





COLLEGIATE RODEO ATHLETES AND CONCUSSIONS

A Thesis

by

KODY NORMAN ALLAN LAMB

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Chair of Committee,  
Committee Members,

Dr. Amber Harris Bozer  
Dr. Thomas Faulkenberry  
Dr. Jennifer Gibson-Dias

Head of Department,  
Dean, College of Graduate Studies,

Dr. Kimberly Ryneerson  
Barry D. Lambert, PhD

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Major Subject: Applied Psychology

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## ABSTRACT

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While empirical evidence of mild-traumatic brain injury (mTBI) is plentiful in contact sports such as football and wrestling, the literature remains sparse surrounding concussions in rodeo athletes. A survey was administered to 74 members of a collegiate rodeo team within the National Intercollegiate Rodeo Association (NIRA). The survey had two focal points: concussion descriptives and concussion perceptions. Descriptive questions focused on overall lifetime history of rodeo-related concussions, symptoms, etc. Perceptions questions measured perceived risk of future concussions, whether concussions could have a long term impact on personality and cognitive performance etc. The first hypothesis was that rodeo athletes who compete in the roughstock (bareback riding, saddle bronc riding and bull riding) and steer wrestling events will display a significantly greater mean quantity of concussions than the remaining five collegiately-sanctioned events. Steer wrestling was included with roughstock due to the high frequency of injury reported in the literature. The second hypothesis was that rodeo athletes who have sustained a concussion in the past will display a significantly greater perceived likelihood of sustaining another concussion in the future than those individuals without a history of concussions. No significant difference was detected in mean concussion quantity based on event type. Participants with a history of at least one diagnosed concussion displayed a significantly greater perceived likelihood to sustain

another concussion in the future compared to participants with no history of rodeo-related mTBI. One-hundred percent of bull riders, 50% of saddle bronc riders, and 33% of bareback riders who currently compete in those events had a history of concussions. An effect between event type and quantity of concussions may not have been found due to a unequal sample size between groups. Explanations for the increased perceived risk in participants with a history of concussions may include the increased awareness of the risk of injury based on personal experience. Limitations include a small sample size in the roughstock and steer wrestling events, as well as undetailed information on the specific events in which injuries occurred. Future research is required to gather information surrounding concussion perceptions in professional rodeo athletes, as well as to determine whether perceived likelihood of sustaining a concussion in the future is in line with actual future injuries.

*Keywords:* concussion, rodeo, mild traumatic brain injury, mTBI

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## **CHAPTER I**

### **INTRODUCTION**

Concussions have been widely studied in a variety of sports including football (e.g. Multani et al. 2016; Liao, Lynall & Mihalik, 2016; Lynall, Campbell, Wasserman, Dompier, & Kerr, 2017), mixed-martial arts (e.g., Heath & Callahan, 2013; Karpman et al. 2016), boxing (e.g., Karpman et al. 2016), ice hockey (e.g., Pauelsen, Nyberg, Tegner, & Tegner, 2017), and rugby (e.g., Roberts et al. 2017). However, there is an insufficient amount of scientific inquiry surrounding rodeo athletes, and the research conducted has focused on the totality of injuries sustained within rodeo (e.g., Crichlow, Williamson, Geurin, & Heggem, 2006; Meyers, Elledge, Sterling, & Tolson, 1990; Meyers & Laurent, 2010). The current research was conducted to gather information from rodeo athletes pertaining specifically to mild-traumatic brain injury (mTBI). Given the high speeds and dynamic nature of the nine college rodeo sanctioned events (bareback riding, saddle bronc riding, bull riding, tie-down roping, steer wrestling, goat tying, barrel racing, breakaway roping, and team roping), concussions have been found to be quite common in rodeo athletes (Meyers & Laurent, 2010). However, while brain injuries are common in rodeo competitors, the systematic investigation of the relationship between head trauma and rodeo require more research. The main focus of the current research was to examine lifetime history of rodeo-related concussions in collegiate rodeo athletes, as well as the perceptions these athletes hold surrounding brain-related injuries. The goal was to provide a foundation for future research in concussions as they relate to rodeo athletes.

## **CHAPTER II**

### **LITERATURE REVIEW**

The Center for Disease Control (CDC), reported that approximately 2.5-million people in America visited hospital emergency rooms in 2013 with traumatic brain injury (TBI)-related symptoms (Taylor, Bell, Breiding & Xu, 2017). In addition, this report detailed approximately 282,000 hospitalizations, and approximately 56,000 deaths as a result of TBI related cases. Other reports show that of all traumatic brain injuries, 80-90% are mTBI (Giza, Prins, & Hovda, 2017).

The growing pool of research that has been created in recent years regarding concussions and mTBI has provided individuals and healthcare professionals greater understanding of the scope and severity of this type of injury. An important distinction is concussions and mTBI may technically be differentiated from one another. Mullally (2017) states the term “concussion” is just a descriptive article for the mildest form of mTBI. However, the primary concern for current study was the total number of officially diagnosed rodeo-related concussions, so this distinction is not necessary, and the two terms will be used interchangeably. Giza, Prins, and Hovda (2017) define a concussion as a biomechanical force resulting in neurological or pathophysiological dysfunction. In the current research, concussions will refer to any neurological or pathophysiological dysfunction (e.g., impaired memory, headache, etc.) caused by a rodeo-related incident. In this context, these injuries may be caused by contact with an animal (e.g., horse, bull, steer, etc.), stationary object required for rodeo events (e.g., fence, chute, etc.), or the ground. Meyers and Laurent (2010) reported that roughly 80% of all traumas pertaining to rodeo injuries were a result of contact between the athlete and livestock.

The current study was also interested in what Giza et al. (2017) describe as a “subconcussion,” defined as a traumatic injury which does not have immediate symptoms, but may result in cumulative effects later in life such as chronic traumatic encephalopathy (CTE). Given the rough nature of rodeo competitions (Meyers & Laurent, 2010), subconcussive injuries are pertinent for this research as they may lead to compounding issues later in the athlete’s life (Giza et al. 2017). Due to both the acute and chronic effects of each, the current research was geared towards investigating both concussive and sub-concussive forces on rodeo athletes.

Primary inspiration for the current research was found in part by the suicide of Canadian professional bull rider Ty Pozzobon in January of 2017 (Gillis, 2017). Following Pozzobon’s death, a growing interest has been generated among the rodeo community regarding the long-term effects of concussions on rodeo athletes. It was reported that Pozzobon suffered 12 concussions during his rodeo career (Gillis, 2017). Those closest to him believe that the long-term symptoms of his concussions may have played a part in him taking his own life. In the 18 months leading up to Pozzobon’s suicide, his family noticed a marked change in his overall affect and behavior, citing depression, panic attacks, and cognitive difficulties. Following Pozzobon’s death, his brain was donated to the University of Washington where it was analyzed in research pertaining to CTE (Gillis, 2017). Research in the area of rodeo-related concussions is necessary in order to gain valuable information to prevent cases such as Ty Pozzobon’s from becoming more common in the future.

The first findings of CTE in a rodeo competitor were published by Keene, Latimer, Steele and MacDonald (2018). The brain of the professional bull rider was

photographed using magnetic resonance imaging (MRI) techniques and compared with computed tomography (CT) and MRI scans that took place prior to the death of the athlete. This imaging revealed damage to the brain characteristic of CTE, including lesions, a contusion to the left medial temporal lobe, and a focal chronic axonal injury. This study used a variety of sources such as records review confirmed by eye witness and video accounts to estimate that this individual had sustained at least 15 concussions in his life, including being knocked out 10 times in a 12-month period (Keene et al. 2018). Accounts such as this provide compelling evidence for the overall severity of head injuries in rodeo competitors.

There have been multiple additional studies which display both injury and concussion statistics in rodeo athletes. One such study conducted by Crichlow et al. (2006) focused on rodeo injuries in Native American professional rodeo athletes, as well as protective gear used by these athletes during competition. While this study was not specifically related to mTBI, the results regarding rodeo-related injuries reported an increased risk of injury to roughstock (bareback riding, saddle bronc riding, and bull riding) contestants (Crichlow et al. 2006).

In a study by Meyers et al. (1990) it was determined that of the total injuries recorded on collegiate rodeo athletes, 92% were sustained by roughstock and steer wrestling competitors. While not considered a roughstock event, steer wrestling requires the athlete to dismount their horse at top speed onto a steer and wrestle it to a lying position on the ground. This dynamic creates a sport which may be a perfect storm for traumatic brain injuries. The hypothesis of the current research is that more roughstock contestants, with the inclusion of steer wrestlers, will have a past history of concussions

and will have a greater number of lifetime head injuries than the remaining timed-event competitors. It is also hypothesized that men will display a significantly greater history of concussions than will women because only men are allowed to compete in the roughstock and steer wrestling events.

Additional support for the prediction of increased likelihood of concussions in roughstock events can be found in Butterwick, Hagel, Nelson, LeFave, and Meeuwisse (2002). This epidemiological study gathered data from the Canadian Professional Rodeo Sports Medicine Team (CPRSMT) over five years (1995-1999) of Canadian professional rodeo which indicated that the roughstock competitions accounted for the greatest frequency of injuries. More specifically, this study found that bull riding accounted for the greatest incidence density of any event at 32.2 injuries per 1000 competitive-exposures. In addition, this study described that concussions accounted for 8.6% of all reported injuries in this time period, ranking second only to knee injuries (Butterwick et al. 2002).

One tool which has proven useful for sports-related concussions is the Sport Concussion Assessment Tool (SCAT). One positive step forward for rodeo in terms of concussion has been the verification of content validity for the SCAT (Lafave, Butterwick, Murray, Freeman, & Lau, 2013). During this verification process, items contained in the SCAT were either altered or removed to make the battery more rodeo-specific, and therefore applicable for assessing rodeo-related concussions. The SCAT provides medical professionals present at rodeo events with a valuable resource to diagnose concussions. However, one issue which may plague the sport of rodeo is that there is not a medical professional on site who can administer post-concussion protocol in

a timely manner (Meyers & Laurent, 2010). While undocumented, this problem may be amplified in smaller professional rodeos, intercollegiate rodeos, and amateur rodeos, as appropriate medical personnel are often not present at these rodeos as they may be at larger professional rodeo events. Because of this, many concussions may go undiagnosed in rodeo athletes, and athletes may continue to compete in future events without taking the necessary steps to ensure that they are physically able to do so. As a result, it may be difficult to gauge the total number of concussions any individual rodeo competitor may have sustained. The current research will address this issue by collecting data regarding both diagnosed concussions, and instances where the athlete believed they may have had a concussion, but were never diagnosed (as in Baugh, Kroshus, Daneshvar & Stern, 2014).

Another important topic of discussion is the use of protective gear in sports and their respective relationship with head injuries. Benson, Hamilton, Meeuwisse, McCrory, and Dvorak (2009) found that protective gear such as helmets are useful in preventing head injuries in sports such as snowboarding and cycling however, the use of helmets to prevent concussions yielded inconclusive results. Additionally, no strong evidence that mouth guards and face shields aid in the prevention of concussions (Benson et al. 2009). Most rodeo competitors, with the exception of bull riders, do not wear helmets when competing. Helmets are anecdotally uncommon in the sport of rodeo and this may have a significant effect on the number of concussions experienced by rodeo competitors, and more specifically, those competing in the roughstock events. Pages 50-51 of the current NIRA rulebook (National Intercollegiate Rodeo Association, 2017) state that all bull

riders are required to wear a helmet with facemask during competition and practice, therefore this will not be a focus of the current research.

Research surrounding sub-concussive forces conducted on football players which has found that even repetitive sub-concussive blows can lead to degenerative brain disorders such as chronic traumatic encephalopathy (CTE) (Mez et al. 2017). For this reason, knowledge about sub-concussive forces sustained by rodeo athletes may prove useful for future research. While other sports such as football may have players perform in practices at half-speed to reduce the risk of injury, given rodeos uncontrollable interaction with livestock (Meyers & Laurent, 2010), this procedure is not generally feasible. This issue results in a prominent risk to the rodeo athlete in both practice and competition. This study aims to investigate head injuries in both rodeo competitions and rodeo practices.

As mentioned above, the goals of the current research were twofold: (1) to assess the lifetime history of head injuries in college rodeo athletes based on their number, duration, and symptoms, and (2) to assess the underlying perceptions that rodeo athletes have regarding rodeo-related brain injuries.

## **Concussions**

A primary area of focus for this research will be the descriptive aspects of concussions in rodeo athletes such as quantity, symptoms, etc. However, as described above, a shortcoming in the sport of rodeo is the lack of proper protocol administered to athletes following a traumatic head injury resulting in many concussions going undiagnosed. Because this research is relying on individuals' self-report of past head



injuries, it is necessary to examine other research which describes the symptoms that are most indicative of concussions. Erlanger et al. (2003) details the notion that while loss of consciousness may be helpful in determining the severity of the mTBI, it may not be the best measure to determine whether or not the individual actually sustained a concussion. Self-reported memory loss within the first 24 hours after a receiving a head injury was a robust indicator of whether or not the individual actually sustained a concussion. The questions in the survey of the current research were geared towards neurocognitive difficulties associated with memory in tandem with a concussive force. A question regarding loss of consciousness was included as a measure to gauge the frequency of this symptom in rodeo athletes.

A better understanding of sport-related concussions can be created by examining concussion frequency in other sports. Including a variety of National Collegiate Athletic Association (NCAA) athletes, Kerr et al. (2017) investigated a variety of concussion parameters across three academic years. Most relevant to the current research, Kerr et al. (2017) quantified concussion frequencies in seven men's and six women's collegiate sports. This report published findings that reflected rates per 1000 athlete-exposures (one athlete in one competition or practice). The three men's sports where concussions were most prevalent were wrestling (0.89), football (0.75), and ice hockey (0.74). In women's sports, the three which displayed the highest rates of concussions were ice hockey (0.78), soccer (0.54), and basketball (0.53). Important to note is the distinction that although concussion frequencies may seem higher in sports such as men's wrestling and women's ice hockey, per team-season, men's football actually had the greatest number of concussions. This is reflective of the size of each squad that was measured. Because the

football teams studied were larger than the wrestling teams, this made wrestling have a higher frequency when football players, in fact, had the greatest number of concussions (Kerr et al., 2017).

Kerr et al. (2017) displayed results based on three intercollegiate academic seasons. The current study focused on lifetime concussions within rodeo athletes. Meyers and Laurent (2010) found a rate of 3.4 per 1000 competitive exposures for concussions in rodeo athletes. Comparing the statistics in Kerr et al. (2017) and Meyers and Laurent (2010), the risk of rodeo athletes to concussions seems to be greater than even that of collegiate football players. While the work of Kerr et al. (2017) examined collegiate athletes over the course of three academic seasons, the current study investigated lifetime frequency in rodeo athletes. Frequencies may be significantly higher due to the greater timespan being studied. Hypothesized projections for this research will predict that concussions in rodeo athletes will be focused on four of the nine college rodeo-sanctioned events. It was predicted that at least 80% of athletes in these events will have personally dealt with a concussion at some point in their career.

The concussions symptoms to be measured have been derived from the work of Merritt, Rabinowitz, and Arnett (2014). This study employed the use of collegiate athletes from a variety of sports who had previously sustained a concussion. In order from most common to least common, the acute concussion symptoms that these athletes were asked about were dizziness, headache, feeling in a fog, visual disturbance, disorientation, balance problems, pressure in the head, difficulties with attention, nausea, and numbness (Merritt et al., 2014). The current research will also investigate the 10

most common symptoms exhibited by those college rodeo athletes who have sustained a concussion (Appendix A).

### **Perceptions**

The current research was also designed to gain a better understanding of the perceptions held by rodeo competitors concerning mTBI in rodeo-related incidences. This was be done by comparing concussion perceptions of those who have sustained a concussion with those who have not. Conducting the study in this manner was advantageous because even if no significant differences had been found between groups, important data was still be collected which may improve empirical understanding concerning perceptions of head injuries within the sport of rodeo for future research.

Following any injury sustained in rodeo, athletes are anecdotally influenced to keep competing regardless of injuries or pain. The culture of these rodeo sports provides strong support for being tough over taking time off to heal from injuries (Pearson & Haney, 1999). This previous research also details that it may be seen as a point of pride in rodeo competitors to persevere through injury rather than seeking medical attention or taking time off to heal. In accordance with this tradition, head injuries may often be downplayed so that the athlete may return to competition as soon as possible. Additional research by Downey (2007) outlined that rodeo athletes quite often would rather return to the arena rather than seek medical attention. While lack of medical professionals at events may contribute to some of the undiagnosed concussions associated with rodeo, it cannot be ignored that despite the best efforts of medical professionals some athletes will continue to compete. Given these tendencies of rodeo athletes, this study looked to gain

some understanding as to how college rodeo athletes regard concussions in terms of their current and future health, as well as the longevity of their careers.

In order to learn about rodeo athlete concussion perceptions, measures used to gather data in other sports were adjusted and used in the current research. Baugh et al. (2014) report on perceived coach support relating to concussions in collegiate football players. Baugh et al. (2014) reported findings that freshman college football players believed that if they reported an event that they thought might be a concussion, they believed that their coach would support their decision. This perceived positive coach support was used as preliminary evidence that perceived coach support may lead to fewer undiagnosed concussions (Baugh et al., 2014). This provides useful insight for the current study because of collegiate rodeo athletes support from their coach, they may be more likely to report brain injuries, and then seek the assistance they need in diagnosis and recovery. Because the work of Baugh et al. (2014) was conducted using multiple football teams, and the current research is only assessing one team, perceived coach support was not specifically measured. However, it is important to take note that perceived support from a coach may decrease the number of undiagnosed concussions in college athletes.

Additional evidence of the pressure for athletes to return to their sport as quickly as possible can be found in Kroshus, Garnett, Hawrilenko, Baugh, and Calzo (2015). This study revealed that athletes generally face pressure to return to competition from four sources: 1) coaches, 2) teammates, 3) parents, and 4) fans. Athletes in contact sports were significantly more likely to return to competition prematurely than those athletes who face pressure from less than all four of these sources (Kroshus et al., 2015). This is important for the current research because pressure from coaches, teammates and parents

may have played some influence in the past history of concussions in rodeo athletes.

While college rodeo is not without fans, it can be expected that the pressure from fans in sports like basketball and football may be greater than those faced by rodeo athletes. For this reason, collegiate rodeo athletes may not be influenced by fans as much as they are by the other three sources. The sources of pressure to return from competition may be a topic of future research. The current study was developed to provide preliminary of understanding of whether or not college rodeo athletes who have sustained a concussion have felt pressure to return to competition quickly, rather than specifically determining the sources of this pressure.

Additional research surrounding concussion perceptions in football players found that concussion perceptions differed in those players who had and had not been diagnosed with a concussion in the past. Baugh, Kroshus, Kiernan, Mendel and Meehan (2017) asked questions focused around topics such as the participants' perceived risk for sustaining a concussion in the future, the possibility of missing games in the future due to a head injury, and whether concussions were predictive of dementia, Alzheimer's and CTE. Players who had been diagnosed with a concussion in the past displayed stronger beliefs about the risks of concussion in the future than did undiagnosed players (Baugh et al. 2017). In the current study, the perceived future concussion risk in rodeo athletes was investigated as well as the perceptions that differ based on history of sport-specific concussion history. Through the empirical study of concussions in collegiate rodeo athletes, this research is aimed at providing foundational evidence towards the wealth of knowledge surrounding concussions within the sport of rodeo.

**Hypothesis 1 (H1):** Those rodeo athletes who compete in the roughstock and steer wrestling events will display a significantly greater mean quantity of concussions than the remaining five collegiately-sanctioned events.

**Hypothesis 2 (H2):** Those rodeo athletes who have sustained a concussion in the past will display a significantly greater perceived likelihood of sustaining another concussion in the future than those individuals who have never sustained a concussion.

## CHAPTER III

### METHOD

#### Participants

Eighty-seven ( $n = 87$ ) members of the Tarleton State University Rodeo Team voluntarily participated in the survey (Appendix 1) at the first general meeting of the spring 2018 semester. Participants ranged in age from 18 to 25 ( $M = 20.44$ ,  $SD = 1.387$ ), including 46 females, and 41 males. A total of 13 participants were removed from the data due to invalid, ambiguous or conflicting answers on the survey. On question 4, a total of nine participants provided unclear responses when asked which of the nine college rodeo sanctioned events they currently compete in. These unclear responses included listing the number of events they currently compete in rather than the names, not listing any events, or listing an incident that is not associated with a specific rodeo event. Two participants were removed on the basis of conflicting responses both did so on the relationship between questions 6 and 13. Both participants stated that they had been officially diagnosed with a concussion in question 6, but responded negatively when asked if they had sought medical attention following the injury in question 13. One participant was removed on the grounds that on question 8 which asks which event they were competing in when they sustained their injury, the participant stated “18.” The final participant was removed due to ambiguous responses on questions 7 and 11. When asked the number of times they had been diagnosed with a concussion in question 7 they stated “a lot,” and when asked if they had ever been knocked unconscious in question 11, the participant stated “not sure.” After these athletes were removed, 74 participants were

included in data analysis. This included 39 females and 35 males ranging in age from 18 to 25 ( $M = 20.5$ ,  $SD = 1.407$ ).

### **Materials and Design**

A survey-style battery created by the researcher was used to gather relevant descriptive concussion information such as demographics (e.g., age, competitive years in rodeo, rodeo events competed in, etc.), as well as concussion-specific information (e.g., number of concussions sustained during rodeo events or practices, amount of time spent recovering after a concussion, etc.). Those questions designed to examine the underlying perceptions of concussions employed the use of a seven-point Likert scale ranging from values of one (Strongly Disagree) to seven (Strongly Agree). Questions 5 and 9 on this portion of the study were reverse-coded in order to determine if participants were giving consistent answers. The full list of questions in the battery can be found in Appendix 1.

In the first portion of the survey, participants were asked questions about their a) total number of head injuries sustained in rodeo-related activities, b) number of years competing in rodeo events or practices, the average number of rodeos that they compete in per year, c) whether these injuries were reported or unreported to a healthcare professional, d) which rodeo events they were competing in for each injury, e) the age at which they suffered the injury, the amount of time they took off from rodeo-related activities, f) the symptoms they experienced, and g) and if they have ever continued to compete with symptoms of concussions.

The portion of the battery designed to assess the perceptions of concussions in rodeo athletes included topics such as, a) the overall belief that they are likely to sustain a rodeo-related concussion in the future, b) whether or not they have felt pressure to return



to competition as quickly as possible following a head injury, c) whether or not they felt their head injury had any long-term effect on their personality or behavior (e.g., mood changes, depression, decreased cognitive ability, etc.), d) how serious they believe concussions are for rodeos athletes, e) whether they view concussions as a sign of weakness, and f) the likelihood they would continue to compete after a head injury regardless of potential detrimental impacts on their overall health in the future.

### **Procedure**

Data was collected following approval from Tarleton State University's Institutional Review Board (IRB). All members over 18 years of age were asked to participate. Participants completed the survey following obtainment of informed consent.

### **Data Analyses**

Responses were collected using pen and paper. Data are presented as mean  $\pm$  SD with an alpha significance level of .05. JASP version 0.8.5.1 (JASP Team, 2018) was used to run statistical analyses. Microsoft Excel was used to clean and prepare the data. The cleaning process involved removal of excluded participants from the dataset as well as returning items 5 and 9 of the concussion perception inventory into standard form (from reverse coding).

Descriptive statistics were run using JASP where means and standard deviations were generated. Age, sex, and official concussion data can be found in Table 1. For hypothesis 1, a one-way ANOVA was run to compare total quantity of concussions by group (roughstock plus steer wrestling events vs. timed-events vs. both). For hypothesis 2, an independent samples t-test was run with group (with concussion history

vs. without concussion history) against perceived likelihood of sustaining a concussion in the future.

## CHAPTER IV

### RESULTS

Sixteen of the 74 participants reported having sustained at least one officially diagnosed concussion, while 24 reported having been involved in an incident where they expected a concussion may have occurred, but were never officially diagnosed. The total quantity of official concussions was 33, and 87 suspected concussion incidents were reported. Table 1 details concussion history based on age and sex.

	Age	Sex	
	<i>M</i> ( <i>SD</i> )	Male (%)	Female (%)
With	20.5 (1.15)	8 (22.9)	8 (20.5)
Without	20.5 (1.47)	27 (77.1)	31 (79.5)

*Table 1.* Rodeo Athletes With and Without History of Sport-Specific Concussions

As per Hypothesis 1, a one-way ANOVA was conducted to compare mean number of concussions sustained by roughstock with the inclusion of steer wrestling competitors ( $M = 1.182$ ,  $SD = 1.471$ ,  $N = 11$ ), timed-event competitors ( $M = 0.333$ ,  $SD = 1.16$ ,  $N = 60$ ), as well as competitors who compete in at least one event in both categories ( $M = 0$ ,  $SD = 0$ ,  $N = 3$ ). There was no significant difference in event type and quantity of concussions reported  $F(2, 71) = 2.572$ ,  $p = .084$ .

For analysis of Hypothesis 2, an independent-samples t-test was conducted to compare perceived likelihood of sustaining a concussion in the future in rodeo athletes with and without a prior history of concussions. There was a significant difference in those with a concussion history ( $M = 4.94$ ,  $SD = 1.73$ ) and this without a concussion history ( $M = 3.38$ ,  $SD = 1.71$ ),  $t(72) = -3.226$ ,  $p < .001$ ,  $r = .355$ .

Exploratory analyses were conducted on remaining data to inform future research and to further understand the data. A chi-square analysis was conducted to compare the total number of men and women who had been officially diagnosed with a concussion. The relative frequencies of those with and without a history of concussions did not differ between males and females,  $X^2 = 0.06$ ,  $p = .807$ . An independent samples t-test was also conducted to compare sex and lifetime number of concussions. There was no significant difference between the number of officially diagnosed concussions in men ( $M = 0.600$ ,  $SD = 1.612$ ) and the number of officially diagnosed concussions in women ( $M = .308$ ,  $SD = .694$ ),  $t(72) = 1.031$ ,  $p = 0.306$ ,  $r = .121$ .

The total percentage of contestants per each event who have sustained at least one concussion in the past are as follows: a) 100% in bull riding, b) 50% in saddle bronc riding, c) 33% in bareback riding, d) 20% in barrel racing, e) 20% in goat tying, f) 17% in breakaway roping, and g) 12% in team roping. No contestants currently competing in the steer wrestling and tie down roping had ever sustained a concussion in the past.

Independent samples t-tests were again conducted comparing perceptions in those with and without a history of sport-specific concussions. Only two questions produced significant differences between groups, in that those with a history of concussions found it significantly more inconvenient to take time off following a head injury than those without a concussion history. Additionally, those with a history of concussions held significantly stronger beliefs that pursuing through pain and injury is part of being a rodeo athlete than those without a history of concussions. A full report of concussion perceptions in those with and without a history of sport-specific concussions was created. The standard alpha criterion of .05 was used. Multiple comparisons were

then corrected for. Outputs can be found in Table 2. A summary of pooled concussion perceptions scores can be found in Table 3.

The reliability and the validity of the Likert items were also investigated. Reliability analyses did not indicate internal consistency (Cronbach's  $\alpha = .078$ ) between items. A correlation matrix of inter-item relatedness can be found in Table 4. In addition, the validity of the items included in the survey was verified by an experienced collegiate rodeo coach and former professional rodeo athlete.

Variable	With		Without		<i>t</i> (72)	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Issue	6.25	0.78	5.86	1.3	-1.13	.13
Future	4.94	1.73	3.38	1.71	-3.23	< .01* <sup>a</sup>
Pain	5.81	0.98	5.03	1.6	-1.85	.03*
Weakness	2.56	1.71	2.1	1.5	-1.05	.15
Personality	5.75	1.48	5.81	1.65	0.13	.55
Cognitive	6.13	1.36	6.21	0.97	0.27	.61
Inconvenience	2.88	1.31	1.85	1.31	-2.79	< .01* <sup>a</sup>
TimeOff	5.19	1.28	5.16	1.57	-0.08	.47
Encourage	5.81	1.11	5.41	1.83	-0.83	.21

Table 2. Concussion Perceptions in Athletes With and Without Concussion History

\*indicates significant results at  $p < .05$  alpha criterion

<sup>a</sup> indicates a significant result after correction for multiple comparisons (  $\alpha/9$  )

	<i>M</i>	<i>SD</i>
Issue	5.95	1.22
Future	3.72	1.82
Pain	5.20	1.52
Weakness	2.20	1.54
Personality	5.80	1.61
Cognitive	6.19	1.06
Inconven.	3.07	1.37
TimeOff	5.16	1.50
Encourage	5.50	1.70

Table 3. Descriptives for Concussion Perceptions

		Issue	Future	Pain	Weakness	Personality	Cognitive	Inconven.	TimeOff	Encourage
Issue	Spearman's rho	—								
	<i>p</i>	—								
Future	Spearman's rho	.22	—							
	<i>p</i>	.06	—							
Pain	Spearman's rho	.02	.22	—						
	<i>p</i>	.89	.06	—						
Weakness	Spearman's rho	-.21	-.02	.24	—					
	<i>p</i>	.08	.84	<b>.04*</b>	—					
Personality	Spearman's rho	.09	-.06	-.25	-.53	—				
	<i>p</i>	.43	.63	<b>.03*</b>	<b>&lt; .001*</b>	—				
Cognitive	Spearman's rho	.25	.01	-.05	-.22	.56	—			
	<i>p</i>	<b>.03*</b>	.95	.67	.06	<b>&lt; .001*</b>	—			
Inconven.	Spearman's rho	-.16	.22	< .001	.27	-.29	-.35	—		
	<i>p</i>	.17	.06	1.00	<b>.02*</b>	<b>.01*</b>	<b>.002*</b>	—		
TimeOff	Spearman's rho	.13	-.09	-.07	-.19	.27	.48	-.52	—	
	<i>p</i>	.26	.43	.57	.10	<b>.02*</b>	<b>&lt; .001*</b>	<b>&lt; .001*</b>	—	
Encourage	Spearman's rho	.47	.16	.07	-.29	.17	.20	-.30	.13	—
	<i>p</i>	<b>&lt; .001*</b>	.16	.54	<b>.01*</b>	.157	.08.	<b>.01*</b>	.29	—

Table 4. Inter-tem relatedness for Concussion Perception Items

\*indicates significant results at  $p < .05$  alpha criterion

## **CHAPTER V**

### **DISCUSSION**

The initial hypothesis that concussion frequency would be greater in the combination of roughstock and steer wrestling events over that of the remaining timed-events was not supported. Additionally, no significant differences were found in those who compete in both roughstock and timed-events compared with each group individually. No significant differences were found between sex and lifetime history of sport-specific concussions. Because only men are eligible to compete in the roughstock and steer wrestling events, we would expect to see similar results in across these tests. Although not supported in the current research, past studies indicate greater frequency of injury in the roughstock and steer wrestling events (Meyers et al. 1990), as well as greater frequency of concussions in the roughstock events, more specifically bull riding (Butterwick et al. 2002). One reason the effect was not found on concussion quantity vs. event type in the current research may be due to the unbalance of group size in this study. Future research could compare an equal sample size of roughstock and steer wrestling competitors against the remaining timed-events. Because there were only 11 active roughstock and steer wrestling competitors compared to 60 timed-event competitors, and only 3 who in the combination group, the imbalance may have resulted in a significant effect that was difficult to detect. The finding that all participants currently competing in the bull riding have sustained at least one concussion in the past provide compelling evidence pertaining to the risk of concussions in at least some rodeo events.

The hypothesis that those participants who have experienced a concussion in the past will feel like they are more likely to experience one in the future was supported. This



conclusion parallels results found in Baugh et al. (2017) which found that football players with a history of concussions displayed significantly greater perceived risk of sustaining a concussion in the future than those players with no history of concussions. Possible explanations for this result could include that once a rodeo athlete has sustained a concussion, they become more cognizant of the risks associated with rodeo in respect to head injuries. This increased awareness due to personal experience may cause the elevated level of perceived future concussion risk over those with no concussion history. More research is necessary to determine if this increased perceived likelihood correlates with actual future injuries.

Empirical evidence supporting the belief that rodeo competitors have a culture of continuing to compete regardless of injury, such as reported in Pearson and Haney (1999) and Downey (2007) can be found in the analysis of one item in the concussion perception inventory. Participants responded favorably the question phrased, “Persevering through pain and injury is all part of being a rodeo athlete.” Although those participants with a history of concussion scored significantly higher than those without such a history, participants as a whole seemed to make this distinction that being tough is part of the rodeo lifestyle.

### **Limitations**

Limitations of the current research include lack of participants in the events which previous research (e.g., Crichlow et al. 2006; Meyers et al. 1990) indicates concussions may be more prevalent. The steer wrestling ( $n = 4$ ), bareback ( $n = 3$ ), saddle bronc riding ( $n = 4$ ), and bull riding ( $n = 4$ ) events contained a small number of participants, as these were all that were available on the current roster of the rodeo team in this research.

Because collegiate rodeo teams do not require a set roster as other sports such as football do, this may make collegiate rodeo studies more difficult. Potential future research could seek to establish a relationship between the low numbers of participation in these events and the overall increased likelihood of injury associated with them. The issue of small sample size in the current research may be corrected in future studies by drawing participants from professional rodeo platforms such as the Professional Rodeo Cowboys Association (PRCA), Canadian Professional Rodeo Association (CPRA), or Women's Professional Rodeo Association (WPRA) where there is a greater quantity of rodeo athletes in all events.

Another limitation of this study is that analysis of concussion history was conducted on the events participants currently compete in rather than in the event the injury took place. Because rodeo competitors often switch between events throughout their careers, the current event they compete in may not be an accurate representation of concussion risk based on event type. While the current research did ask about which event the injury took place in, there was no delineation between whether or not it was an officially diagnosed or suspected injury. However, given the nature of the current study to examine the descriptives of lifetime concussion history in rodeo-related incidents, valuable information was still obtained about the overall risk of mTBI in the rodeo athlete.

### **Future Directions**

While the present research provides insight surrounding concussions in collegiate rodeo athletes, more research will be needed in the future. Improvements to the current design will be necessary if this study is to be completely or partially replicated in the

future. One specific area of concern is the quantity of data which needed to be removed due to errors made by participants during completion of the survey. More specifically, nine of the 87 original participants were removed on question 4, when they were asked to state in which of the nine rodeo events they currently compete. An amendment to the survey must be made in the future if this battery is to be used again. A simple solution would be to provide a list of the nine events and have participants circle those in which they currently compete.

Additional improvements to the current design could improve the research of lifetime concussion history. This would require having multiple spaces where participants could fill in events they currently compete in, as well as all events they have competed in in the past. Participants would then be able to state whether or not they had sustained an officially diagnosed concussion in each event. This would help to solve the logistical problem of participants switching events throughout their rodeo careers. Such measures would improve the accuracy of concussion history by event type.

One specific avenue of potential future research is that of concussions in professional rodeo athletes. While the collegiate rodeo athlete competes in about 10 rodeos per season, the men and women of professional rodeo may compete in upwards of 100 rodeos per season. These athletes often depend on their performance in the arena to provide for both them and their families, so concussion descriptives and perceptions may be vastly different in professional rodeo athletes. A study of this nature would likely require the cooperation of the PRCA, CPRA and WPRA. Another avenue of concussion research on professional rodeo athletes may examine pressure from outside sources to

keep competing, as many top-level rodeo athletes hold lucrative endorsements and may be influenced to compete regardless of injury.

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## APPENDIX 1

1. Current age
2. Sex
3. At what age did you begin competing in rodeo?
4. Which of the nine college rodeo-sanctioned events do you currently compete in?
5. On average, how many rodeos do you currently compete in per year? (Please Circle)  

0-25	25-50	50-75	75-100	100+
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6. How many times have you been diagnosed with a concussion by a medical professional (doctor, athletic trainer, nurse) following a rodeo-related injury?
7. How many times have you sustained an impact in a rodeo-related incident that you suspect was a concussion but that was never diagnosed?
8. What event were you competing in when you sustained the injury?
9. How old were you when each of these concussion or suspected-concussion events occurred? (Please state each age)

10. Of the following, which symptoms did you exhibit? (Circle all that apply)

Dizziness

Balance problems

Headache

Pressure in the head

Feeling in a fog

Difficulties with attention

Visual disturbance

Nausea

Disorientation

Numbness

11. Have you ever lost consciousness (i.e., been knocked out) from a rodeo-related incident?

12. How many times have you returned to rodeo competition or practice while experiencing symptoms after an impact?

13. Did you seek medical attention following this injury?

14. Did you tell anyone (parent, coach, teammate, etc.) about this injury?

Perceptions on concussions in myself: For the following questions, answer by indicating a value ranging from one (Strongly Disagree) to seven (Strongly Agree).

1. Concussions are a serious issue for rodeo athletes.

1      2      3      4      5      6      7

2. I am likely to sustain a concussion in the future.

1      2      3      4      5      6      7

3. Persevering through pain and injury is all part of being a rodeo athlete.

1      2      3      4      5      6      7

4. Taking time off following a concussion or head injury is a sign of weakness.

1      2      3      4      5      6      7

5. I believe that concussions and head injuries do not have a long-term negative impact on overall personality (e.g. differences in mood, changes in behavior, etc.).

1      2      3      4      5      6      7

6. I believe that concussions and head injuries can have long-term negative impact on overall cognitive capabilities (e.g., changes in memory capabilities, changes in concentration).

1      2      3      4      5      6      7

7. I believe that seeking medical attention after a head injury is an inconvenience and usually unnecessary.

1      2      3      4      5      6      7

8. If I sustain a concussion or head injury in the future, I am likely to take all of the time necessary to recover before I return to competition.

1      2      3      4      5      6      7

9. If I see a fellow competitor or teammate sustain a head injury, I am likely to encourage them to return to competition as soon as possible.

1      2      3      4      5      6      7

## APPENDIX 2

## Recruitment Script

(Kody Lamb) Today you can choose to participate in a research study for my thesis project. There is a lack of scientific inquiry surrounding rodeo athletes and concussions. This study has been designed to investigate concussions and perceptions of concussions in collegiate rodeo athletes. If you choose to participate, you will fill out a short survey and your identity will be kept separate from your answers to protect confidentiality. If you would like to cease participating at any time please feel free to do so.



