Report of the Ivy League Concussion Review Committee
Review of Concussions in Men's and Women's Rugby

Action Item

- Review and endorse rugby recommendations in Section IV.

I. Introduction

The Ivy League Council of Presidents, in December 2010, agreed to form an ad hoc Concussion Committee to discuss how the Ivy League could assume a leadership role in trying to limit the incidence of concussion. The Council adopted measures in football in June 2011, and charged the committee to consider the review of other sports.

The original ad hoc Concussion Committee expanded to cover multiple sports, and in 2015-16 a new ad hoc committee was formed for men's and women's rugby. (See **Appendix A** for the committee roster). The Rugby Committee met in February 2016 to formulate initial recommendations. The rugby club and varsity coaches reviewed those initial recommendations in March 2016. The full rugby recommendations are included with this report. Following Council and other reviews, the Committee intends to implement the approved recommendations in the fall of 2016.

This report is a summary of the background information and data used to review men's and women's rugby, in addition to the Committee's recommendations for measures to limit the incidence of concussion. **Appendix B** contains a summary of rugby concussion data within the Ivy League. For further reference **Appendix C** contains a summary of current practices in club rugby related to athletic training coverage and other aspects addressed in the report. **Appendix D** contains a summary of research related to injuries in Rugby.

II. Rugby Background and Rules

A. Background information

Although rugby is not an official NCAA sport, women's collegiate rugby has been considered a NCAA "emerging sport" since 2002. In the Ivy League Harvard, Brown and Dartmouth have varsity women's rugby programs. Rugby is a unique contact and collision sport with the same rules for men and women.

Rugby is a fast-paced sport with few stoppages of play. A rugby fifteens match has 40-minute halves and consists of 15 players per team. A rugby sevens match consists of seven players per team with seven-minute halves. Within a team, athletes are split between groups of positions called forwards and backs. Forwards are typically responsible for acquiring and maintaining ball possession through tackling and scrummaging. Backs tend to be more responsible for moving the ball

towards a goal line via passing, kicking, and running. Although there are specialty positions, each position is both offensive and defensive in nature because all players are allowed to move the ball up the field or tackle. Unlike American football, rugby does not require players to wear protective equipment. Common rugby equipment includes: mouth guards, cleats, soft headgear, or padded undershirts.

B. Club versus varsity rugby

The Committee noted there are important distinctions between varsity and club rugby, and took into account these differences when discussing and formulating the recommendations.

1. Practice

NCAA varsity programs are limited to four hours of practice per day, 20 hours per week, and must have a day off in-season. Club teams do not have practice limits in terms of the number of hours per day or per week, though according to the survey summarized in **Appendix C**, the club teams tend to practice two to four days per week.

2. Competition

NCAA varsity programs are limited to 16 dates of competition with a few exemptions for postseason and other special events. Club teams do not have a limit on the number of contests or dates of competition.

3. Access to Training Room and Strength and Conditioning

NCAA varsity programs are often assigned a trainer for practices and games and work regularly with institutional strength and conditioning staff. Club teams may not have access to athletic trainers or strength and conditioning resources on campus. See **Appendix C** for a detailed summary by institution.

C. Rugby Rules and Rules Changes Addressing Head Injuries

World Rugby Laws have recently instituted rules and regulations related to head injuries and return-to-play protocol. In elite levels of rugby, one recent change (May 2015) involves the temporary replacement concussion protocol. In elite matches, if a player is suspected of sustaining a concussion s/he must be immediately removed from the field of play and follow the Head Injury Assessment (HIA) Tool and Process.[1] When a player is suspected of having a concussion, this protocol allows medical staff to administer the HIA tool, formerly titled the Pitch Side Concussion Assessment (PSCA) tool. Even if a team has already used their maximum allotted substitutions, this temporary player can still be utilized so that the injured player

can complete the HIA.

Below are a few key concepts that govern the temporary replacement:[1]

- If the removed player does not return within ten minutes of leaving the field of play, the replacement player will automatically become permanent and the replaced player is not allowed to return to the match.
- If the temporary replacement takes place within the ten minutes before half-time, the replacement shall become permanent unless the replaced player returns to the field of play immediately at the start of the second-half.
- The temporary replacement can also be temporarily replaced if the player also requires a head injury assessment.

In addition to the HIA protocol, a Graduated Return To Play (GRTP) program must also be followed before an athlete is permitted to play rugby again. World Rugby's GRTP guidelines follow the 6-stages of the Zurich Concussion Consensus Statement GRTP protocol.[2] The GRTP protocol should not start, or continue to the next stage, until an athlete is symptom free. In addition, each stage of the protocol should last a minimum of 24 hours. World rugby strongly recommends that athletes with a concussion/suspected concussion are referred to a medical professional for their GRTP guidance and final return to play decisions.

The 6 stages of the GRTP protocol include:[2]

- Physical rest period (World Rugby recommends 1 week post-injury)
- Light aerobic exercise
- Sport-specific exercise
- Non-contact training drills
- Full contact practice
- Full return to play

III. Research regarding concussions in Rugby

A. Rugby Literature Review

Unfortunately, data focusing exclusively on concussions in American collegiate rugby are limited. However, research has reported a high injury rate in rugby players generally. A full summary of the research related to rugby may be found in **Appendix D**.

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[1] http://laws.worldrugby.org/downloads/World_Rugby_Laws_2016_EN.pdf
[2] World Rugby Concussion Guidance, Version 2, Last Updated September 8, 2015

- Overall injury rates for competition for women were 16.9 per 1000 player game hours (PGH). Overall injury rates in competition for men were with 17.1 per 1000 PGH. (Kerr, *Br J Sports Med.*, 2008)
- One study on New England club rugby teams found that men and women had a similar game to practice injury rate ratio of 4:1 (Kerr, *Br J Sports Med.*, 2008)
- One study reported the most commonly injured body site was the head/face (rate of 4.58 per 1000 PGH) with the majority of those injuries categorized as severe (includes concussions, lacerations and fractures). (Kerr, *Br J Sports Med.*, 2008)
- Regarding head injuries specifically, men had a higher game concussion rate than women with 2.16 (men) and 1.58 (women) per 1000 PGH. (Kerr, *Br J Sports Med.*, 2008)
- Comparing NCAA injury rate data, men's and women's rugby (22.5 and 22.7 injuries per 1000 game athletic exposures [GAE]) had similar rates to those of men's and women's soccer (23.5 and 19 injuries per 1000 GAE), but lower than American football (41.4 injuries per 1000 GAE). (Garraway, *The Lancet*, 1995)(Bird, *Br J Sports Med*., 1998)(Shankar, *American Journal of Sports* Med, 2007)
- Concerning mechanisms of injury, tackling and being tackled is the game and practice event most associated with injury. (Kerr, *Br J Sports Med.*, 2008)

B. Ivy League Concussion Rates in Rugby

Ivy League data were found to be consistent with the rugby research literature, with the highest rates of concussion occurring during competition. The concussion rate in practice is 1.2 per 1000 AE, with the competition rate more then ten times that rate at 12.6 per 1000 AE. Of the 81 reported concussions in rugby, 57 (70.4%) resulted from person-to-person contact, with most of the remaining instances from contact with the ground (24.7%), and a few from the ball or other contact (4.9%).

IV. Identified Areas of Risk and Corresponding Recommendations

The Ad Hoc Committee on Men's and Women's Rugby, with the support of the rugby coaches, recommends each Ivy League institution review its practices and policies in the following areas and institute the appropriate policies and best practices to potentially reduce the incidence of concussion in men's and women's rugby. For further reference, attached as **Appendix D,** is a comparison among the Ivy institutions in the areas of medical coverage and other topics addressed by the committee.

A. Higher Incidence of Concussion for Novice Players

- Students new to the sport should normally attend a minimum of ten practices prior to participating in competition or an appropriate acclimatization period determined by the institution.
- Best practices should include implementing a tackling learning progression and tackling test protocol, requiring specified skill levels for activities that include contact
- As a best practice, team strength and conditioning programs should be in place to enhance players' resistance to injury.
- Strength and conditioning programs should include an emphasis on neck strength as well as general proprioception and body awareness.

B. Higher Incidence of Concussions in Competition

- Limit the annual competition dates to 16 plus post-season tournaments per player.

C. Incidence of Concussions in Practice

- Teams should limit practices to no more than two per day, for a total of no more than five hours, and only one of those should include full scrimmage/tackling (taking players to the ground).
- Teams must have a minimum of four hours of rest (no countable athletic activity, including film review or chalk talk) between practices.

D. Best Practices for Player Safety and Ongoing Care

- Institutions should have a protocol in place for pre-participation physicals by all incoming and returning students.
- All participating student-athletes should wear mouth guards for competition and as a best practice for contact practices as well.
- Institutions will implement and adhere to the World Rugby 5-step return to play protocol following injury
- A trained medical professional should be available to treat players at all practices and competitions.
- As a best practice, students should be encouraged to sign up with USA Rugby to be fully covered by USA Rugby's insurance program (i.e. Club and Individual Participation Program or "CIPP").

E. Small Data Set For the Sport of Rugby

- All Ivy League rugby teams should participate in the Ivy League Epidemiology of Concussions study in order to provide ongoing relevant data to inform coaches and players regarding the cause of concussions in Ivy League rugby and thus possible means of prevention.

F. General Concussion Education

- Each institution must develop a mechanism to educate coaches and students on the signs and symptoms of concussion and encourage reporting.

V. Timeline for Review and Endorsement

The Committee on Administration approved the recommendations and best practices from the Ad Hoc Committee on Rugby Concussions. The full report will be presented to the Council for its endorsement on June 8.

Appendix A: Committee Roster

Kathy Flores, Brown (Head Coach)
Beth Conroy, Brown (Athletic Trainer)
Brian Jines, Columbia (Director of Intramural and Club Sports)
Eric Wamsley, Columbia (Athletic Trainer)
Dexter Kozen, Cornell (Faculty advisor to Rugby Clubs)
Shanna Kornachuk, Harvard (Athletic Administrator)
Sue Parker, Harvard (Head Coach)
Wendy Bordeau, Dartmouth (Athletic Administrator)
Ben Shuler, Dartmouth (Trainer)
Eric Laudano, Penn (Athletic Administrator)
Allison Rich, Princeton (Athletic Administrator)
Duke Diaz, Yale (Senior Associate Athletic Director of Payne Whitney Gymnasium Adminisration and Physical Education)
Greg McWilliams, Yale (Head Coach, Men's Rugby)
Tom Migdalski, Yale (Director of club Sports and Intramurals)
Milli Luciano, Official

Ivy League Office:
Robin Harris, Executive Director
Carolyn Campbell-McGovern, Deputy Executive Director
Megan Morrison, Assistant Executive Director

MECHANISM OF INJURY BY POSITION PLAYED IN MEN'S AND WOMEN'S RUGBY

W Rugby Varsity

	Ball	Ground	Person	Other	TOTAL
Forward	1	6	14	1	**22**
Back	0	3	6	0	**9**
Lock/Second Row	0	0	1	0	**1**
Prop	0	1	0	0	**1**
ALL POSITIONS	**1**	**10**	**21**	**1**	**33**
	3.0%	**30.3%**	**63.6%**	**3.0%**	**100%**

W Rugby Club

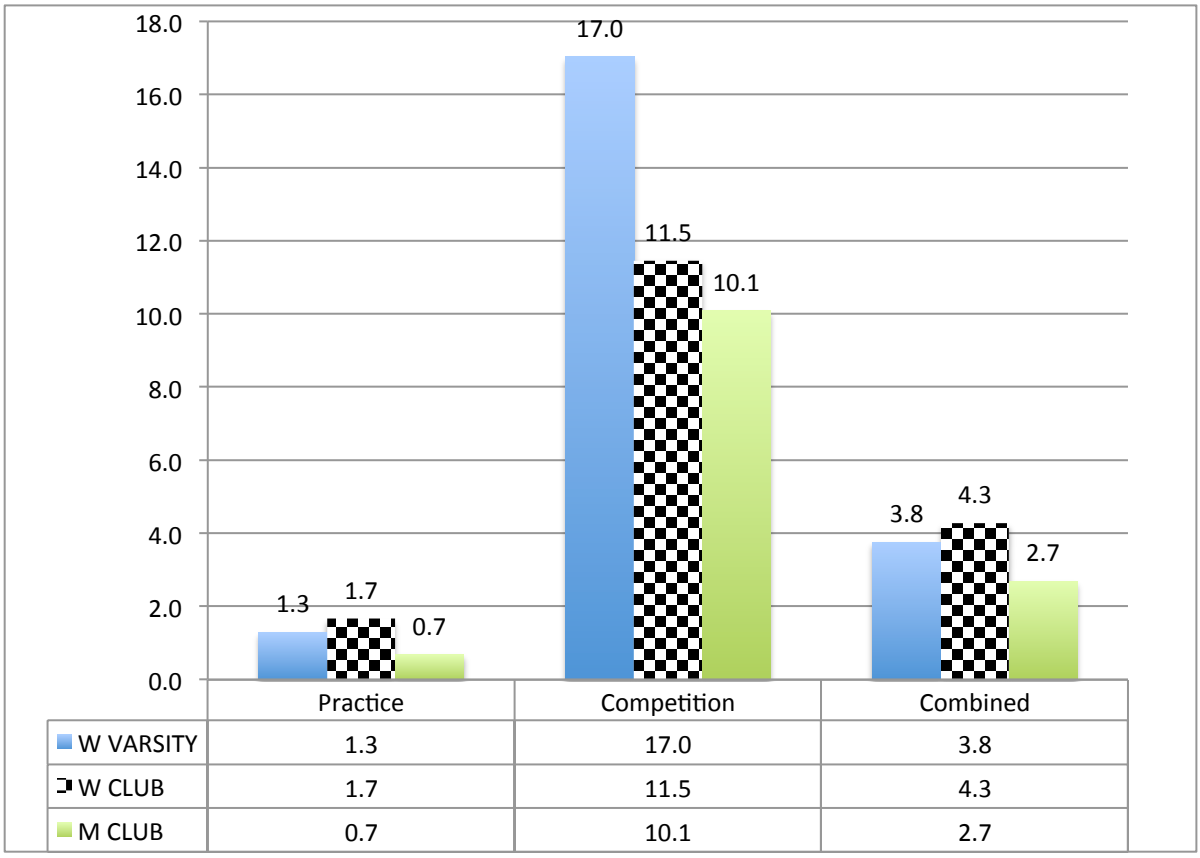
	Ball	Ground	Person	Other	TOTAL
Forward	0	1	3	1	**5**
Back	0	3	4	0	**7**
Prop	0	0	1	0	**1**
Hooker	0	0	1	0	**1**
Flanker	0	0	1	0	**1**
Lock/Second Row	0	1	0	0	**1**
Fly half	0	0	1	0	**1**
Wing	0	0	4	0	**4**
No specific position	0	0	3	1	**4**
ALL POSITIONS	**0**	**5**	**18**	**2**	**25**
	0.0%	**20.0%**	**72.0%**	**8.0%**	**100%**

M Rugby Club

	Ball	Ground	Person	Other	TOTAL
Forward	0	0	5	0	**5**
Back	0	3	6	0	**9**
Prop	0	1	0	0	**1**
Hooker	0	1	2	0	**3**
Lock/Second Row	0	0	2	0	**2**
Fly half	0	0	1	0	**1**
Center (inside or outside)	0	0	1	0	**1**
Sweeper/Fullback	0	0	1	0	**1**
ALL POSITIONS	**0**	**5**	**18**	**0**	**23**
	0.0%	**21.7%**	**78.3%**	**0.0%**	**100%**

ALL RUGBY	**1**	**20**	**57**	**3**	**81**
	1.2%	**24.7%**	**70.4%**	**3.7%**	**100.0%**

RUGBY CONCUSSIONS RATES PER 1000 AE BY TEAM TYPE AND ACTIVITY, YEARS 1- 3



	Practice	Competition	Combined
W VARSITY	1.3	17.0	3.8
W CLUB	1.7	11.5	4.3
M CLUB	0.7	10.1	2.7

Attachment H

	Comparison of Club Rugby Medical Coverage						
School	**Does the institution provide physical exams before season for all players, if not do you confirm physicals have been done within the last 6 months/year?**	**What baseline pre-cognitive testing is done for new/returning players?**	**What is the level of medical coverage at practices?**	**What is the level of medical coverage at games?**	**Do students have the ability to follow up with University medical personnel post injury?**	**May students use varsity trainers/ training facilities for rehab/treatment?**	**How are medical needs of the club rugby teams funded?**
Brown	Yes, provided by Athletic Training staff.	All players complete an Impact test.	We only have a trainer at one practice a week to assess any injuries from the previous week's game. There is a hospital 1/4 mile away from our field. We have an AED on site. Coach is first aide/CPR/AED certified. We are exploring the cost of adding Athletic Trainers to all practices.	Home Games - Athletic Trainers. We are exploring the option of having a MD at games.	Yes.	No.	Through our program budget, which is an endowment.
Columbia	No.	We require all club members take the Impact baseline pre-cognitive test.	We have ATC coverage for Men's & Women's practice.	Home Games - ATC coverage for both Men's & Women's Rugby Away Games - occasional ATC coverage.	Yes.	No.	From Club Sports Program budget.
Cornell - Men's Rugby	No.	No baseline cognitive testing.	Occasionally an athletic trainer.	Home Games - EMS and an athletic trainer.	Yes.	No.	Dues and Cornell funding.
Cornell- Women's Rugby	Cornell does not provide physical, nor do they ask if players have had physicals in the last 6 months.	No baseline cognitive testing.	No medical coverage at practice.	Home Games - We have an athletic trainer and try to have EMTs on site.	Yes, not immediate care, but we do follow with up with our student medical service for concussions, sprains, etc.	No access to any varsity facilities what so ever.	Dues and Cornell funding.
Dartmouth	Does not provide physical, but physical is required. Physical prior to first date of participation. Each year after complete medical questionnaire.	Baseline Neuro-Cognitive test is the impact test. Also baseline balance test.	Athletic trainer at all sessions in fall and spring. Winter season is considered "out of season"; coverage only for full team field sessions. Trainer in training room for any treatment.	Home Games - Athletic Trainer and an M.D. - usually an orthopedic surgeon. Away games - Athletic trainer.	Yes. Rugby student - athletes have same access to care as all varsity athletes.	Yes - year round. For us, four terms.	Full time athletic trainers paid by student health services. Per diem trainers for extra coverage and M.D.s paid from club funds.
Harvard	No.	N/A	Nothing required	Home Games - Ambulance required to be present at all contests.	Yes. The athletic training room is open and available to club athletes on Tuesdays and Thursdays in the morning.	Yes - Tuesdays & Thursdays	The department's club fund.
Princeton	Covered by athletic medicine under the same continuity of care model that is provided for the varsity athletes. This includes all NCAA requirements - full physical, EKG, sickle cell test.	Impact baseline test per NCAA requirements.	Each team has a primary ATC who cares for them. All contact practices are covered on site by athletic trainers. ATC available to respond, but not on site for non-contact practices. Teams are limited to 2 contact practices per week.	Home & away games - Athletic Trainers are on site	Students have access through ATC to all University Athletic Medicine resources, including University Physicians and Sports Medicine specialists.	Any student who requires rehabilitation and/or treatment meets with their Athletic Trainer in Athletic Medicine facilities.	Princeton University funds and employs the two Athletic Trainers who cover Men's and Women's Rugby. Any medical care costs above that coverage are incurred by the student and their insurance.
Penn	No.	No.	On-site EMT services through campus police.	On-site EMT services through campus police.	Yes, via the on-campus Student Health Services.	No.	No.
Yale	No.	No. Beginning testing this Spring	No.	Home Games -We have an Athletic Trainer for the Men's team, but we struggle to have one for the Women's program.	Through Yale Health, but inconsistent follow up.	No	Through club sports & donations.

Attachment H

Comparison of Club Rugby Policies and Practices								
School	**Does your program have the ability for off season strength training with S&C staff?**	**Does your program have the ability to access the varsity S&C facilities?**	**Does your institution allow "pre season" practices, before the start of classes in the fall?**	**Do you limit the number of games the Rugby team plays?**	**Average number of practices per week**	**Any limit to start/end of seasons?**	**Minimum practices before an athlete "new to Rugby" can compete? Minimum for returning players each year/season?**	**Do you have paid coaches? If so, how many?**
Brown	Yes and no. We have varsity weight room privileges, however we independently fund the S&C trainers (contracted through the University from an outside vendor).	Yes and no. We have varsity weight room privileges, however we independently fund the S&C trainers (contracted through the University from an outside vendor).	Yes.	No.	3 per week in the fall. 2 per week in the spring.	Only academic restrictions.	No, however newer players are brought up to speed independently of the regular team by the coach and introduced only after the coach is confident they have progressed through the correct techniques to assimilate into regular practices.	Yes, one full time head coach. In the process of hiring a part time assistant . We are not allowed to have volunteer coaches.
Columbia	Yes, only Men's Rugby	Yes.	Yes.	No.	2 per week.	Yes.	No	Yes, one coach.
Cornell - Men's Rugby	No.	No.	Yes.	No.	3-4 per week	No.	No.	Yes, one coach.
Cornell-Women's Rugby	No access to any varsity facilities what so ever.	No access to any varsity facilities what so ever.		We try to play only one game per weekend (tournaments permitting).	3 per week	Cornell does not regulate when we play, but does have to grant us permission to use our field in the spring.	No.	Yes, one part time coach.
Dartmouth	Yes. Rugby shares the cost of a S&C coach with varsity athletics.	Yes	Yes. The start date is the same as the first varsity sport - usually soccer.	Schedule set in consultation with athletic administration.	4 per week	Not really - Academic term and weather dictate season.	We have a 10 day training period prior to first match for returning players. For new players, 10 days minimum plus the input of the development coach and the athletic trainer before game play.	Yes. Two full time coaches; one full time shared with football S&C and one part time developmental coach.
Harvard	Yes.	Yes.	No, only during term time.	No.	2 per week	Only in-season during academic term time.	No.	Yes, two. One head coach and one assistant. Both are part time.
Princeton	No current ability to provide S&C support for M/W Rugby, in-season or off-season.	Teams are not allowed to use S&C space/ equipment or staff for training purposes	Yes, three days prior to student-body move in.	We have a limit for total games for each semester.	3-4 per week. Maximum 2 contact practices.	We have a minimum amount of days from first practice to first game, as well as total number of competitions. Outside of this, we do not restrict length unless it would fall too far outside normal season/schedule.	Both teams must wait 10 days from their return to implement this physical preparation/education. New and inexperienced players must wait 3 weeks before their first competition.	One paid head instructor, plus one paid assistant. In years past we have had multiple paid assistants. All instructors are independent contactors for the University.
Penn	No.	No.	Not usually, but if they request it and we have fields available, we may consider.	No.	3 per week.	We attempt to operate within the academic calendar.	No.	Paid head coach and two paid assistant coaches for Men's Rugby.
Yale	Yes.	Yes.	No. Players arrive as per normal student.	No, but we are conscious of player welfare in terms of exposure.	3 per week.	We attempt to operate within the academic calendar.	No. But we adhere to a baseline tackle test and education before exposures	Yes, Two (men and women head coaches) and one assistant.

Appendix D
Summary of Research Findings on Concussions in Rugby

Concussion is defined as a "traumatically induced transient disturbance of brain function and involves a complex pathophysiological process" by the American Medical Society for Sport Medicine (AMSSM).[1] The AMSSM continues, further defining concussion as a "subset of mild traumatic brain injury (MTBI) which is generally self-limited and at the less-severe end of the brain injury spectrum."[1]To date, there is limited data that focuses exclusively on concussions in American collegiate rugby.

A major setback to data collection is that men's collegiate rugby is unable to track injury data through the National Collegiate Association (NCAA) Injury Surveillance System (ISS). This is due to the fact that rugby is not fully recognized by the NCAA, with only women's rugby be considered an "emerging sport."[2] In 2005, the ISS expanded to include emerging sports; however, there is no published ISS rugby data to date.[3] In 2007 the International Rugby Board, now World Rugby, developed definitions and data collection procedures to improve the quality of rugby union research.[4]Without US collegiate rugby data being consistently tracked, however, it is difficult to accurately compare US injury rate data to that of other countries. As a result, many studies have tried to compare rugby injury rates to other NCAA sports such as soccer and American football.[5,6,8,10,12]

Research has reported a high injury rate in rugby players,[6,7,8] with the majority being mild traumatic brain injuries (mTBIs).[9]One study by Kerr et al. prospectively tracked game and practice injuries with 31 men's and 38 women's New England rugby union teams.[9] Injuries were reported per 1000 player game hours (PGH), per 1000 game athletic exposures (GAE), and per 1000 practice athletic exposures (PAE). After tracking injury data over the course of a fall season, it was found that men and women had a similar game to practice injury rate ratio of 4:1 with 16.9 vs 17.1 per 1000 PGH respectively. These game injury rates are about equal to those of men's and women's collegiate soccer (23.5 vs 19 injuries per 1000 GAE respectively)[10] and lower than

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[1] Harmon, K. G., Drezner, J. A., Gammons, M., Guskiewicz, K. M., Halstead, M., Herring, S. A., ... & Roberts, W. O. (2013). American Medical Society for Sports Medicine position statement: concussion in sport. *British journal of sports medicine*, *47*(1), 15-26.

[2] http://www.ncaa.org/about/resources/inclusion/emerging-sports-women

[3] Dick, R., Agel, J., & Marshall, S. W. (2007). National Collegiate Athletic Association injury surveillance system commentaries: introduction and methods. *Journal of Athletic Training*, *42*(2), 173.

[4] Fuller, C. W., Molloy, M. G., Bagate, C., Bahr, R., Brooks, J. H., Donson, H., ... & Quarrie, K. L. (2007). Consensus statement on injury definitions and data collection procedures for studies of injuries in rugby union. *British journal of sports medicine*, *41*(5), 328-331.

[5] Benson, B.W., McIntosh, A.S., Maddocks, D., Herring, S.A., Raferty, M., & Dvorak, J. (2013). What are the most effective risk-reduction strategies in sport concussion?. *British journal of sports medicine, 47*(5), 321-326.

[6] Cassidy JD, Carroll LJ, Peloso PM, et al. (2004). Incidence, risk factors and prevention of mild traumatic brain injury: results of the WHO collaborating centre task force on mild traumatic brain injury. *J Rehabil Med. 36, 28-60.*

[7] Garraway WM, Lee AJ, Hutton SJ, Russell EB, Macleod DA. (2000). Impact of professionalism on injuries in rugby union. *Br J Sports Med.47,* 348-351.

[8] Koh JO, Cassidy JD, Watkinson EJ. (2003). Incidence of concussion in contact sports: a systematic review of the evidence. *Brain Inj.* 17, 901-917.

[9] Kerr HA, Curtis C, Micheli LJ, et al. (2008). Collegiate rugby union injury patterns in New England: a prospective cohort study. *Br J Sports Med.* 42, 595-603.

[10] Garraway, W. M., & Macleod, D. A. D. (1995). Epidemiology of rugby football injuries. *The Lancet*, *345*(8963), 1485-1487.

those found in amateur rugby[11] and collegiate American football.[12] The authors do note that international and professional rugby unions are at a much higher competitive level than its American counterpart.

Regarding concussions specifically, men had a higher game concussion rate (2.16 per 1000 PGH) than women (1.58 per 1000 PGH). The study also found that major injuries (time loss >7 days) were more common in games, while minor injuries (time loss 1-7 days) were more common in practices. The study found no significant difference between injury rates in male and female player positions. Within a game setting, the Number 8 position had the highest major injury percentage for both men (82%) and women (79%) with the men's flanker (3.13 per 100 PGH) and women's center (2.92 per 1000 PGH) having the highest injury rates. Considering the mechanism of injury, the study reported that tackling/being tackled was the game and practice event most associated with injury.[9] Comparing Kerr et al.'s contact event injury rates to that of professional rugby players,[13] their data suggests that collegiate players are three times less likely to be injured via a ruck (men's professional 7 per 1000 PGH; men's collegiate 2.7 per 1000 PGH; women's collegiate 2 per 1000 PGH) and four times less likely to be injured via tackling (men's professional 33.9 per 1000 PGH; men's collegiate 8.2 per 1000 PGH; women's collegiate 9.0 per 1000 PGH).

As mentioned previously, the current literature lacks rugby union sevens data at the US collegiate level. Dropping from 15 players-a-side to 7 players-a-side dramatically changes the nature of the game. Theoretically, this change in player behavior should be reflected in the concussion and injury rate data. A study by Lopez et al. investigated injuries in 1536 amateur American rugby sevens players at 4 tournaments.[14] The study found an overall injury rate of 55.4 per 1000 PGH with tackling being the most common mechanism of injury. Although the mechanism of injury is similar to that of rugby fifteens, the injury rate in Lopez et al.'s study seems low when compared to similar studies on amateur rugby sevens players.[15,16] With that said, the current paucity of rugby sevens injury rates limits an effective comparison.

Regarding rugby concussion prevention equipment, the evidence is not as conclusive. For example, studies have found that padded headgear and mouth guards are effective in reducing the incidence of mild traumatic brain injury.[17,18,19]Conversely, there are also studies that find no protective benefit of padding in rugby.[20] Some research even suggests that aspects of a person's personality may predispose an athlete to injury if the headgear and mouth guard encourage more

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[11] Bird, Y. N., Waller, A. E., Marshall, S. W., Alsop, J. C., Chalmers, D. J., & Gerrard, D. F. (1998). The New Zealand Rugby injury and Performance Project: V. Epidemiology of a season of rugby injury. *British Journal of Sports Medicine*, *32*(4), 319-325.

[12] Shankar, P. R., Fields, S. K., Collins, C. L., Dick, R. W., & Comstock, R. D. (2007). Epidemiology of high school and collegiate football injuries in the United States, 2005–2006. *The American journal of sports medicine*, *35*(8), 1295-1303.

[13] Fuller, C. W., Brooks, J. H., Cancea, R. J., Hall, J., & Kemp, S. P. (2007). Contact events in rugby union and their propensity to cause injury. *British journal of sports medicine*, *41*(12), 862-867.

[14] Lopez, V., Galano, G. J., Black, C. M., Gupta, A. T., James, D. E., Kelleher, K. M., & Allen, A. A. (2012). Profile of an American amateur rugby union sevens series. *The American journal of sports medicine*, *40*(1), 179-184.

[15] Gabbett, T. J. (2002). Incidence of injury in amateur rugby league sevens. *British journal of sports medicine*, *36*(1), 23-26.

[16] Fuller, C. W., Taylor, A., & Molloy, M. G. (2010). Epidemiological study of injuries in international rugby sevens. *Clinical Journal of Sport Medicine*, *20*(3), 179-184.

[17] Blignaut, J. B., Carstens, I. L., & Lombard, C. J. (1987). Injuries sustained in rugby by wearers and non-wearers of mouthguards. *British journal of sports medicine*, *21*(2), 5-7.

[18] McCrory, P. (2001). Do mouthguards prevent concussion?. *British Journal of Sports Medicine*, *35*(2), 81-82.

[19] McIntosh, A. S., & McCrory, P. (2005). Preventing head and neck injury. *British Journal of Sports Medicine*, *39*(6), 314-318.

[20] McCrory, P. R., Bladin, P. F., & Berkovic, S. F. (1997). Retrospective study of concussive convulsions in elite Australian rules and rugby league footballers: phenomenology, aetiology, and outcome. *Bmj*, *314*(7075), 171.

reckless play.[21] For example, a player may increase their risk of injury if they tend to act implosively, which can be very dangerous in rugby situations like a tackle.[22] With the possibility of head injuries altering functional connectivity of the brain, further research on preventative equipment is important.[23] Alternatively to concussion prevention, there is strong evidence supporting certain equipment, like mouth guards, decrease the severity of lacerations and dental injuries.[24] Although World Rugby has approved protective equipment, it is not mandatory to wear. Without definitive evidence on reducing the risk of head injuries, it is unlikely that World Rugby will shift its voluntary protective equipment laws in the near future.

Over the years, there has been an increased interest in concussion education and symptom awareness. A primary example is World Rugby's investment in concussion-related research. Recently, World Rugby published findings on their Pitch-Side Concussion Assessment (PSCA) tool which had been piloted between October 2012 and June 2013.[23] The PSCA was used in elite competition to evaluate potentially concussed players. The study consisted of more than 700 matches and found that the PSCA tool, now the HIA tool, is 84.6% accurate in successfully identifying players with concussion.[25] Prior to the temporary substitution rule, 56% of players with a confirmed concussion remained on the field following injury. After the concussion assessment rule was in place, the rate has dropped to 12%.[23] Although World Rugby is heading in the right direction, further data gathered is still needed on collegiate-level players.

[21] Garraway, W. M., Lee, A. J., Macleod, D. A., Telfer, J. W., Deary, I. J., & Murray, G. D. (1999). Factors influencing tackle injuries in rugby union football. *British Journal of Sports Medicine*, *33*(1), 37-41.

[22] Finch, C. F., McIntosh, A. S., & McCrory, P. (2001). What do under 15 year old schoolboy rugby union players think about protective headgear?. *British journal of sports medicine*, *35*(2), 89-94.

23 Johnson, B., Neuberger, T., Gay, M., Hallett, M., & Slobounov, S. (2014). Effects of subconcussive head trauma on the default mode network of the brain. *Journal of neurotrauma*, *31*(23), 1907-1913.

[24] McIntosh AS, McCrory P, Finch CF, Best JP, Chalmers DJ, Wolfe R. (2009). Does padded headgear prevent head injury in Rugby Union football? *Med Sci Sports Exerc.*41,306-313.

[25] Fuller, G. W., Kemp, S. P., & Decq, P. (2014). The International Rugby Board (IRB) Pitch Side Concussion Assessment trial: a pilot test accuracy study. *British journal of sports medicine*, bjsports-2014.