
i. “At the high school level the rules are great, The refs I feel do a poor job enforcing helmet to helmet contact and using the helmet as a weapon/spearing during the games. I have been coaching at the varsity level for 8 years now and never once seen a player who lowers his head and uses the helmet as a weapon called as a penalty like it should.”
j. “Mandatory IMPACT tests for players. Trainers required at each home event by hosting school”
k. “Quit beating a deadhorse,[at] these seminars no listens anyway.”
l. “Schools should reduce the number of contacts during practices. We have greatly (almost entirely) stopped full contact scrimmages and are scoring more points than ever. Too much contact in practices.”
m. “Rules do not need to be changed, but need to be consistently enforced & promoted by coaches & officials. Mostly unprotected players on peel back blocks (usually special teams).”
n. “State of Iowa has a condensed playoff schedule, where there are 3 games in 10 days. This is unacceptable in today's society, where health and safety is

supposed to be the highest priority. Administrators and Athletic Directors are more concerned about money!"

o. "Watering fields.. in my experience, as many concussion happen as a result of hitting the ground as they do from helmet to helmet contact"

p. "I tried to rank most of them a 6 but it would not let me. None of your choices will improve concussion prevention with the exception of continuing to properly tackle. Additional training is not needed. We teach it properly already to keep the head out of the game, I believe we are pretty well educated already. If you keep making changes to the rules, we will all be wearing flags and it will be called flag football with pads. Don't hear what I am not saying. Concussions are a serious concern but the game of football has contact. That is why helmets are worn. We pay very close attention to our players in practice and games as to concussions. If in doubt, we sit them out. We follow the proper protocol and our medical people do all the work in the protocol."

q. "Train officials as well, they would rank along with the coaches."

r. "Regulate training year round. Too many student athletes are not physically prepared. Have periods where they can wear equipment to get accustomed to it spring/summer leading into the season."

s. "Having certified athletic trainers at every practice"

t. "Information and training is out there. We error on the side of caution. There is also bad information out there and questions [20] could add to that bad info by saying from that questions that the number one need is.... I did not want to put a number to some of those because additional stuff is not needed and rules changes could possible cause more damage to the game injuries. Why is it okay for the X games to say in regards to a death that it risk associated with the event and football is bashed. Injuries happen, we have done a great job in education and awareness with concussion, but now we have the C word being thrown around and kids and parents self-diagnosing and talking themselves into concussion."

u. "Over the past years our practice contact time to teach tackling has been cut in half."

v. "Additional Practice time number 1"

22. Rate the following positions on their likely hood to experience a concussion: [Quarterbacks (QB), Running Backs (RB), Fullbacks (FB), Wide Receivers (WR), Tight Ends (TE), Offensive Linemen (OL), Defensive Linemen (DL), Linebackers (LB), Defensive Backs (DB), and Special Teams (ST)]

*Likelihood to Experience a Concussion by Position – Coaches' Opinion**

	Mean Rating	No Possibility = 1	Very Unlikely = 2	Unlikely = 3	Likely = 4	Extremely Likely = 5
QB	3.66	0.0% (0)	6.5% (16)	26.4% (65)	61.8% (152)	5.3% (13)
RB	3.93	0.0% (0)	3.7% (9)	15.4% (38)	64.6% (159)	16.3% (40)
FB	3.95	0.0% (0)	4.1% (10)	16.3% (40)	60.2% (148)	19.5% (48)
WR	3.54	0.4% (1)	8.1% (20	35.0% (86)	50.4% (124)	6.1% (15)
TE	3.49	0.0% (0)	7.3% (18)	40.2% (99)	48.9% (120)	3.6% (9)
OL	3.27	0.0% (0)	13.0% (32)	50.0% (123)	34.1% (84)	2.9% (7)
DL	3.31	0.0% (0)	12.6% (31)	46.7% (115)	37.8% (93)	2.8% (7)
LB	3.95	0.0% (0)	3.7% (9)	16.2% (40)	61.8% (152)	18.3% (45)
DB	3.69	0.4 (1)	5.7% (14)	27.6% (68)	57.3% (141)	9.0% (22)
ST	3.83	0.0% (0)	4.5% (11)	23.6% (58)	56.9% (140)	15.0% (37)

*N = 246

23. Are concussions occurring due to single, large incidents (big hits) or repeated, smaller contact?

*Collision Mechanisms Causing Concussions – Coaches' Opinion**

	Rating Average	All Repeated Hits = 1	More Repeated Hits = 2	Equal Causes = 3	More Big Hits = 4	All Big Hits = 5
Overall	3.75	0.8% (2)	0.8% (2)	27.7% (68)	63.8% (157)	6.9% (17)
8-Man	3.69	2.8% (1)	0.0% (0)	25.0% (9)	69.4% (25)	2.8% (1)
A	3.83	0.0% (0)	2.4% (1)	19.0% (8)	71.4% (30)	7.2% (3)
1A	3.58	0.0% (0)	2.3% (1)	41.9% (18)	51.2% (22)	4.6% (2)
2A	3.83	0.0% (0)	0.0% (0)	26.0% (12)	65.2% (30)	8.7% (4)
3A	3.86	0.0% (0)	0.0% (0)	21.6% (11)	70.6% (36)	7.8% (4)
4A	3.64	3.6% (1)	0.0% (0)	35.7% (10)	50.0% (14)	10.7% (3)

*N = 246

24. Are concussions being diagnosed more frequently due to greater information or bigger, faster players?

*Explanation for Increased Concussion Frequency – Coaches' Opinion**

	Rating Average	All Bigger, Faster = 1	More Bigger Faster = 2	Equal Causes = 3	More Due to Info = 4	All Due to Info = 5
Overall	3.75	0.0% (0)	5.7% (14)	34.1% (84)	54.1% (133)	6.1% (15)
8-Man	3.50	0.0% (0)	8.3% (3)	38.9% (14)	47.2% (17)	5.6% (2)
A	3.60	0.0% (0)	0.0% (0)	45.2% (19)	50.0% (21)	4.8% (2)
1A	3.58	0.0% (0)	4.7% (2)	39.5% (17)	48.8% (21)	7.0% (3)
2A	3.57	0.0% (0)	10.9% (5)	23.9% (11)	63.0% (29)	2.2% (1)
3A	3.76	0.0% (0)	0.0% (0)	27.4% (14)	68.6% (35)	3.9% (2)
4A	3.57	0.0% (0)	14.3% (4)	32.1% (9)	35.7% (10)	17.9% (5)

*N = 246

25. State your agreement with the following statement: As a coach, I have been tempted to place a player back into a game who I have suspected of having concussion symptoms.

*Temptation to Intentionally Re-enter Players with Suspected Concussion Symptoms**

	Rating Average	Strongly Disagree = 1	Disagree = 2	Neutral = 3	Agree = 4	Strongly Agree = 5
Overall	1.48	66.6% (164)	24.0% (59)	4.9% (12)	4.1% (10)	0.4% (1)
8-Man	1.44	63.9% (23)	27.8% (10)	8.3% (3)	0.0% (0)	0.0% (0)
A	1.33	78.6% (33)	16.6% (7)	0.0% (0)	4.8% (2)	0.0% (0)
1A	1.58	58.1% (25)	30.2% (13)	7.0% (3)	4.7% (2)	0.0% (0)
2A	1.48	69.6% (32)	19.6% (9)	4.3% (2)	6.5% (3)	0.0% (0)
3A	1.39	70.5% (36)	23.5% (12)	2.0% (1)	4.0% (2)	0.0% (0)
4A	1.71	53.6% (15)	32.1% (9)	7.1% (2)	3.6% (1)	3.6% (1)

*N = 246

26. State your agreement with the following statement: Parents have pressured me to put their son/daughter back into the game when I suspected they may have concussion symptoms.

*Parental Pressure to Re-Enter Players with Suspected Concussion Symptoms**

	Rating Average	Strongly Disagree = 1	Disagree = 2	Neutral = 3	Agree = 4	Strongly Agree = 5
Overall	1.87	53.3% (131)	23.6% (58)	8.1% (20)	13.0% (32)	2.0% (5)
8-Man	1.97	47.2% (17)	27.8% (10)	5.6% (2)	19.4% (7)	0.0% (0)
A	1.52	64.3% (27)	23.8% (10)	9.5% (4)	2.4% (1)	0.0% (0)
1A	1.98	55.8% (24)	20.9% (9)	0.0% (0)	16.3% (7)	7.0% (3)
2A	1.96	50.0% (23)	21.7% (10)	10.9% (5)	17.4% (8)	0.0% (0)
3A	1.84	49.0% (25)	27.5% (14)	13.7% (7)	9.8% (5)	0.0% (0)
4A	2.00	53.6% (15)	21.4% (6)	3.6% (1)	14.3% (4)	7.1% (2)

* N = 246

APPENDIX B

Concussion Rate per 10,000 Athletic Exposures Calculations

To calculate a concussion frequency comparable to previous research (Committee on Sports-Related 2013; Gessel et al., 2007; Guskiewicz et al, 2003; Marar et al., 2012), the total concussions sustained must be compared to total athletic exposures. The number of athletic exposures varies per team based upon practice schedule and advancement to the state playoffs. Because these two variables are not known for this study, an estimation of athletic exposures was needed. An aggressive practice approach dictates that coaches will use almost all of the practices they are allotted. With a conservative practice approach, the exposures are calculated using estimated practice schedules in which contact occurs. One athletic exposure is the participation of one player in a practice or game. If a team of 30 individuals plays in a single game, the event counts for a total of 30 athletic exposures. To calculate the large scale estimation of athletic exposures, predicted days of practices and games are multiplied by the estimated number of players participating in those activities. Calculation of the statistic involves the total number of players and the total number of concussion sustained. From the 2014 study of Iowa high school football coaches, 757 concussions were diagnosed. Coaches in the study oversaw 14,722 players.

Aggressive Concussion Frequency Calculation

The state of Iowa allows 12 pre-season practices counting for 12 athletic exposures. An average team has nine games during the season. With four practices

during the week, a regular season game week include five athletic exposures. This equates to 45 athletic exposures during the regular season. Due to the shortened schedule of the first three rounds of the playoffs, it is reasonable to assume only four athletic exposures can be accumulated per game. For the final two playoff games, the regular game schedule resumes allowing for five athletic exposures per week for a total of ten days.

Combining pre-season and regular season exposures, all teams experience 57 athletic exposures. The playoffs result in an additional 22 athletic exposures. However, not all teams participate in the playoffs. The exposures accumulated in each week of the playoff must be multiplied by the percentage of teams in that round to keep consistent reporting.

Athletic exposures calculations are listed below:

56.47% of teams participate in the first round - .5647 x 4 = 2.2588 First Round

28.24% of teams participate in the second round - .2824 x 4 = 1.1296 Second Round

14.12% of teams participate in the third round - .1412 x 4 = .5648 Third Round

7.06% of teams participate in the fourth round - .0706 x 5 = .3530 Fourth Round

3.53% of teams participate in the fifth round - .0353 x 5 = .1765 Fifth Round

Results in 4.4827 dates of athletic exposure in the playoffs

12 - Pre-Season

45 - Regular Season

4.4827 - Playoffs

61.4827 Dates of Athletic Exposure x 14,722 Players = 905,148.3094 Athletic Exposures during the 2014 season.

X Concussions/ 10,000 AEs = 757 Concussions/905,148.3094 AEs

X = **8.36 Concussions/10,000 AEs** using an aggressive practice approach.

Conservative Concussion Frequency Calculation

The state of Iowa allows 12 pre-season practice exposures. However, two of those practices on Saturdays. For the conservative calculation, that practice is not included. An average team has nine games during the season. With an average routine of three practices during the week, a regular season game week include four athletic exposures. This equates to 36 athletic exposures during the regular season. Due to the shortened schedule of the first three rounds of the playoffs, it is reasonable to assume only four athletic exposures can be accumulated per game. For the final two playoff games, the regular game schedule resumes allowing for four athletic exposures per week for a total of eight days.

Combining conservative estimations of pre-season and regular season exposures, all teams experience 46 athletic exposures. The playoffs result in an additional 20 athletic exposures. However, not all teams participate in the playoffs. The exposures accumulated in each week of the playoff must be multiplied by the percentage of teams in that round to keep consistent reporting. Athletic exposures calculations are listed below:

56.47% of teams participate in the first round - .5647 x 4 = 2.2588 First Round

28.24% of teams participate in the second round - .2824 x 4 = 1.1296 Second Round

14.12% of teams participate in the third round - .1412 x 4 = .5648 Third Round

7.06% of teams participate in the fourth round - .0706 x 4 = .2824 Fourth Round

3.53% of teams participate in the fifth round - .0353 x 4 = .1412 Fifth Round

Results in 4.3768 dates of athletic exposure in the playoffs

10 - Pre-Season

36 - Regular Season

4.3768 - Playoffs

50.3768 Dates of Athletic Exposure x 14,722 Players = 741,647.2496 Athletic Exposures during the 2014 season.

X Concussions/ 10,000 AEs = 757 Concussions/741,647.2496 AEs

X = **10.21 Concussions/10,000 AEs** using a conservative practice approach.

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