USA WOMEN'S RUGBY SEVENS CONTACT INJURY RISK FACTORS

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The purpose of the study was to identify the rates and causes of contact injuries in U.S. women's Rugby-7s tournament players (2010-2015) and present guidelines for injury prevention to reduce the risk of injury in this emerging female contact-sport athlete. Data were captured using the Rugby Injury Survey & Evaluation (RISE) methodology. Contact injuries were frequent over the study period (direct=56%; indirect=38%, unknown=6%). Contact injuries overall were similar among positions ($p<0.065$) and were categorized as direct contact injuries (overall 56%). Contact injuries resulted in a mean 52.2 days absent. Most injuries were from a tackle (83%) and resulted from collision with another player (66%) through a direct mechanism (70%, $p<0.001$). Overall injured body parts were most commonly the head/face (25%), knee (14%), and shoulder (14%).

KEYWORDS: Rugby-7s, injury biomechanics, females, sports injuries.

INTRODUCTION: The importance of women's participation in rugby, for both exposure and growth of the sport internationally, has been supported by the World Rugby's Women's Rugby Plan over 2011-2016. Rugby has seen a recent surge in popularity in the U.S. (greater than 80,000 members in 2010 to greater than 1.6 million participants in 2016) (WorldRugby.org). Women and girls have seen a growth of 1.7 million globally (WorldRugby.org, 2015). However, there is a lack of injury data on women's Rugby-7s, and even less on U.S. Rugby-7s (Gabb N, Trewartha G, Kemp SP & Stokes KA, 2014; Lopez et al., 2012; Ma, et al., 2016). The literature supports contact injuries as the most common types of injuries among both backs and forwards (Ma, et al., 2016). Identifying risk factors associated with contact injuries may guide injury prevention efforts minimizing risk in new contact athletes.

METHODS: A prospective epidemiological study of injured U.S. women Rugby-7s players, using the Rugby Injury Survey & Evaluation (RISE) methodology (Lopez et al., 2012; 2014; 2016; Ma, et al., 2016), compliant with international consensus statement on rugby studies was performed (Fuller et al., 2007). Injury data were collected from a population of 10,328 U19 to elite U.S. women's players on 852 teams involved in 1,892 matches in 80 USA Rugby-sanctioned tournaments. Injuries were defined as "medical attention" (no absence from play), "time-loss" (not able to return to play the same day) and "overall" (combining medical attention and time-loss) (Fuller et al., 2007). Recurrent injury data were evaluated when an injured player suffered a prior index injury over the study duration. Post-tournament follow-up telecommunications (i.e.: calls or emails) were conducted at 1, 3, and 6-months to obtain severity (days absent before return to full-contact training and/or competition or retiring).

Contact mechanisms (impact with an opposing player or collision-type mechanism), were further subdivided into, direct contact (i.e. accidents, where specific injury occurred from direct blow by another player to body part injured); or indirect contact, (i.e. accidents, where specific injury occurred from player impact, body part injured made contact with another factor such as ball or turf) (Marshall, 2010). Observations with missing data were excluded from the sample. Statistical analysis was performed with Stata v15.1. Results are presented as means, percentage frequencies, and incidence per 1000 player-match hours (ph). T-tests compared means, z-tests compared proportions, and rates were calculated using the Mantel-Haenszel method. Exact confidence intervals were used to evaluate and compare rate-ratios. Significance was set at $p<0.05$.

RESULTS: The final analytic sample consisted of 523 injuries (13-46 years). Players were aged 23.5±5.0 years, 166.5±6.6 cm, 67.9±10.6 kg, and had a BMI of 24.4±3.2. Contact injury mechanisms in women players occurred frequently (59.0/1000ph; 71%; n=371) over the study period (direct=61%, n=226; indirect=39%, n=145; $p<0.001$). Sixty-five injuries (18%) were documented as recurring injuries. Among contact injuries, time-loss (71%; 22.6/1000ph; n=270) and medical attention injuries (71%; 60.6/1000ph; n=101) occurred at similar frequency ($p=0.953$). Injuries due to direct contact mechanisms occurred at similar rates between medical attention (60%; 25.9/1000ph; n=163) and time-loss injuries (62%; 10.0/1000ph; n=63; $p=0.725$). Rate of overall injuries associated with contact mechanisms were observed equally between backs (74%; 62.0/1000ph) and forwards (71%; 51.6/1000ph; $p=0.086$). Most injuries were categorized as direct contact injuries (overall 61%) among backs (direct=58%; indirect=42%; $P<0.001$) and forwards (direct=63%; indirect=37%; $P<0.001$).

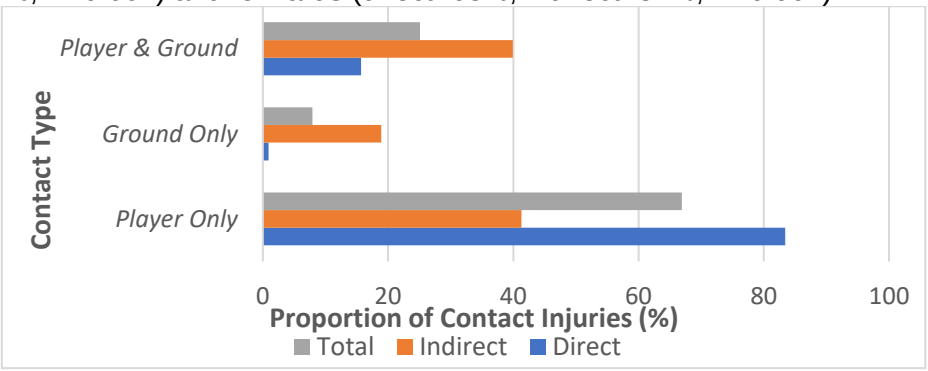

Figure 1: U.S. Women's Rugby-7s injured players by contact risk factors (2010-2015).

Figure 1 shows direct contact injuries were mostly due to impact with another player (overall 66.9%; direct 83.4%; indirect 41.3%). Time-loss contact injuries occurred equally between backs (27%; 6.4/1000ph) and forwards (30%; 6.3/1000ph; $p=0.970$). Time-loss contact injuries resulted in an average severity of 56.7 days with no difference between causes (direct=59.2 days; indirect=52.4 days; $p=0.694$). Among positions, backs (58.6 days) encountered similar mean injury severity as forwards (53.6 days; $p=0.776$). Most contact injuries were new injuries (overall=82%, direct=83%, indirect=81%) as opposed to recurring. Figure 2 demonstrates that the lower extremity injuries were mostly associated with indirect contact among backs and forwards. Most contact injuries occurred during the tackle (83%) (TABLE 1). Among direct contact injury mechanisms, ligament injuries were common among both positions (overall=32%; backs=33%; forwards=30%). Meanwhile, direct contact injured the head/neck body region among forwards greater than backs (overall 34%; backs 32%; forwards 38%). The most commonly injured body parts were the head and face (overall 25%; backs 24%; forwards 25%) followed by the knee (overall 14%; backs 15%; forwards 13%) and the shoulder (overall 14%; backs 13%; forwards 14%). Concussive contact injuries, alone, were found similarly among direct (10%) and indirect causes (12%; $p=0.503$). Most common recurring injuries were ligament injuries (35%), concussions (14%), and dislocations/subluxations (12%). Most repeat concussions were due to direct contact causes (67%). Recurrent contact injuries were found at similar rates among overall (18%), time-loss (21%), and medical attention injuries (16%).

Among both positions, recurrent time-loss injuries were observed at similar rates (forwards 21%; backs 22%; p=0.956). Overall contact injuries were more common among artificial turf (115.8/1000ph) than grass fields (76.8.7/1000ph; p<0.001).

Table 1: U.S. Women's Rugby-7s contact injuries by phase of play and position.

Phase of Play	*Overall (2010-2015) Contact Injury Incidence /1000 playing hours (95% CI)*				
	All	**Backs**	**Forwards**	**IRR (Back v Forward)**	**p-Value**
Tackle	47.25 (42.03-52.95)	52.87 (45.62-60.94)	37.47 (30.52-45.53)	1.41 (1.10-1.81)	0.005
Scrum	1.91 (0.99-3.34)	0.28 (0.01-1.55)	4.08 (2.04-7.30)	0.07 (0.00-0.47)	<0.001
Ruck	4.14 (2.70-6.06)	3.62 (1.93-6.19)	4.82 (2.57-8.25)	0.75 (0.32-1.75)	0.468
Running/ Open Play	2.86 (1.70-4.53)	3.06 (1.53-5.48)	2.60 (1.04-5.35)	1.17 (0.42-3.59)	0.749
Missing	2.86 (1.70-4.53)	2.23 (0.96-4.39)	2.60 (1.04-5.35)	0.85 (0.27-2.78)	0.766
(All Phases) Total	47.25 (42.03-52.95)	52.87 (45.62-60.94)	37.47 (30.52-45.53)	1.20 (0.97-1.50)	0.086

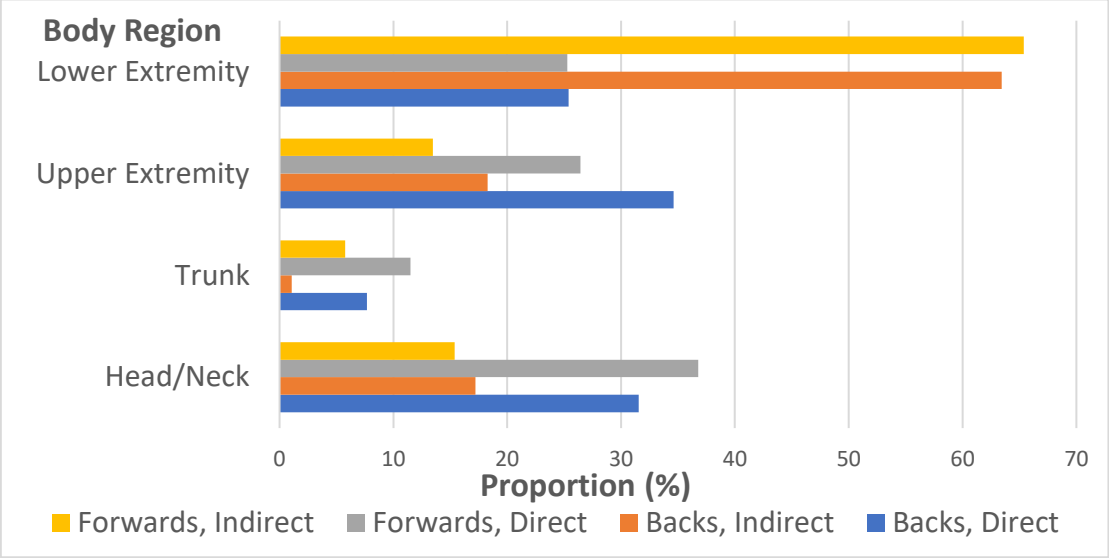

Figure 2. U.S. Women's Rugby-7s overall injuries by body region injured, position and biomechanical contact factors (2010-2015).

DISCUSSION: There has been limited research on U.S. women Rugby-7s (Ma et al 2016). Our study of causes of contact injuries in the emerging U.S women Rugby-7s population showed a lower match injury incidence than international elite Rugby-7s players of either sex (107-188 injuries/1000ph) (Cruz-Ferreira A, Cruz-Ferreira E, Santiago L & Taborda-Barata L, 2016; Gabb et al., 2014). Our study raises the concern for the high risk of injury associated with contact in women Rugby-7s, specifically the tackle phase which is a new skill for women players (Hendricks S, Till K, Brown JC, & Jones B, 2016). The tackle is a concern because the need to practice it and its cause of injury in training as well as in the match (Hendricks S, 2016). Elite Rugby-7s athlete may be at greater risk of contact injuries due to an increase in energy transfers during tackles and other collision/contact events. Cruz-Ferreira, et al. (2016) noted match demands among men in Rugby-7s tournaments internationally were involved in up to 40% more contact events, than their 15-a-side match, nurturing higher fatigue among players, which is a known risk for injury. This may therefore, be prevalent in women's Rugby-7s but has not yet been documented. The speed and intensity approximated by elite players includes an average distance of 1556.2±189.3 m per game (14 minutes), and of this distance, 3.7% (57.1±40.8 m) is high-intensity running and 5.4% (84.0±64.8 m) sprinting out of total match (Suarez-Arrones et al., 2012). The combination of a new collision sport with increased ball in

play, and greater speeds, compared to Rugby-15s, may be resulting in higher injury rates seen in elite international women (187/1000ph) (Gabb et al., 2014). The overall injury rates in our current study and prior study (Ma et al, 2016) among U.S. women's Rugby-7s were lower than international elite likely due to our developing population not approximating the game intensity and conditioning necessary to meet Rugby-7s demands (Portillo J, Gonzalez-Rave JM, Juarez D, Garcia JM, et al., 2014). While our current study found lower rates of contact injuries (71%) as compared to our earlier study on U.S. women (87%), both were higher than elite international women (67%) (Ma et al, 2016; Gabb et al, 2014). The severity among our athletes were also greater (56.7d absent) than elite internationals (33d) (Gabb et al, 2014). This may be explained due to the fact that developing U.S. players are not as conditioned and have decreased skillsets (especially among the tackle) and therefore, prone to more severe injuries. Most of our contact injuries were due to direct impact with a player (67%), which was greater than our earlier study (57%) (Ma et al., 2016). Contact injuries among other causes in the current study were lower (ground 8%; player and ground combined 25%), than an earlier study in U.S. women's Rugby-7s (ground 11.4%±6.6; player and ground combined (31.8%±9.7) (Ma et al., 2016). The results of our study imply that U.S. women players would benefit from proper tackling to minimize injury within game collisions and would benefit from education on proper landing from a tackle to avoid awkward impacts.

CONCLUSION: Among all levels of Rugby-7s, most injuries in the sport result from contact events, particularly the tackle. This study provides needed data on biomechanical influences in match contact injuries encountered in the emerging and expanding population of women Rugby-7s. In addition to lower extremity injuries, we found a high frequency of head, neck, shoulder and upper extremity injuries, attributed to this new skill of tackling in this US cohort. This phenomenon among U.S. women's Rugby-7s is interesting when taken in context that there are no cross-over athletes as in U.S. men's Rugby-7s and American Football. This points to a need to address tackle training programs specific for women, including a focus on proper landing, while being tackled. More studies on this tackle injury relationship would benefit female athletes, who have a prevalence of sustaining lower body injuries.

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ACKNOWLEDGEMENTS: The authors thank USA Rugby & United World Sports for attendance at their events, the pilot grant support of USA Rugby Empire & New England GU RFU's, Hospital for Special Surgery (Award #2028) and the National Operating Committee on Standards for Athletic Equipment, Chapel Hill, NC (Award #44-16).