Sudden Impact: Concussion in Female Roller Derby Athletes

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Abstract

Objectives: Roller derby is one of the fastest-growing women’s sports in America. Known for its aggressive nature as a full-contact sport, no concussion studies have been undertaken on these athletes. Increasing awareness of head injury in all sports has drawn attention that brain trauma in roller derby athletes needs evaluating. An exploratory study was undertaken to assess the occurrence of concussion to enable further preventive research of brain trauma in this sport.

Methods: Adult female athletes attending the 2014 Roller Con international roller derby conference were surveyed about roller derby related concussion rates. Additional information included league protocols, competition level, and demographics. A sample of 75 participants, stratified by age and sex, was theorized to reach information saturation as an explorative study.

Results: In total, 75 out of 97 randomly approached athletes consented (response rate 77.3%). Mean age of athletes surveyed was 32, with over 3 years’ experience playing roller derby and represented four countries. On interview 58% self-reported a concussion history. Twenty-two athletes changed their concussion history after reading medical concussion criteria (29.7%). The mean concussion history was 1.5 (range 1-5) per player.

Conclusion: Concussion occurrences in adult female roller derby athletes represent a serious risk when playing this sport. Pre-season head trauma evaluation for leagues is recommended to raise awareness of properly identifying and treating concussion. More in-depth studies are needed to correlate if on-track observations agree with recall.

INTRODUCTION

Roller Derby is described as the fastest-growing women’s sport in America and boasts over 1,500 leagues world-wide [1,2]. The sport attracts athletes of all ages and abilities, from those who have never skated or participated in team sports to Olympic gold medalists [3,4]. The first and largest competitive international organization is the Women’s Flat Track Derby Association. By 2015, WFTDA had grown to 316 full member leagues and 98 apprentice leagues [1]. WFTDA is divided into three competitive divisions and holds an international bracketed tournament annually for the top two divisions. This fast-paced, full-contact sport takes place on a flat-track court with athletes on quad speed skates. A bout consists of two 30-minute halves broken up into multiple 2-minute “jams”. Each team fields 5 players on the track for each jam, which consists of 4 blockers – collectively referred to as “the pack” – and one jammer, identified by a star on her helmet. The jammer is the athlete who scores points. In order to be eligible to score, she must legally pass through the pack once, and then she enters scoring laps. On a scoring lap, for each opposing athlete’s hips she passes, she receives one point. The blockers’ objective is to block the opposing jammer while assisting their own jammer through the pack (Figure 1). Blockers can do this by passive blocking or direct hits delivered with the hips, shoulders, or chest targeting a legal blocking zone. The legal blocking zone extends from above the knees to the shoulders, excluding the back. An illegal block is if the blocker targets an illegal blocking zone, or utilizes forearms, elbows, or head to make contact (Figure 2). League members skate under a set of rules and adhere to a safety protocol developed by a risk management committee (composed of skaters, officials, and team physicians and are online at www.wftda.com) [5,6]. WFTDA acknowledges the importance of concussion safety and awareness through articles addressing concussion in their magazine, Five on Five, and an extensive concussion protocol is documented that includes removal from play and a graded return-to-play protocol in the WFTDA safety manual [7-12]. For additional safety of the athlete, in order to be eligible to participate in sanctioned games, new skaters must pass a minimum required skill set, e.g., 180-degree turns, skating on one foot, and be deemed to be safe for full-contact (able to safely accept and deliver hits). While these important safety measures were put in place to protect...
When compared to sports with the same rules as males (e.g., lacrosse), females had a higher concussion incidence than males [15,19]. In sports such as ice hockey and soccer the concussion rates are higher in female athletes compared to their male counterparts [20-22]. This higher risk is especially pertinent to roller derby because it is a predominantly female sport and is full-contact – high risk factors for concussion [22,23]. Another issue surrounding concussion is the underreporting of symptoms – from not recognizing concussion symptoms to believing that it was still safe to play [24-26]. In a survey of rugby teams, 38.5% of male players were unaware of the symptoms of concussion and 10% thought it was safe to return to play after sustaining a concussion [27]. Even the small percentage of individuals believing it is safe to play with a concussion is considered too much because of the severe consequences, such as second impact syndrome, which can result in death [28, 29]. Literature specific to female athlete injuries is emerging, but as of 2015 there were no published studies assessing any form of injury in the sport of roller derby. With the absence of literature on roller derby injury epidemiology, and an increased focus on concussion awareness and education in sports, this study was undertaken to explore the knowledge of roller derby athletes on concussion and to identify the occurrence of concussion by the athletes in the sport.

METHODS

Study Population

Adult female athletes attending the 2014 International Rollercion roller derby convention in Las Vegas, NV.

Survey Design

Based on discussions with coaches and roller derby athletes an exploratory survey using a convenience sample random encounter technique was selected as an efficient strategy to explore concussion occurrence in female roller derby competition. Seventy-five athletes were estimated as the number needed to research “information saturation” (the point in data collection when no new or relevant information emerges with respect to a newly constructed theory) [30]. Athlete participant encounter occurred over a five-day period. Every tenth roller derby athlete walking by the researcher in the convention hallway, female and over 18, was invited to take the mobile survey. To control some of the variables while collecting data, the researcher wore the same professional attire, was located in the same area of the convention center, and approached volunteers with a scripted greeting [31]. The survey was administered on an iPad. Approval of research was granted through the University of Washington’s Institutional Board Review Human Subjects Division.

Questionnaire Variables

The survey collected concussion history regarding self-reported roller derby related injury rates before and after the provision of a medical definition of concussion [13,14,32]. Additional questions centered on whether the athletes’ roller derby league had an existing concussion protocol and if they had read the Women’s Flat Track Derby Association’s Safety Manual. If answering “yes” to their league having an existing concussion protocol, the athlete was asked if that protocol included baseline concussion testing administered by a trained healthcare
To determine the level of play, athletes disclosed the competitive division (Division 1, 2, 3, or Apprentice) and the league structure they skated on. General demographics such as age, state/province, and country were collected so that the study population could be accurately described. The full questionnaire is in the Appendix.

**RESULTS**

A total of 97 roller derby athletes were approached at the convention. Of the athletes approached, 75 agreed to participate in the survey with a response rate of 77.3%. Seventy-four of the 75 surveys were included in the analysis (the excluded was under 18 years age). The mean age was 31.7 (±6.4) yrs., had been in competitive roller derby 3.6 (±2.2) yrs., and almost exclusively (98.7%) played under the WFTDA rule set (Table 1). Before reading a medical definition of concussion, the baseline concussion occurrence screening found 35.1% of the athletes met roller derby related concussion criteria. This increased to 54.1% after providing a medical definition of concussion (Table 2). The mean baseline concussion occurrence (pre-definition) was 0.53 roller derby related concussions, and the mean increased to 0.96 after providing a medical definition of concussion (P <0.001). In total, 22 (29.7%) athletes changed their self-reported concussion history post-definition with only one athlete decreasing her total, 22 (29.7%) athletes changed their self-reported concussion history based on pre- and post-medical concussion definition. Logistic regression models incorporating risk factors (e.g. age, time playing derby, competitive division) to concussion were assessed using the generalized linear model in R (an open source statistical package) [33].

### Table 1: Mean player profile.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age at time of survey</td>
<td>31.7 ±6.42</td>
</tr>
<tr>
<td>Mean years played roller derby</td>
<td>3.6 ±2.20</td>
</tr>
<tr>
<td>Uses WFTDA rule set</td>
<td>96.7%</td>
</tr>
<tr>
<td>WFTDA Division: D1</td>
<td>35.1%</td>
</tr>
<tr>
<td>WFTDA Division: D2</td>
<td>10.8%</td>
</tr>
<tr>
<td>WFTDA Division: D3</td>
<td>21.6%</td>
</tr>
<tr>
<td>WFTDA Division: Apprentice</td>
<td>12.2%</td>
</tr>
<tr>
<td>Non-WFTDA</td>
<td>20.2%</td>
</tr>
</tbody>
</table>

### Table 2: Concussion Protocols and Safety.

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Percentage</th>
<th>(Count/Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concussion protocol</td>
<td>58.1%</td>
<td>(43/74)</td>
</tr>
<tr>
<td>No concussion protocol</td>
<td>17.6%</td>
<td>(13/74)</td>
</tr>
<tr>
<td>Unsure of concussion protocol</td>
<td>24.3%</td>
<td>(18/74)</td>
</tr>
<tr>
<td>Concussion protocol baseline testing</td>
<td>62.8%</td>
<td>(27/43)</td>
</tr>
<tr>
<td>Players who have read WFTDA safety</td>
<td>44.6%</td>
<td>(33/74)</td>
</tr>
<tr>
<td>Players who have not read WFTDA safety</td>
<td>55.4%</td>
<td>(41/74)</td>
</tr>
</tbody>
</table>

**DISCUSSION**

This is the first exploratory study into concussion occurrences in the sport of roller derby – a high impact, primarily female sport. As with any full-contact sport, understanding the injury implications and filling in knowledge gaps is essential for athlete safety. This survey revealed a high occurrence of brain trauma: 54.1% reporting one or more concussions over their roller derby

![Figure 3](3. Post definition concussion occurrence in roller derby athletes.)
career. Yet half of these athletes play under a concussion protocol and had read the WFTDA safety protocol. Robbins et al. evaluated the effect of providing a definition of concussion on lifetime self-reported concussion to athletes in any sport and found that 73% of their sample population (n=459) increased the number of self-reported concussions from baseline [32]. This suggests that concussion awareness among roller derby athletes is meaningful, and the majority of athletes are aware of the medical definition of concussion. However, 30% of athletes changed their self-reported concussion history post-definition showing there are opportunities for improvement in concussion education.

Overall occurrence was one concussion per player over a mean of 3.6 years of sport participation. That observation, with over 10% reporting three or more concussions, is concerning because it raises the question, how many concussions are too many? Having had a concussion increases an athlete’s chance of incurring additional head trauma, prolonging recovery, and increases the chance of long-term effects [19, 23, 34]. No statistical differences emerged in concussion reporting between pre- and post-concussion definition (or higher self-reporting if an athlete’s league had a concussion protocol compared to those athletes who were unsure if their league had a protocol or reported no protocol). Nor was there meaningful differences between athletes’ pre- and post-definition concussion reporting whose leagues performed baseline testing as part of their concussion protocol compared to leagues that did not. While baseline testing is not required for adequate assessment and evidence does not support the widespread use, pre-season medical evaluation which includes concussion history and education is data supported [14]. Advocates of baseline testing maintain that it allows for consideration of demographic factors, such as gender and age, considers individual strengths and weaknesses, and aides in determining concussion severity [35]. Pre-season baseline testing, much like concussion evaluation, presents an opportunity to educate athletes on the prevention, symptoms, and management of concussion while providing a comparison should an athlete become concussed [14]. An additional educational resource is the CDC’s free online training program "Heads up Concussion" which has modules geared toward coaches and clinicians [36].

LIMITATIONS

The nature of this study is based on individual recall. As an exploratory study, it drew on a convenience sample to maximize accessibility and concentration of athletes. Almost all of the skaters surveyed were associated with WFTDA teams providing some uniformity of attendees. A survey that would go out to all WFTDA teams and registered athletes could capture a broader measure of concussion occurrences in roller derby athletes, but it would remain a retrospective study of contributing risk factors to concussion and survey participation rates tend to be low. The fact that no correlation was seen with any of the surveyed factors and concussion awareness in this study suggests a high variability between leagues and concussion practices.

A larger sample size may reveal a correlation between the leagues’ concussion policies and concussion awareness and history. Additional information gathered about these participants’ concussions and whether they were removed from a game or practice, followed a graded return-to-play protocol, or were evaluated by a health care professional would evaluate if leagues are properly managing concussed athletes. Furthermore, because this was exploratory in nature, this study did not categorize the setting in which concussions occurred (e.g. practice, bout, or tournament play). The time interval between concussions of those athletes who reported more than one concussion could also help evaluate a protocol for an acceptable number of sustained concussions within a season or career. This study was unable to evaluate true competitive level due to the complex nature of rankings and league structure. However, prospective research could film track events, record contacts per unit time, falls, axial and limb injury, health injury, and minutes of game event and participation per injury.

CONCLUSION

Concussions are one of the serious risks of playing full-contact sports, and the importance of having a concussion protocol is fundamental to educate and protect athletes. Female roller derby athletes attending an international conference were surveyed about concussion history. Over half reported at least one concussion in their roller derby careers and some as many as five occurrences. While WFTDA’s safety manual has a concussion protocol and graduated return to play, the concussion awareness rate by half of those surveyed suggests that leagues could better educate their athletes. Additional research is needed to better understand the incidence, prevalence, severity, and long-term effect this growing sport has on its athletes.

ACKNOWLEDGEMENTS

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