

A Review of a Decade of Rugby Union Injury Epidemiology: 2007-2017

Pierre L. Viviers, MBChB, MMedSc, MSc, FACSM,^{*†‡} Jeandré T. Viljoen, BSc, MPhil,^{†‡} and Wayne Derman, MBChB, BSc (Med) (Hon), PhD, FFIMS^{†§}

Context: Rugby union is the most widely played team collision sport globally. As with other contact sports, there is substantial risk of injury. To date, the majority of studies on injury epidemiology have focused on elite male cohorts, which inherently prevents extrapolation of research findings to other groups within the player continuum. This review aims to describe emerging injury trends across the spectrum of various rugby union subpopulations and to highlight gaps that may influence future injury prevention tactics.

Evidence Acquisition: Relevant articles published from 2007 to 2017 were obtained by searching MEDLINE, PubMed, and SPORT Discus. Studies on 15-a-side rugby union, implemented according to the 2007 consensus statement on injury definitions and data collection procedures for injuries in rugby union, were used.

Study Design: Clinical review.

Level of Evidence: Level 3.

Results: Match injuries occur more frequently than training injuries. Injury rates increase consistently according to age and level of play. Severity of injury often is greater among lower levels of the game, and sex-specific differences relating to injury patterns and incidence rates exist.

Conclusion: To date, a paucity of injury surveillance data exists for women and players of both sexes at all levels of community rugby union. Furthermore, the incidence of injuries and illnesses are poorly reported in epidemiological studies. Despite methodological differences, injury trends remain consistent throughout all levels of play.

Keywords: rugby union; injuries; time-loss; medical attention

Rugby union (RU) is a team contact sport played globally by both sexes across a wide spectrum of ages. It is rapidly growing in popularity and is played in 121 countries by 7.73 million players, of whom 1.76 million are female. Additionally, 4.91 million rugby players are not registered with an official body and are thus deemed to be recreational or community players.³⁵ RU became a professional sport in 1995 and is currently played in a variety of formats (7s, 10s, 12s, and 15s), with the most popular variations being the 7s (which was introduced during the 2016 Rio Summer Olympic

Games for the first time) and 15s formats (an Olympic sport in 1900, 1908, 1920, and 1924).³⁴ Very few rule differences exist between the various formats of the game across different groups. Over the years, rule changes were introduced to minimize the risk of serious injuries and to keep the ball in play for longer periods of time. Despite these efforts, compared with other collision sports, including American football, injury rates in RU remain roughly 3 times higher.³³

Consensus guidelines for injury surveillance in RU were accepted in 2007 to address the lack of uniformity in

From [†]Institute of Sport and Exercise Medicine, Division of Orthopedics, Faculty of Medicine and Health Sciences, Stellenbosch University, Stellenbosch, South Africa, [‡]Campus Health Service, Stellenbosch University, Stellenbosch, South Africa, and [§]IOC Research Centre, Cape Town, South Africa

*Address correspondence to Pierre L. Viviers, MBChB, MMedSc, MSc, FACSM, Campus Health Service, Stellenbosch University, Private Bag X1, Matieland, Stellenbosch 7602, South Africa (email: plviviers@sun.ac.za).

The following author declared potential conflicts of interest: Wayne Derman, MBChB, BSc (Med) (Hon), PhD, FFIMS, is a paid consultant for Ossur South Africa.

DOI: 10.1177/1941738118757178

© 2018 The Author(s)

classification systems.¹⁰ Accordingly, injuries are classified as either medical attention injuries, time-loss injuries, or nonfatal catastrophic injuries (eg, a brain or spinal cord injury resulting in severe functional disability, usually for longer than 12 months). To date, the recording of only time-loss injuries has been adopted widely and provides useful insight into the severity of injuries by logging the number of days a player is absent from training or match play. Categories of injury include slight (0-1 days), minimal (2-3 days), mild (4-7 days), moderate (8-28 days), severe (>28 days), career-ending, and nonfatal catastrophic injuries.¹⁰

Injuries requiring medical attention are often trivialized and overlooked. In fact, players can leave the field, as in the case of “blood injury,” receive medical attention at field-side to stop the bleeding, and rapidly return to play. Similarly, in certain elite-level matches, players with suspected concussion may leave the field to undergo a field-side evaluation, and, if concussion is excluded, may return to the field of play. Such instances are typically not recorded as injuries unless they result in time-loss or form part of a specific case study to focus on these types of injuries. However, such apparently innocuous injuries may affect the health of the athletes and should therefore not be ignored.³⁰ Thus, in some instances, non-time-loss injuries may have important medical consequences and should be monitored and reported. Increasingly, rugby-related catastrophic injuries (eg, cardiac events, acute spinal cord injuries, and traumatic brain injury) are also being studied among amateur and professional players at both the junior and senior levels.^{2,3,7,21} Significantly, in countries like South Africa and New Zealand, this has resulted in the successful implementation of nationwide injury prevention and surveillance programs.^{3,7}

To date, systematic reviews of RU injuries have focused on distinct subpopulations of athletes, including professional players and age categories, or are limited by sex,^{5,6,32} and certain age groups, formats, and levels of play have not been adequately studied. Therefore, comparisons between studies remain difficult, and the determination of risk based only on the existing incidence and severity data might not be a true reflection of all injuries, thus influencing the design and implementation of effective preventative interventions.

The aim of this review is to compare the existing epidemiological data with regard to different age groups, levels of play, and sex and to identify gaps in research that may influence future injury prevention strategies.

METHODS

The PubMed, MEDLINE, and Sport Discus databases were searched from 2007 to 2017 (up to January 1, 2017). Studies prior to May 2007 were specifically excluded as only studies that fulfilled the criteria as described in the 2007 consensus statement¹⁰ with regard to definition of injury and data collection procedures for the study of injury in RU were selected for review. Medical subject heading (MeSH) terms used included *rugby union* OR *rugby*, while the search terms used in

conjunction with MeSH terms were *injury* OR *injur**. This initial search was limited to studies in the English language and yielded 651 results. Inclusion criteria for retrieved articles were set as (1) prospective and/or retrospective cohort studies, (2) studies comprising 15-a-side RU populations, (3) studies that fulfilled the 2007 consensus statement criteria with respect to definition of injury and data collection procedures for the study of time-loss injury, (4) studies on either sex, (5) studies reporting any level of play or age group, (6) studies conducted in any geographical location, (7) studies reporting on injury incidence rates for match play or training, and (8) studies reporting 1 or more of the following epidemiological data: severity of injury, type of injury, location of injury, period of match when injury was sustained, and incidence of injury in forwards or backs. After the identification and removal of all duplicate records, full-text versions of all outstanding articles were retrieved and evaluated against the inclusion criteria by 2 independent reviewers. As a secondary search, the reference lists of these retrieved articles as well as any appropriate RU reviews were scrutinized for additional studies that may have been missed in the initial database search. Identified articles were individually selected for further review based on the quality and focus of the study and the population studied. In total, 16 studies were included in this article after the aforementioned primary and secondary search methods.

EPIDEMIOLOGY OF INJURY

To date, research on injury epidemiology in RU has targeted mostly male international and professional rugby players while a lesser focus has been on youth players of various ages and experience categories.^{4,9,11-14,18,22,29} Consequently, there is a relative paucity of injury surveillance data for women and players of both sexes at all levels of community rugby.^{23-25,29}

The studies evaluated in this review are listed according to study type, level of play, age category as well as type, incidence rate, and severity of injury (see Table A1 in the Appendix, available in the online version of this article). Furthermore, the incidence of injuries during match play from 11 studies is depicted in descending order to make comparisons between distinct RU subpopulations (Figure 1).^{8,10-12,14,18,23,25,26,29,33} Seven studies were also selected to demonstrate the consequences of match-related injuries as a function of incidence and severity for various RU subpopulations (Figure 2).^{9,12,13,18,23,29,31}

DISCUSSION

Injury Trends in Rugby Union

The reviewed literature shows that match injuries occur more frequently than training injuries, injury rates increase consistently according to age and level of play, and sex-specific differences relating to injury patterns and incidence rates exist.^{9,12,13,23-25,29}

Men's professional RU represents the upper end of the spectrum of injury, having the greatest incidence at this level of the game. Injury rates in this review are in keeping with a

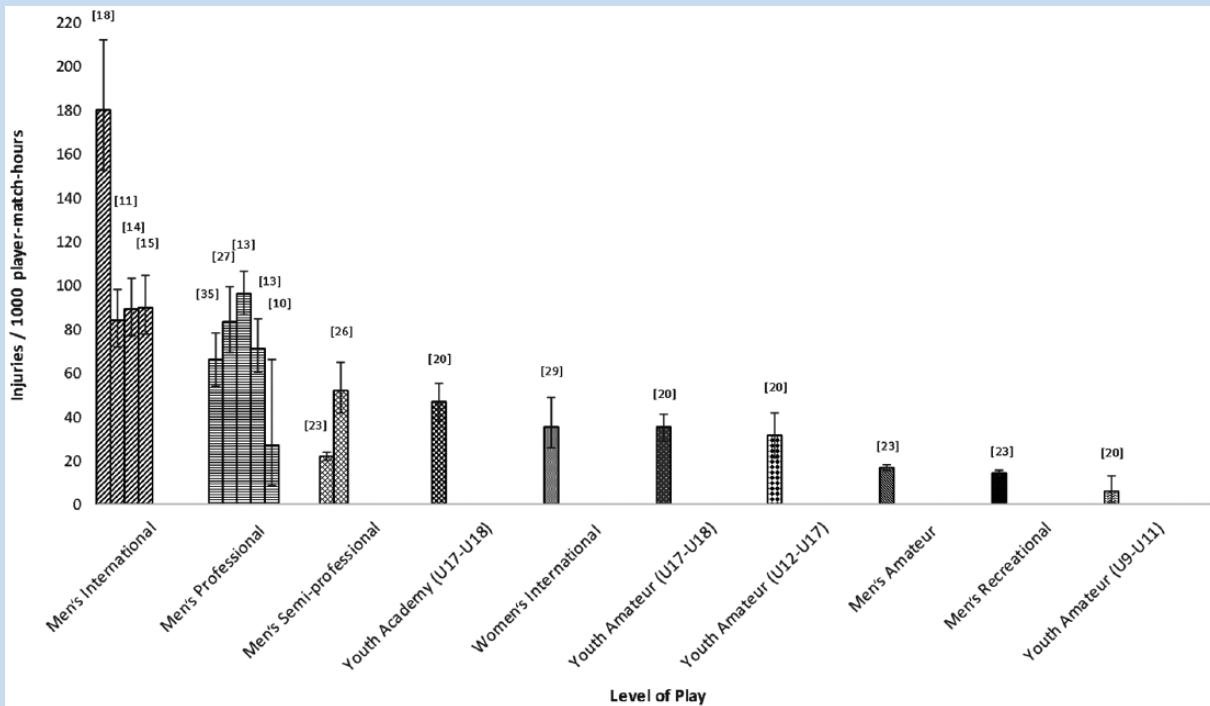


Figure 1. Incidence (with 95% CIs) of match-related injuries for various subpopulations in rugby union.

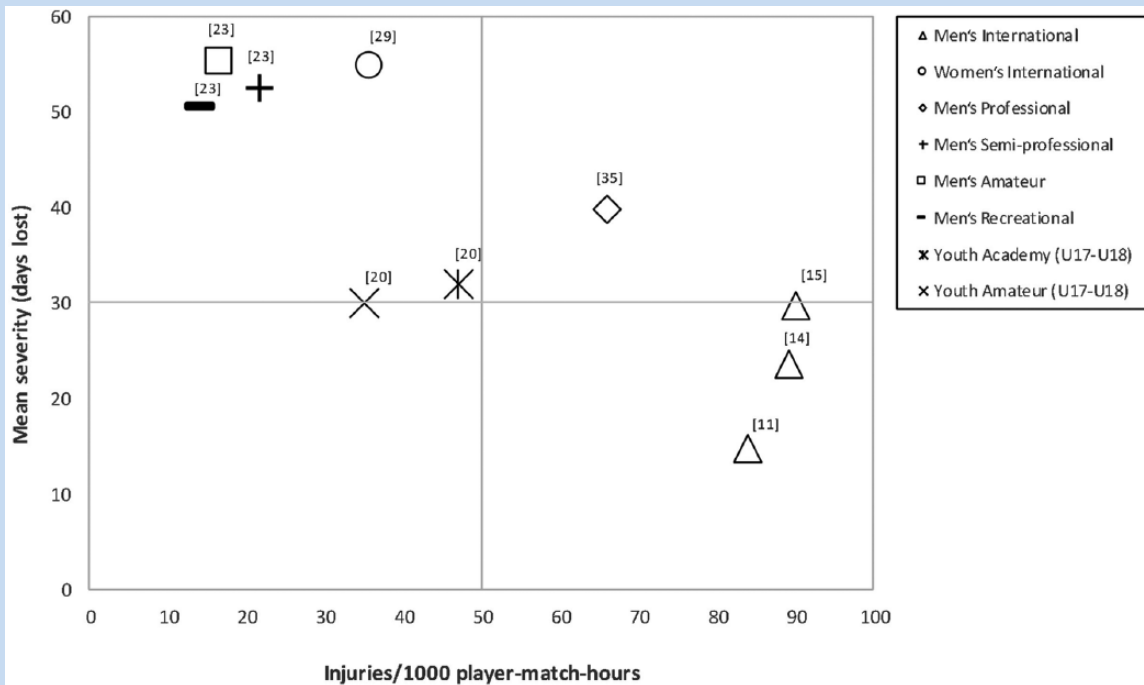


Figure 2. Representation of match-related injury incidence and severity for different subpopulations in rugby union.

recent meta-analysis of senior men's professional RU, which calculated the incidence of time-loss match-related injuries as 81 injuries per 1000 player-hours and training injuries as 3 injuries per 1000 player-hours.³³ Notably, within the professional categories of the game, injury rates are highest in men's international-level RU followed by premier league RU.

Overall, a trend toward lower injury rates was noticeable in decreasing levels and ages of RU play. An exception within the age continuum was that of adolescent boys in both the academy and amateur settings, who demonstrated higher incidence of injury compared with certain men's community-level RU groups (eg, men's amateur and recreational rugby). An explanation for this finding could be that the current lack of high-quality methodological studies for men's community RU provides an underestimation of actual injury rates within this group, thereby skewing overall injury profiles within the player age continuum. Alternatively, this may be a true reflection of injury, as schoolboy rugby is a demanding environment where pressure to perform is perhaps highest (especially due to parental and coaching expectations). Furthermore, factors including player skill (which is lower than adult men's community play) and physiological variables, specifically player size (older adolescents are larger and can cause more injury on collision), may make this age group more susceptible to injury. Evidence suggests that the incidence and severity of injuries in boy's adolescent RU increases significantly with increasing age. In perhaps the most comprehensive study on youth players to date, more injuries occurred within the U12 to U17 age groups (34.2 injuries/1000 player-match-hours) compared with those measured in the younger U9 to U12 player groups (11.9 injuries/1000 player-match-hours).¹⁴

Besides the trend in the incidence of injury within the distinct subpopulations of RU, the consequences of the injury, namely time-loss, are inversely related to the level of play (see Figure 2). An explanation for these trends in incidence and severity across the full spectrum of RU play may be that, in general, the higher the level at which the game is played, the greater the intensity of competition, which inevitably requires players to tackle and contest for the ball more frequently. Ultimately, this increases chances of exposure to injury. Simultaneously, player anticipatory experience, physical conditioning, and technical ability are factors that generally improve with age and level of play and may lessen exposure to more serious injuries. Furthermore, access to optimal medical support and excellent resources at the professional level of the game may fast-track rehabilitation and return to play.

This review also highlights a number of sex-specific differences in injury incidence rates and injury patterns; specifically, that match injuries in female athletes are lower in comparison with male athletes, while training-related injuries are proportionally higher. Moreover, the mean severity of injury in women's Rugby World Cup (RWC) is greater compared with that in men's RWC tournaments. These observable differences may be attributable to physiological variation between sexes (eg, smaller physical stature resulting in relatively lower strength, speed, and power

indices during intermittent high-intensity sport or athletic activities).²⁸ Additionally, inherent anatomical and biomechanical differences likely predispose women to specific injuries during collision sport, which may result in more severe injuries (eg, anterior cruciate ligament injuries in female athletes typically result in the most days lost).^{1,20,29}

It is also apparent from this review that training injuries form a significant proportion of the total number of injuries in RU, yet these injuries have not been as comprehensively studied as match injuries. Furthermore, a full understanding of the risk factors and predisposing factors that relate to training and indeed match injuries can only be understood through a comprehensive study of both.

Risk Factors

The tackle situation for both ball carrier and tackler is the event with the greatest propensity to cause injury across all levels and ages of RU play.^{26,27,29,31,33} In addition, other events or phases of play most likely to cause injury include the ruck and maul, collisions, scrum, and open play or running (without collision or contact with another player). Indeed, since the 1995 RWC, there has been a gradual decrease in set phases (scrums and lineouts) and an increase in general play such as ruck and mauls as well as passing. The change toward a more open and running style of the game has resulted in a need for added versatility from players who classically function in a specialized position. The result is a reduced requirement for set phases of play and an increase in contests for possession of the ball during open play. For example, in the modern version of the game, a loose head prop has to engage more frequently in other phases of play as opposed to mainly scrummaging. However, this still warrants further investigation to determine the effect on actual injury rates.

The association between player fatigue and injury rate is another aspect that needs further study. To date, studies place emphasis on the chronological occurrence of game injuries (measured in quarters of match time) to determine the effect of fatigue on injury rates.^{12,26,27} However, this trend is based on match playing time and does not take any other individual objective fatigue data into account.

CONCLUSION

Injury trends remain consistent in various RU subpopulations. Notably, injury rates are proportional to age and level of play, match-related injuries occur more frequently than training-related injuries, and the severity of injury seems inversely related to the level of play. Moreover, a number of sex-related differences may exist. The severity of injury (based on time lost) seems higher among female rugby players compared with males at similar levels of RU play. In addition, the proportion of training-related injuries compared with match-related injuries, as well as the incidence of knee ligament injuries, is greater among female international players compared with their male counterparts.

REFERENCES

1. Beynonn BD, Vacek PM, Newell MK, et al. The effects of level of competition, sport, and sex on the incidence of first-time noncontact anterior cruciate ligament injury. *Am J Sports Med.* 2014;42:1806-1812.
2. Brown JC, Lambert MI, Verhagen E, Readhead C, van Mechelen W, Viljoen W. The incidence of rugby-related catastrophic injuries (including cardiac events) in South Africa from 2008 to 2011: a cohort study. *BMJ Open.* 2013;3:002475.
3. Brown JC, Verhagen E, Knol D, Van Mechelen W, Lambert MI. The effectiveness of the nationwide BokSmart rugby injury prevention program on catastrophic injury rates. *Scand J Med Sci Sport.* 2016;26:221-225.
4. Burger N, Lambert MI, Viljoen W, Brown JC, Readhead C, Hendricks S. Tackle-related injury rates and nature of injuries in South African Youth Week tournament rugby union players (under-13 to under-18): an observational cohort study. *BMJ Open.* 2014;4:e005556.
5. Bleakley C, Tully M, O'Connor S. Epidemiology of adolescent rugby injuries: a systematic review. *J Athl Train.* 2011;46:555-565.
6. Freitag A, Kirkwood G, Scharer S, Ofori-Asenso R, Pollock AM. Systematic review of rugby injuries in children and adolescents under 21 years. *Br J Sports Med.* 2015;49:511-519.
7. Fuller CW. Catastrophic injury in rugby union. *Sports Med.* 2008;38:975-986.
8. Fuller CW, Clarke L, Molloy MG. Risk of injury associated with rugby union played on artificial turf. *J Sports Sci.* 2010;28:563-570.
9. Fuller CW, Laborde F, Leather RJ, Molloy MG. International Rugby Board Rugby World Cup 2007 injury surveillance study. *Br J Sports Med.* 2008;42:452-459.
10. Fuller CW, Molloy MG, Bagate C, et al. Consensus statement on injury definitions and data collection procedures for studies of injuries in rugby union. *Br J Sports Med.* 2007;41:328-331.
11. Fuller CW, Raftery M, Readhead C, Targett SG, Molloy MG. Impact of the International Rugby Board's experimental law variations on the incidence and nature of match injuries in southern hemisphere professional rugby union. *S Afr Med J.* 2009;99:232-237.
12. Fuller CW, Sheerin K, Targett S. Rugby World Cup 2011: International Rugby Board injury surveillance study. *Br J Sports Med.* 2013;47:1184-1191.
13. Fuller CW, Taylor A, Kemp SP, Raftery M. Rugby World Cup 2015: World Rugby injury surveillance study. *Br J Sports Med.* 2017;51:51-57.
14. Haseler CM, Carmont MR, England M. The epidemiology of injuries in English youth community rugby union. *Br J Sports Med.* 2010;44:1093-1099.
15. McIntosh AS, McCrory P, Finch CF, Wolfe R. Head, face and neck injury in youth rugby: incidence and risk factors. *Br J Sports Med.* 2010;44:188-193.
16. Moore IS, Ranson C, Mathema P. Injury risk in international rugby union: three-year injury surveillance of the Welsh national team. *Orthop J Sport Med.* 2015;3:2325967115596194.
17. Nicol A, Pollock A, Kirkwood G, Parekh N, Robson J. Rugby union injuries in Scottish schools. *J Public Health (Oxf).* 2011;33:256-261.
18. Palmer-Green DS, Stokes KA, Fuller CW, England M, Kemp SPT, Trewartha G. Match injuries in English youth academy and schools' rugby union: an epidemiological study. *Am J Sports Med.* 2013;41:749-755.
19. Palmer-Green DS, Stokes KA, Fuller CW, England M, Kemp SPT, Trewartha G. Training activities and injuries in English youth academy and schools' rugby union. *Am J Sports Med.* 2015;43:475-481.
20. Prodromos CC, Han Y, Rogowski J, Joyce B, Shi K. A meta-analysis of the incidence of anterior cruciate ligament tears as a function of gender, sport, and a knee injury-reduction regimen. *Arthroscopy.* 2007;23:1320-1325.
21. Quarrie KL, Gianotti SM, Hopkins WG, Hume PA. Effect of nationwide injury prevention programme on serious spinal injuries in New Zealand rugby union: ecological study. *BMJ.* 2007;334:1150.
22. Quarrie KL, Hopkins WG. Tackle injuries in professional rugby union. *Am J Sports Med.* 2008;36:1705-1716.
23. Roberts SP, Trewartha G, England M, Shaddick G, Stokes KA. Epidemiology of time-loss injuries in English community-level rugby union. *BMJ Open.* 2013;3:e003998.
24. Roberts SP, Trewartha G, England M, Stokes KA. Incidence and nature of medical attendance injuries in English community rugby union. *Orthop J Sport Med.* 2014;2:2325967114562781.
25. Schick DM, Molloy MG, Wiley JP. Injuries during the 2006 Women's Rugby World Cup. *Br J Sports Med.* 2008;42:447-451.
26. Schneiders AG, Takemura M, Wassinger CA. A prospective epidemiological study of injuries to New Zealand premier club rugby union players. *Phys Ther Sport.* 2009;10:85-90.
27. Schweltnus MP, Thomson A, Derman W, et al. More than 50% of players sustained a time-loss injury (>1 day of lost training or playing time) during the 2012 Super Rugby Union Tournament: a prospective cohort study of 17,340 player-hours. *Br J Sports Med.* 2014;48:1306-1315.
28. Sekulic D, Spasic M, Mirkov D, Cavar M, Sattler T. Gender-specific influences of balance, speed, and power on agility performance. *J Strength Cond Res.* 2013;27:802-811.
29. Taylor AE, Fuller CW, Molloy MG. Injury surveillance during the 2010 IRB Women's Rugby World Cup. *Br J Sports Med.* 2011;45:1243-1245.
30. Viviers PL. Rugby union collisions—anticipate more than just concussion: 2467 June 3, 10. *Med Sci Sports Exerc.* 2016;48(suppl 5):677-678.
31. Whitehouse T, Orr R, Fitzgerald E, Harries S, McLellan CP. The epidemiology of injuries in Australian Professional Rugby Union 2014 Super Rugby Competition. *Orthop J Sport Med.* 2016;4:2325967116634075.
32. Williams S, Trewartha G, Kemp S, Stokes K. A meta-analysis of injuries in senior men's professional rugby union. *Sports Med.* 2013;43:1043-1055.
33. Willigenburg NW, Borchers JR, Quincy R, Kaeding CC, Hewett TE. Comparison of injuries in American collegiate football and club rugby: a prospective cohort study. *Am J Sports Med.* 2016;44:753-760.
34. World Rugby. What is rugby? <http://www.worldrugby.org/welcome-to-rugby/what-is-rugby>. Accessed December 3, 2016.
35. World Rugby. Player numbers. <http://www.worldrugby.org/development/player-numbers>. Accessed December 3, 2016.

For reprints and permission queries, please visit SAGE's Web site at <http://www.sagepub.com/journalsPermissions.nav>.