BIOMECHANICAL CONTACT INJURY INFLUENCES IN USA MENS RUGBY-7S

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The aim of this study was to prospectively report injury incidence and contact mechanisms in U.S. men's under-19 to elite Rugby-7s players (n=852) over 2010-2015, using the Rugby Injury Survey & Evaluation (RISE) methodology. Contact injuries occurred with frequency (Overall, including time-loss and medical attention=55.4/1000ph; time-loss=17.2/1000ph; P<0.001). Among positions, overall contact injuries were frequent (backs=65%; forwards=35%; P<0.001). Direct contact injuries (59%) occurred more often than indirect causes (31%; P<0.001). Severity from contact injuries was similar between positions (backs=42.1 days; forwards=36 days; P=0.387). Phase of play most commonly involved with injury was the tackle (81%). Meanwhile, impact with another player (86%) as compared to impact with the ground or combination was the most common impact surface." Ligament (35%) and muscle (29%) injuries were frequent. These results will provide much needed data on Rugby-7s, impacting emerging countries.

KEYWORDS: rugby-7s, risk factors, males, sports injuries.

INTRODUCTION: Rugby-7s is an Olympic global collision sport played among both genders, with a high injury rate (107-188 injuries/1000 player-match-hours (ph) (Cruz-Ferreira A, Cruz-Ferreira E, Santiago L & Taborda-Barata L, 2016; Fuller CW, Taylor A, & Molloy MG, 2010; Gabb N, Trewartha G, Kemp S, & Stokes KA, 2014). Rugby-7s is growing in popularity, however, there is limited understanding of its match injuries and mechanisms particularly in the expanding United States (U.S.) population (Lopez et al., 2012, 2014, 2016). Due to the tackling and collision nature of Rugby-7s and its influence in injury, contact is of concern (Cruz-Ferreira et al., 2016, Fuller et al., 2010, Lopez et al., 2012). Providing a profile of the injury rates found with contact biomechanisms among various risk factors in rugby-7s, would allow areas to be evaluated for injury prevention and translation of the sports injury prevention cascade. The impact of these data will be provision of pilot information on biomechanical injury concerns in the North American playing population. Furthermore, it may define if these rates are symptomatic to a specific global region or, a developing rugby market. The study aims were to report men's tournament injury incidence and contact risk factors in U.S. Rugby-7s.

METHODS: A prospective epidemiological study on U.S. men's Rugby-7s players match injury incidence and contact mechanisms as risk factors were determined using the Rugby Injury Survey & Evaluation (RISE) report methodology (Lopez et al., 2012, 2014, 2016). Tournament injury data were collected from 1459 injured players (age: 13-54 years) from a total of 26,334 U19 to elite U.S. men participants on 2,174 teams involving 4,768 matches (14-minute

matches, and 10-minute finals) in 67 USA Rugby-sanctioned tournaments (94 days), over 2010-2015. Total exposure was calculated to be 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). Follow-ups were conducted at 1, 3 and 6-months to obtain severity (days absent before return to full-contact training and/or competition). Contact mechanisms (impact with an opposing player or collision-type mechanism), were further subdivided into direct contact (where the specific injury occurred from a direct blow by another player to the body part of the injured player); or indirect contact, (where the injury occurred as a result of the injured player contact the playing surface or another object - e.g. ball, goal posts) (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 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: From 2010-2015, U.S male rugby players sustained 1,189 injuries during a match-exposure of 15,368.3 ph, culminating an overall injury rate of 77.4 injuries/1000ph. Contact mechanisms of injury in men players occurred frequently (72%, 55.4/1000ph; n=852) over the study period (direct=59%, n=500; indirect=31%, n=267; undefined mechanism=10%, n=85). Incidence of contact injuries among time-loss (75%; 17.2/1000ph) and medical attention (71%; 38.3/1000ph;) injuries were similar (P=0.097). Overall contact injuries occurred more often among backs (65%; 63.4/1000ph) than forwards (35%; 44.8/1000ph; P<0.001). Similarly, time-loss contact injuries occurred more often among backs (69%; 20.7/1000ph) than forwards (31%; 12.4/1000ph; P=0.001). In terms of direct versus indirect mechanisms, contact injuries due to direct contact mechanisms were common among medical attention (61%; 23.2/1000ph) and time-loss (54%; 9.3/1000ph; P=0.153). Direct mechanisms (59%) were more common than indirect (31%; P<0.001). Eighty-five contact injuries (10%) could not be classified as direct or indirect. Similar differences in contact mechanism were observed among backs (direct=57%; indirect=35%; P<0.001) and forwards (direct=63%; indirect=24%; P<0.001). Table 1 shows among positions, backs were more likely to sustain a direct injury (overall) (35.6/1000ph) as compared to forwards (28.4/1000ph, p=0.013). Indirect injuries were more frequent among backs (22.2/1000ph) than forwards (10.9/1000ph; p<0.001). Among positions and time-loss, backs encountered more direct injuries (51%) than indirect (41%; p=0.007). Forwards encountered a similar relationship (direct=61%; indirect=27%; p<0.001).

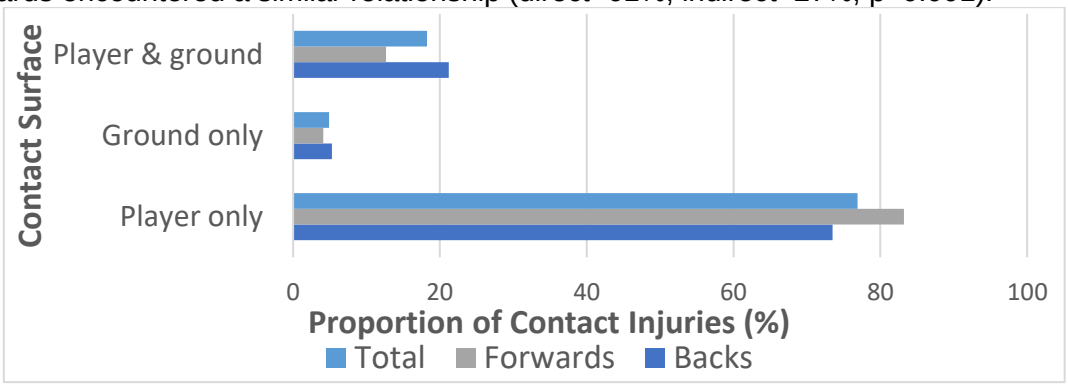

Figure 1: **U.S. Men’s Rugby-7s injured players by contact risk factors over 2010-2015.**

Figure 1 shows contact injuries associated with a direct mechanism were most frequently due to impact with another player (overall 86%; forwards 89%; backs 84%). Contact injuries with time-loss resulted in 40 mean days absent (direct 38 days; indirect 41 days). Among positions, backs (42 days) encountered similar injury severity as forwards (35 days). Most contact injuries were new injuries (overall=80%, direct=82%, indirect=79%) as opposed to recurring. Figure 2 shows trunk contact injuries were the least commonly encountered body region injured (P<0.001). Shoulder injuries were most commonly caused by direct mechanisms (71%;

P<0.001). Ligament (35%) injuries were the most common types of injury overall (11%). Concussive contact injuries were found similarly among direct (15%) and indirect causes (10%; P=0.094). Ankles (12%) were injured more often than knees (9%, P=0.012). The overall incidence of contact injuries were similar with regards to field types (grass 55.6/1000ph; artificial 54.7/1000ph; P=0.885).

Table 1: U.S. Men's Rugby-7s overall injury rates by phases of play, and position.

Phase of Play	*Overall (2010-2015) Contact Injury Incidence / 1000 playing hours (95% CI)*				
	(n)	**Backs**	**Forwards**	**Overall**	**p-Value**
Tackle	688	51.70 (47.05-56.68)	35.53 (31.12-40.38)	44.77 (41.48-48.24)	<0.001
Scrum	21	0.34 (0.07-1.00)	2.73 (1.62-4.32)	1.37 (0.85-2.09)	0.001
Ruck	78	6.26 (4.72-8.15)	3.49 (2.21-5.24)	5.08 (4.01-6.33)	0.016
Lineout	1	0.11 (0.00-0.63)	0.00 (-)	0.07 (0.00-0.36)	(-)
Running/ Open Play	58	4.44 (3.16-6.07)	2.88 (1.74-4.50)	3.77 (2.87-4.88)	0.121
Maul	6	0.57 (0.18-1.33)	0.15 (0.00-0.85)	0.39 (0.14-0.85)	0.226
Total (All Phases)	852	63.43 (58.27-68.92)	44.79 (39.82-50.20)	55.44 (51.78-59.29)	<0.001

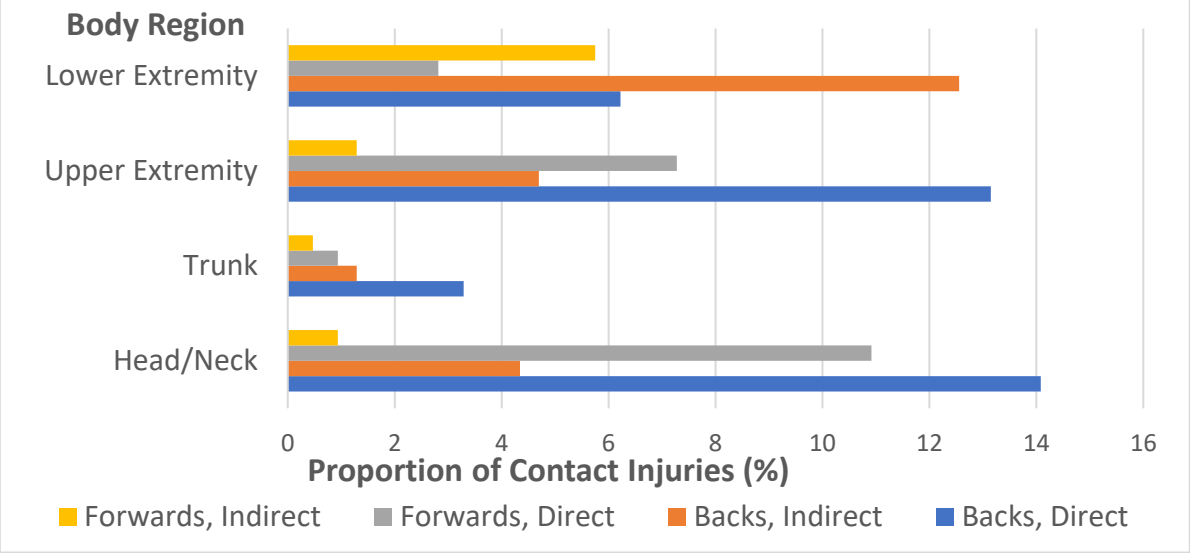

Figure 2. U.S. Men's Rugby-7s overall injuries by body region injured, position and biomechanical contact factors.

DISCUSSION: Match injury incidence from contact causes in the current study cohort of U.S. men's Rugby-7s (among all competition levels combined) were lower than international elite Rugby-7s players (Cruz-Ferreira et al., 2016; Gabb et al., 2014). Rugby-7s is played with greater speed, higher numbers of sprints and contact with opponents, than Rugby-15s, thereby leading to an increase in energy transfers during tackles and other contact events (Cruz-Ferreira et al., 2016; Ross A, Gill N & Cronin J, 2015; Suarez-Arrones LJ et al., 2012). Cruz-Ferreira et al. (2016), noted that match demands remain consistent across tournaments internationally and that Rugby-7 players were involved in up to 40% more contact events in a typical match than in a 15-a-side match, which may lead to higher fatigue among players and predispose to match injuries. Most injuries resulted from contact events, including tackles and collisions from higher speeds in open play/running (Cruz-Ferreira et al., 2016, Fuller et al., 2010, Lopez et al., 2012). Our U.S. cohort's rates of contact injuries were less (overall=72%; time loss=75%) than international elite Rugby-7s time-loss (77.8% (69.7–85.8) or overall U.S. amateur play alone (72.9% (59.0–83.0)). This is probably due to the U.S. emerging amateur cohort likely not replicating the game speed and energy, which produces lower amounts of energy during collisions, when compared to elite international play. Although our overall incidence of injuries were lower than elite international play, our U.S. cohort had a higher proportion of time-loss contact injury rates among the head/neck (32%) than has been reported in previous studies (Cruz-Ferreira et al., 2016, Fuller et al., 2010). Tackling (81%) was the most

common cause of injury across positions (backs 82%; forwards 79%) (frontal tackles were most common), followed by the ruck (overall 9%; backs 10%; forwards 8%). Elevated direct contact rates of injury, highlights the nature and demands of Rugby-7s, and might account for the high injury incidence rate of the sport (Cruz-Ferreira et al., 2016, Fuller et al., 2010, Gabb et al., 2014). The higher proportion of direct tackling head/neck injuries in our U.S. cohort highlights the importance of providing education on tackle technique as a point of intervention to reduce injuries among U.S. men amateur Rugby-7 players. Therefore, variations in injury patterns in rugby likely exist between countries based on a variety of factors. Joint or ligament injuries on the lower limb, were most common following contact events among elite international (Cruz-Ferreira et al., 2016, Fuller et al., 2010) and amateur U.S. Rugby-7s (14.6-42.8%) (Lopez et al., 2012, 2014). Contact injuries overall (combined) were most common in upper extremities with joint and ligament systems (18%). Time-loss injuries among the head and neck were common (32%). Concussions were associated with direct contact mechanisms among both forwards (direct=5%; indirect=2%; $p<0.001$) and backs (direct=10%; indirect=4%; $P<0.001$). Contact injuries and field types were similarly seen with direct (grass, 32.5/1000ph; artificial, 32.8/1000ph; $p=0.923$) and indirect causes (grass, 17.6/1000ph; artificial, 16.0/1000ph; $p=0.600$). Grass and artificial overall injury rates were similar among forwards and backs. Severity of injury did not differ by mouth-guard use among players who sustained a contact time-loss injury to the head/neck region (mouthguard 32d, no mouthguard 29d, $P=0.733$). No differences were noted comparing head/neck injury severity and scrumcap use.

CONCLUSION: The results of this study provide much needed data on Rugby-7s in emerging countries, such as the U.S. While our rates of direct contact injuries were less than international cohorts, our proportion of head/neck injuries are higher than those reported in international cohorts. Understanding contact injuries are key for developing biomechanical-based injury prevention protocols. Further analysis to determine if there is a greater risk of injuries based on playing experience would be needed. Tackling and rucking techniques and standardized training and conditioning programs are areas for injury prevention for the U.S. cohort. Education interventions on the risk factors would aid in the global public health concern with the expansion of this collision sport and developing rugby nations involved.

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