

SECONDARY PREVENTION STRATEGIES FOLLOWING  
CONCUSSIONS IN HIGH SCHOOL FOOTBALL STUDENT-  
ATHLETES

by

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A THESIS

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## **An Abstract of the Thesis of**

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Objective: The focus of this research is the implementation of secondary prevention strategies in high school football. Specifically, the study will assess how Oregon high school coaches adhere to concussion laws and test their knowledge of concussion management.

Background: “A concussion is a type of traumatic brain injury that is caused by an impact to your head or a blow to the body that causes your head and brain to move back and forth rapidly” (Centers for Disease Control and Prevention). It is estimated that between 1.7-3 million people sustain a sports-related concussion every year, and 300,000 of all concussions reported are from athletes that play football (UPMC). Between 2018-2019, researchers estimated that around 44% of all concussions that occur in high school sports are from football (Injury Claim Coach). Because sports concussions cannot be completely prevented, researchers and youth sports leaders agree that the focus should shift to implementing efficient concussion management strategies. This *secondary prevention* approach centers increasing awareness of concussion signs and symptoms, promoting recognition when it first happens, and implementing effective management strategies (i.e., removal from play, monitoring symptoms, gradual return to activity). High school students’ brains are still developing and rushing them back into sports puts their safety and health at risk in both the short-term and long-term. Furthermore, the culture of sports negatively influences athletes’ self-reporting of concussion symptoms and their compliance with return-to-play guidelines, exposing them to more safety and health concerns (Committee on Sports-Related Concussions in Youth, 2014).

Methods: In order to analyze and assess concussion knowledge, a survey will be distributed to Oregon high school football coaches. The survey will assess coaches' knowledge of common concussion signs and symptoms. Items will address knowledge of Max's Law guidelines and the degree to which coaches are following the law. The survey will be sent out via email from the Oregon Athletic Coaches' Association. The data gathered from the survey will be analyzed in a table format containing the most commonly missed signs and symptoms and most common beliefs. The responses to the Max's Law questions will be sorted based on frequency.

## **Acknowledgements**

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## Introduction

There are an estimated 1.7 – 3 million sports-related concussions reported every year, with an estimated 300,000 occurring from football (UPMC, 2022). Of greatest concern is that only 5 out of 10 concussions are reported so the number of concussions is actually underreported (DePadilla et al. 2017, Kroshus and Chrisman, 2019). Approximately 55% of athletes are high school students; more than 7.6 million students played a sport during the 2010-2011 academic school year (Koebler, 2011). Since then, that number has only been growing, reaching 7.9 million athletes during the 2018-2019 school year (NFHS, 2020). In the same year, researchers estimated that 455,000 high school football injuries occurred. PIPER<sup>1</sup> conducted a study that found 99,036 high school football injuries were from head and face concussions (U.S. High School Injury Statistics, 2022). Concussions were the most commonly reported injury. The prevalence of concussion is a significant health concern because if it is not diagnosed and treated properly, it can cause lingering long-term effects that can hinder the student’s development and ability to perform well in school.

According to the CDC<sup>2</sup>, “a concussion is a type of traumatic brain injury – or TBI – caused by a bump, blow, or jolt to the head or by a hit to the body that causes the head and brain to move rapidly back and forth” (CDC, 2022). When a concussion occurs, there are both signs, which are observed by others, and symptoms, which are reported by the individual. Some common include appearing dazed or stunned, moving clumsily, loss of consciousness, confused about where one is or what one is doing, and the inability to recall moments before or after the

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1 Colorado School of Public Health’s Program for Injury Prevention, Education & Research (PIPER)

2 Centers for Disease Control and Prevention



hit. Common symptoms include headaches, nausea or vomiting, balance problems, dizziness, sensitivity to light or noise, and confusion or memory problems (CDC, 2022).

### **Sports Culture:**

The culture of sports negatively influences athletes to report their concussion symptoms and adhere to return-to-play guidance (Committee on Sports-Related Concussions in Youth et al. 2014, Bissett et al. 2020). Corman et al. (2019) analyzed the relationship between six different belief variables and how they corresponded with general behaviors. The six variables are stake, salience, certainty, immediacy, self-efficacy, and response-efficacy. They serve as the bridge connecting ones' attitudes with an associated behavior. When an athlete scores low on these variables, their attitude will venture to a less predictable state, leaving them more susceptible to increased risk and negative outcomes (Corman et al. 2019). It is important to note that the athlete is not the sole party responsible for concussion management; athletic trainers and coaches are also responsible for recognizing common symptoms of brain injuries and acting accordingly. However, signs may not be expressed or easily perceived, emphasizing the importance of athletes reporting their injury. Due to an athlete's competitive nature, many injuries are underreported or not taken seriously enough, especially concussions.

In the Corman et al. study, it was reported that certainty and immediacy were the two lowest elements. To understand the context of these variables, the paper defines certainty as the athlete is the one to evaluate how certain their injury is, and the consequences associated with it. The measure or perceived probability works in tandem with how likely they will report their injury and take health-protective measures. Immediacy is defined as the athlete determining whether and when consequences will take place. When this variable is perceived as low, athletes believe consequences will take place in the long-term, so they shift their focus back to winning

the game. This is concerning due to these athletes putting themselves at further risk because concussions have short-term consequences and require immediate action and removal (Corman et al. 2019).

### **Post-Concussive Syndrome**

If a concussion is not properly diagnosed or managed, it can lead to post-concussive syndrome (PCS). PCS symptoms include headaches, dizziness, fatigue, sensitivity to light and sleep problems and others; combined, these symptoms can lead to a decreased quality of life. Patients diagnosed with PCS are typically those who do not recover from a concussion within an expected timeframe. An expected timeframe for adult male patients to fully recover is 14 days, while both females and younger patients require more time. 24%-84% of TBI patients develop PCS, and these long-term effects remain for months post-injury. Furthermore, out of the patients who develop PCS, nearly a quarter of them experience symptoms for over six months (Kim and Priefer, 2020). If symptoms continue for six weeks, it can start to alter how people live their lives by affecting how they sleep, changing their personality, and causing fatigue, headaches, and dizziness (Leddy et al. 2017). This shows the importance of educating people and raising awareness so they can correctly diagnose and manage concussions when it is first sustained; otherwise, it may lead to post-concussive syndrome and affect the student-athlete long-term by degrading their quality of life.

### **Concussion Prevention Strategies**

There are various ways in which concussions can be prevented: primary prevention, secondary prevention, and tertiary prevention. Primary prevention focuses on preventing concussions from occurring by changing and enforcing rules, updating equipment, and reducing head-to-head contact. Secondary prevention entails enforcing the best practices to manage and

diagnose concussions properly. Tertiary prevention prioritizes looking into long-term complications. Furthermore, raising awareness and educating the general public about the importance of concussions is a form of prevention that falls into all three categories (Tator, 2013). For this thesis, the main focus will be on how secondary prevention strategies are being implemented in Oregon high schools.

The CDC estimates that in any given sports season, five to ten percent of athletes will experience a concussion (“Concussion in Athletes”, n.d.). To ensure player safety and health, it is vital for there to be both awareness and education when it comes to concussions, and what to do following the injury. Sometimes when a player sustains a concussion, coaches fail to recognize it when it happens, and therefore fail to give football players proper treatment and intervention (DePadilla, 2020).

Currently, there are a variety of effective methods to manage and diagnose concussions properly by healthcare providers. For example, doctors use an acute concussion evaluation as well as a standardized assessment of concussion (Scorza, 2019). In addition, there are numerous numbers of neuropsychological tests that identify cognitive deficits like losses in memory, increased reaction time, and slower cognitive processing speed (Scorza, 2019).

## **Concussion Laws**

Due to the increasing concern about sports concussions and PCS, in 2009, states started enforcing laws to promote athlete safety. Each state has its own law and set of protocols to follow. I will be focusing on the laws implemented and enforced in Oregon in correlation with high school football. The first law is Max’s Law, created in 2010 and applies only to Oregon School Districts. Max’s Law, adopted and implemented by the state of Oregon in 2009, discusses various aspects of concussion management when a student is assumed to have sustained a

concussion. Successful concussion management policies in high schools must follow the “Recognize, Remove, Refer, Return protocol” (Oregon Health Authority, 2019). All coaches must receive annual training to recognize the symptoms of a concussion. If a student is suspected of sustaining a concussion, they must be removed from play. Students must be properly evaluated by a trained medical professional. Finally, a student can return to play once they have fully recovered. They must have a medical release form from the medical professional. The second law that Oregon has created is Jenna’s Law, which is an extension of Max’s law that requires Oregon Non-School Sports and Officiating Organizations to enforce concussion management guidelines to protect children 17 years and younger (Oregon Concussion Laws, n.d.).

## Literature Review

My thesis extends the work of the Oregon Health Authority, which conducted a survey in 2019 to examine how well schools in Oregon have implemented Max's Law. The survey's results, reported in publication, *Implementation of Max's Law in Oregon High Schools* (Oregon Health Authority, 2019), summarizes a survey sent out to Oregon high school athletic directors in 2019. The purpose of the survey was to assess "implementation of the law, barriers to implementing the law, adoption of recommended best practices, and the extend of policies and leadership."

The key findings of this survey on athletic directors included that all schools required 100% of coaches to be trained, 100% of athletes to be removed when a concussion was suspected, and 100% of those athletes had to be cleared by a professional health care provider. Athletic directors reported that the protocols implemented followed a 98%, 90%, and 93% rate, respectively to the requirements stated above. This shows that Oregon schools, reported by athletic directors, are following the implementation of Max's Law and the guidelines and protocols mandated by it at an extremely high rate (Oregon Health Authority, 2019).

The survey conducted focused on athletic directors, who are typically not present at all football games or practices. Because of this, it is important to survey the people on the ground level of concussion management: the coaches. Coaches observe the players who sustain concussions, and they are the ones responsible for following the protocols of Max's Law. To better ensure the health and safety of student-athletes, it is critical to know how well coaches understand the signs and symptoms of a concussion and are aware of Max's Law protocols.

Many coaches do not realize the health concerns associated with a concussion. Due to their competitive nature, coaches want their players back ahead of a big game. If these football

players return too quickly without fully recovering from the concussion they sustained, they may later suffer from post-concussion syndrome, which is defined as the “persistence of a constellation of physical, cognitive, emotional, and sleep symptoms beyond the usual recovery period after a concussion” (Graham et al. 2014). It is crucial that coaches understand the causes, effects, and prevention methods of concussions and the importance of the athlete fully recovering before returning to play. There have been many studies looking into coaches’ knowledge and ability to identify signs and symptoms of concussions. It was reported that 82.6-96.2% of coaches correctly identified that loss of consciousness does not have to occur for a concussion to be sustained. In addition, 80-100% of coaches correctly identified the cognitive and physical symptoms, but a much smaller percentage were aware of the emotional and sleep symptoms (Feiss et al. 2020).

Since concussion laws were enacted, there has been an increase in coach education. For example, the first educational program created is HEADS UP, implemented by the CDC to help coaches, parents, and athletes properly identify and respond to a concussion. It provides information and resources for specific audiences to become more educated and to raise awareness. This program is recommended and available to anyone on a national level and is free in every state (CDC, 2022).

There are a handful of published studies focused on concussion management and prevention. One study examined the efficacy of online training in sports concussion for youth sports coaches (Glang et al. 2010). This study assessed the impact of the training program on coach knowledge and self-efficacy and behavioral intention. It compared coaches who used ACTIVE Training Program to those that did not take the program. The training program is composed of three short modules that covers information on youth concussions and includes

simple graphics and videos. The study concluded that coaches who underwent training and used the program had a significant and larger overall gain compared to the coaches that did not use the program. In addition, coaches who received training were more well-versed on concussions. However, the study had some limitations; one being the majority of coaches surveyed were already well-educated on concussions. Also, coaches with less education or who struggle using computers, may not result in the same kind of benefit from using the program. Another concern is that the coaches' training may not be replicated in practices or games.

Many high school football players do not have the appropriate knowledge of either the symptoms or consequences of concussions. For example, Cournoyer et al. 2014 distributed a written questionnaire to eleven Florida varsity football teams to evaluate players' concussion knowledge. Around 90% of players were able to identify the common symptoms like headaches, dizziness, and confusion, but only 81% selected loss of consciousness, 53% recognized nausea and vomiting as a symptom, and less than 50% correctly identified personality change, sleep disturbance, becoming emotional, and an increase in anxiety and nervousness. Even fewer players knew of the long-term consequences that include early onset of Alzheimer's disease, dementia, and Parkinson's. Another key finding of the study is that only 60% of players had received some kind of formal education on concussions and a staggering 25% reported that they had never received any kind of education at all. It is the job of the coaches to educate the players, raise awareness, and stress the importance of proper management and care if a player sustains a concussion.

## **Research Questions:**

1. How do high schools in Oregon follow the protocols and guidelines of Max's Law?
2. How educated and aware are coaches on concussion signs and symptoms?
3. Do demographics play a role in concussion knowledge and beliefs?

## **Methods**

The study was conducted online via email between the months of January and April 2023. Participants were recruited in collaboration with the Oregon State Athletic Association and the Oregon Athletic Coaches Association. Emails were sent out to potential participants and included a brief introduction of the purpose of the survey and the link to the survey. The survey was created on a secure site, Qualtrics, and the participants were made aware that it was completely anonymous.

## **Participants**

A total of 70 Oregon high school coaches completed the survey. The demographic information regarding the participating coaches can be found in Table 1.

## **Survey**

The survey was constructed to gain relevant information on Oregon high school coaches' knowledge and beliefs on concussion management. It is broken up into various sections: demographics, beliefs on actions associated with concussion management, and knowledge-based questions. Questions include items that are similar to those in a previous study with Oregon athletic directors (Oregon Health Authority, 2019). The current survey builds on this work, surveying coaches about the protocols and guidelines enforced by Max's Law. It also assesses how educated and aware coaches are about concussions, and how best to manage an athlete who



has experienced a concussion. For example, the survey asks about common concussion signs and symptoms of concussions. The preview to the survey can be found here:

[https://oregon.yu1.qualtrics.com/jfe/preview/previewId/0f493be8-7ca9-4ece-985e-28d47aad4b9e/SV\\_3OvGEk9XX8INWIM?Q\\_CHL=preview&Q\\_SurveyVersionID=current](https://oregon.yu1.qualtrics.com/jfe/preview/previewId/0f493be8-7ca9-4ece-985e-28d47aad4b9e/SV_3OvGEk9XX8INWIM?Q_CHL=preview&Q_SurveyVersionID=current)

### *Study Design and Statistical Analysis Plan*

A summary of survey responses is presented in Table 1. For each knowledge-based question, the percentage of correct and incorrect answers was calculated and can be found in Table 2. For the belief-based questions, the number of coaches who chose each answer is presented in a bar graph, as shown in Figure 1.

All survey items and the knowledge and belief scores are summarized using descriptive statistics including frequency distributions, means, and standard deviations. The descriptive summary addressed research questions 1 and 2. To address research question 3, crosstabulations with chi-square statistics did inform on whether coach demographic characteristics are associated with protocols followed; and t-tests and one-way ANOVAs did inform on whether coach demographic characteristics are associated with the knowledge and belief scores.

### *Statistical Analysis Tests*

Hypothesis: Coaches that have spent more than 20+ years coaching will be better at recognizing common concussion signs and symptoms better than those who have less than 20 years of coaching experience.

## **Results**

A total score for common concussion signs and symptoms was created by computing the total percent correct. On average, participants who coached less than 20 years (n = 29) had an

average common concussion signs and symptoms score of 92.5% (SD = 9.3%) and participants who coached more than 20 years (n = 35) had an average score of 94.6% (SD = 5.6%). An independent group t-tests showed that the differences in percent correct did not significantly differ ( $t[62] = 1.05, p = .276$ ) between those who coached less than 20 years and those who coached more than 20 years.

Descriptive statistics are summarized in Tables 2, 3, and 4, each corresponding to a various section of the survey. In Table 2, the percentage of coaches responding to each of Max's Law protocols was never 100% as required; instead they were 98.5%, 95.5%, and 98.5% respectively. In contrast to the Max's Law survey done on athletic directors, there is a difference in reporting at the coaches level as Max's Law is not followed in every situation. In Table 3, the coaches correctly identified concussion symptoms 97.18% of the time. The most commonly missed concussion symptoms were "sleep problems" and "moodiness" (62.8% and 60% correctly identified). The non-concussion symptom that was identified the most was "Sharp burning pain in neck and shoulders", identified by 10% of respondents. Table 4 displays the results from the True/False portion of the survey. The bolded answers are the correct responses. Two of the true/false questions were answered incorrectly by the majority of coaches, and a third was answered on a 60/40 split.

## **Discussion**

On average, according to the coaches surveyed, Max's Law is being implemented approximately 97.5% of the time in Oregon high school sports, suggesting there are a few student-athletes who are being put at risk in Oregon. The initial Max's Law survey with athletic directors was helpful and provided hope that the protocols were being followed with 100%

adherence. The coaches who are directly involved in player practices and games report slightly lower rates of adherence. There is actually an increase in following Max's Law.

Responses on the knowledge portion of the survey revealed interesting gaps in concussion knowledge. Results indicate that coaches were able to correctly identify concussion signs and symptoms in student-athletes. However, the majority of coaches scored poorly on true/false items that measured deeper knowledge of concussions (e.g., "After a concussion, people can forget who they are and not recognize others but be perfect in every other way".) This indicates that coaches are more familiar with what happens right after a concussion but are less aware of the concussion recovery trajectory over time. One possible method to mitigate this knowledge gap is to include secondary prevention methods in coach training programs. It is possible that coaches are putting some student-athletes at risk because they are under-educated and less aware of possible repercussions of concussions over the long-term.

## **Limitations**

Although the results of this study provide valuable information, there are several limitations. Firstly, the survey was self-report. Although the survey was anonymous, some coaches have felt that the questions were attempting to trick them. Coaches may have been afraid to answer honestly, as they knew what the "correct" responses should be. For example, when it comes to the responses of the implementation to Max's Law or reporting their beliefs, coaches may have answered differently for fear that they would get in trouble if they did not respond how the majority would.

Secondly, the survey sample is not representative of coaches in America. When looking at the demographics, the coaches surveyed were mostly "White/Caucasian", from a "Rural" school, and attended "Graduate school". This is not representative of coaches in America, as

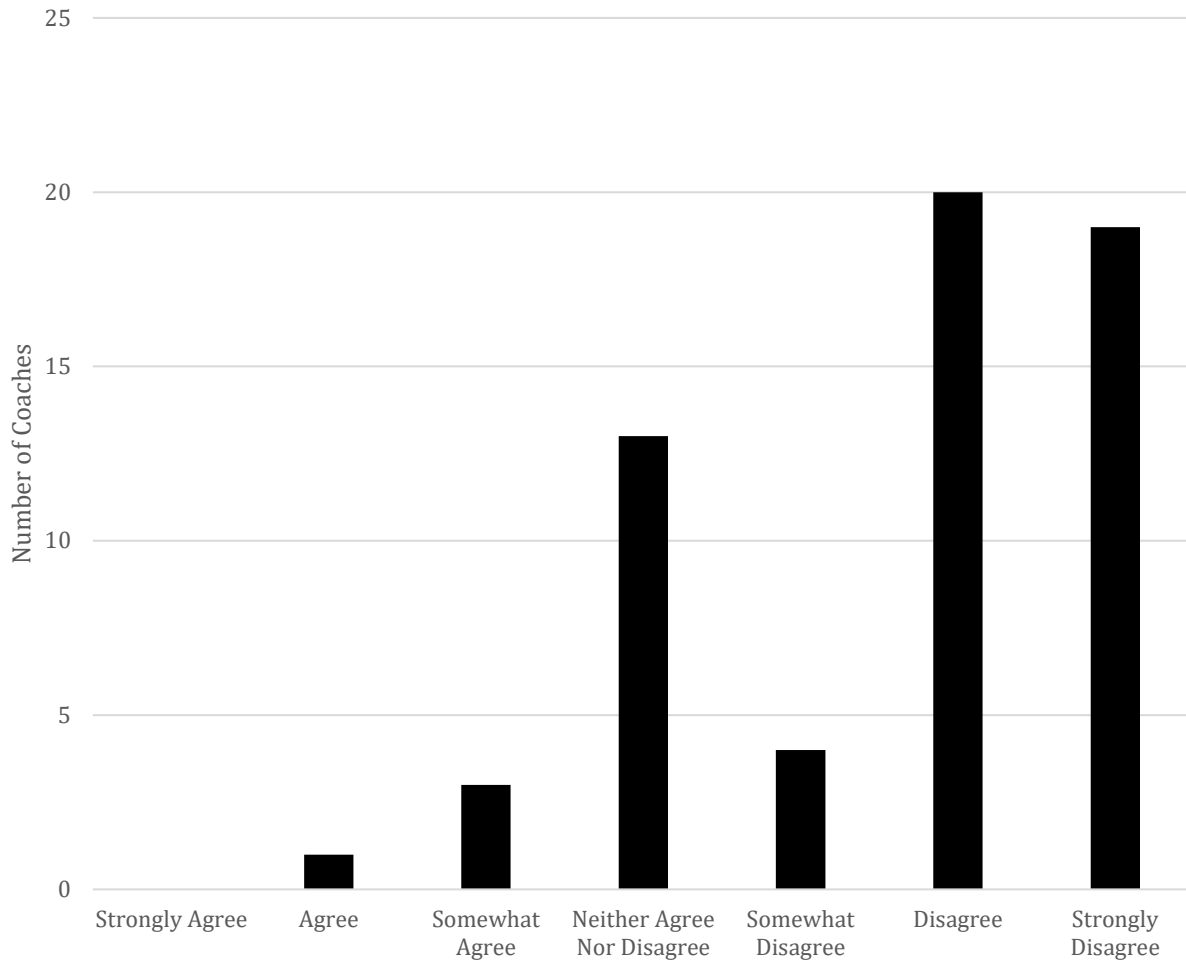
there is more diversity in other states, more coaches in suburban and urban areas, and many coaches who have not graduated from a graduate school program.

Finally, another limitation of the survey is that coaches may have ignored Max's Law because of their inability to field players. Since many of these coaches are from rural schools, they may have a limited number of players, meaning that some players have to play both offense and defense. When a player gets injured, instead of pulling them out and facing an automatic forfeit, the coaches leave them in and try and let them finish the game.

## Figures

Figure 1

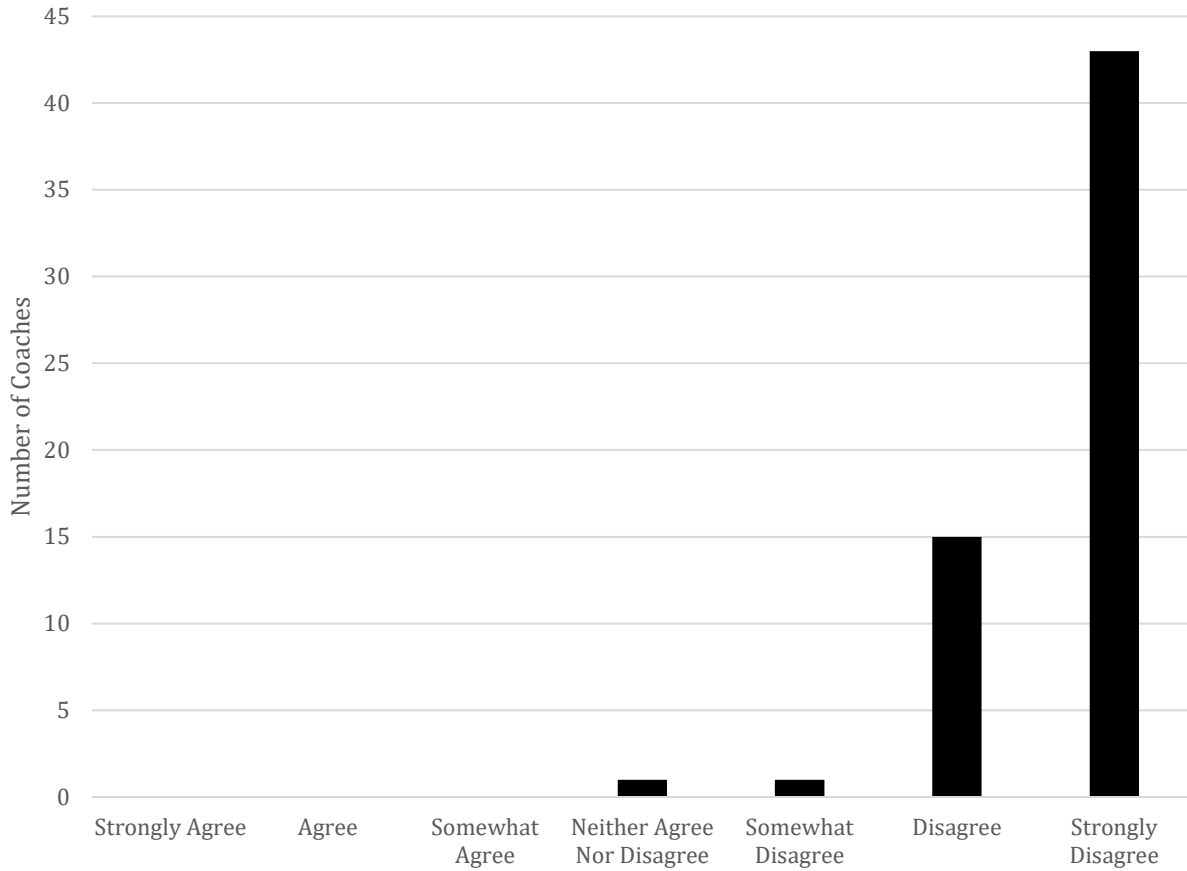
Frequency of Coaches' Beliefs in Response to Statement 1



*Note: This figure summarizes the frequency in beliefs of Oregon high school football coaches in response to statement 1 of the beliefs section in the survey. Statement 1 states, “I think the athletic medicine staff is too conservative in the return to play process after a concussion.”*

Figure 2

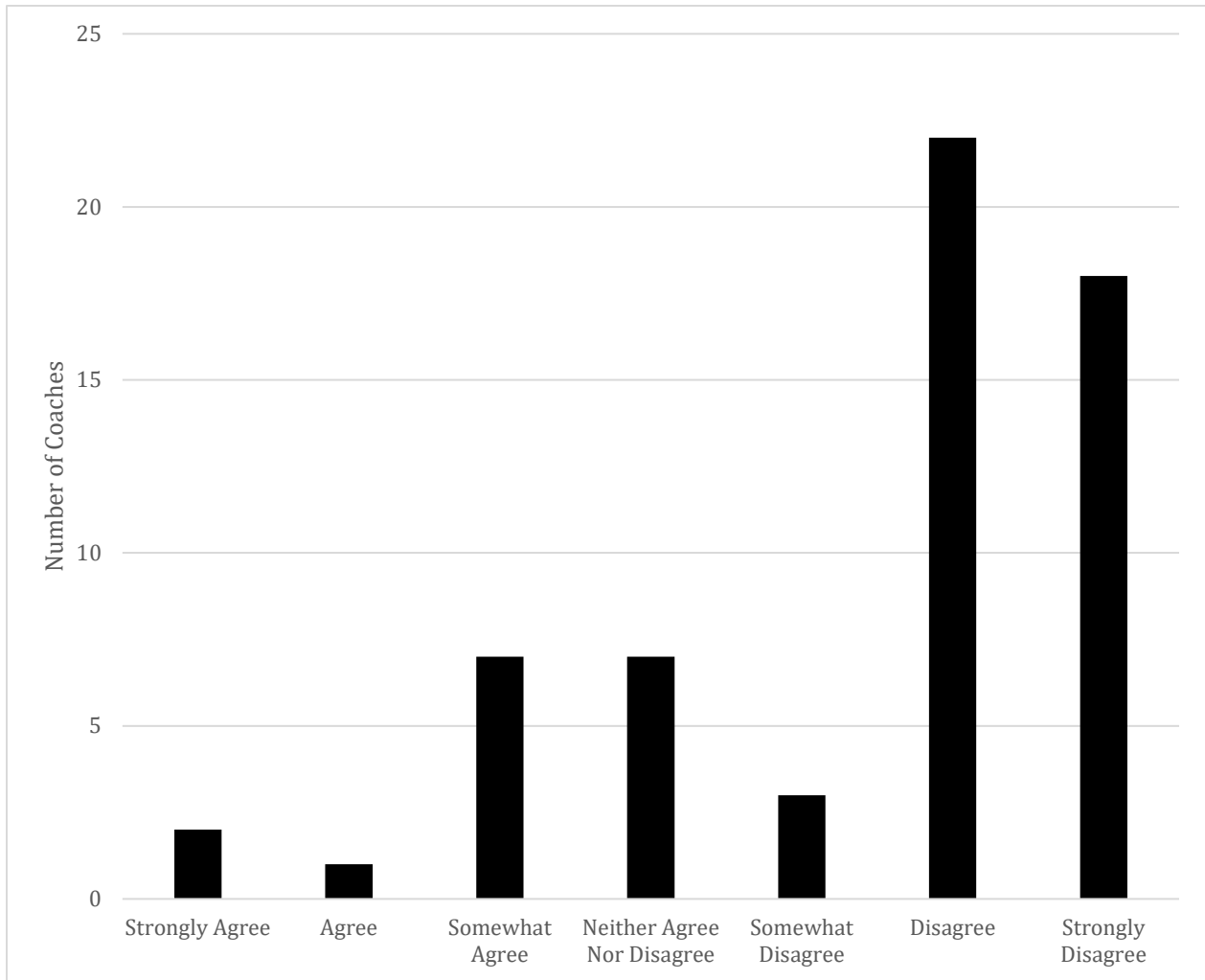
Frequency of Coaches' Beliefs in Response to Statement 2



*Note: This figure summarizes the frequency in beliefs of Oregon high school football coaches in response to Statement 2 of the beliefs section in the survey. Statement 2 states, “If a player sustains an impact that might be a concussion during a critical part of an important game, I think it's okay if they choose to wait until after the game to talk to the sports medicine staff about their symptoms.”*

Figure 3

Frequency of Coaches' Beliefs in Response to Statement 3



*Note: This figure summarizes the frequency in beliefs of Oregon high school football coaches in response to Statement 3 of the beliefs section in the survey. Statement 3 states, “I’m worried about what all the rules and policies about concussions are doing to our sport.”*

## Tables

Table 1

Demographics of Oregon High School Football Coaches

<b>Demographics</b>	<b>Categories</b>	<b># of Coaches</b>
<b>Location of HS</b>	Urban	10
	Suburban	16
	Rural	44
<b>Gender</b>	Male / Female	70 / 0
<b>Highest Level of Education</b>	< High school comp.	0
	High school or GED	2
	Some college, associate degree, trade, military	10
	College degree (BS, BA)	8
	Graduate school (MA, MS, PhD)	50
<b>Age</b>	Average	46.32
	Standard Deviation	9.25
<b>Race</b>	American Indian or Native American	2
	Asian	2
	Native Hawaiian or Pacific Islander	0
	Black or African American	1
	White or Caucasian	61
	Prefer not to say	0
	Not listed (Please describe)	0
<b>Years spent coaching</b>	Average	23.23
	Standard Deviation	1.46



Table 2

Responses to the Implementation of Max’s Law

<b>Max’s Law Protocols</b>	<b>Percent with requirement</b>	<b>Percent reporting protocol happening “all the time”</b>
Coaches have received annual training in concussion recognition and management.	100%	98.5%
Student athletes suspected of having a concussion have been removed immediately from practice or competition.	100%	95.5%
Student athletes have only returned to practice or competition after being cleared by a health care provider.	100%	98.5%

Table 3

Percentage of Concussion/Non-Concussive Symptoms Identified

<b>Symptoms</b>	<b>Percent Identified (%)</b>
<b>Concussion symptoms</b>	97.18
<b>Not concussion symptoms</b>	2.82

Table 4.

Responses to True/False Questions Regarding Concussion Statements

Statements	True (%)	False (%)
Being knocked unconscious always causes permanent brain damage.	21.67	<b>78.33</b>
Symptoms of a concussion can last for several weeks.	<b>100</b>	0
After a concussion occurs, brain imaging (e.g., CAT Scan, MRI, X-Ray, etc.) typically shows visible physical damage (e.g., bruise, blood clot) to the brain.	40.68	<b>59.32</b>
After 10 days, symptoms of a concussion are usually completely gone.	<b>48.33</b>	51.67
After a concussion, people can forget who they are and not recognize others but be perfect in every other way.	60	<b>40</b>

\*Correct answers are bolded\*

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