

Supplementary Table 1. Rugby code, participant characteristics, aims, outcome measures and key findings of studies within ‘Fatigue and Recovery’ evidence-based theme (n=6)

Study	Rugby Code	*Cohort, sample size (n)	*Participant characteristics: age (yrs), height (cm), body mass (kg)	Study aims	Study outcome measures	Key findings
[45]	Sevens	State (n=10) and national (n=12)	State: 24 ± 4 yrs, 167 ± 3 cm, 66 ± 8 kg National: 22 ± 3 yrs, 167 ± 4 cm, 66 ± 5 kg	To examine relationships between on-field movement patterns and changes in markers of neuromuscular fatigue and muscle damage during a 2-day tournament.	Perceptual (self-reported soreness and recovery), muscle damage (CK) and neuromuscular (CMJ) responses. GPS (SPI HPU) derived external match load: duration, distance, relative distance, and distance covered in various speed zones and total impacts in various zones.	National players had greater on-field movements for total time, distance, high-speed running, and impacts (ES = 0.55–0.97) and displayed a smaller decrement in performance from day 1 to day 2. State players had a 4-fold increase in CK compared with the 2-fold increase in national players (ES = 0.73). Both groups had similar perceived soreness and recovery while CMJ was unchanged. High-speed running and impacts >10 g were largely correlated (r = .66–.91) with DCK for both groups.
[46]	Sevens	State (n=10) and national (n=12)	State: 24 ± 4 yrs, 167 ± 3 cm, 66 ± 8 kg National: 22 ± 3 yrs, 167 ± 4 cm, 66 ± 5 kg	To quantify the short-term changes in biochemical and haematological variables of inflammation and haemolysis induced by a 2-day tournament and explore the relationship between on-field movement patterns and select biomarkers.	Biochemical and haematological variables. GPS (SPI HPU) derived external match load: playing time, TD, distance covered at high speed, total number of impacts and impacts >10 g.	National players completed greater on-field movements (ES = 0.55–0.97), post-tournament leukocyte count increased similarly (30-50%) in both groups (ES = 1.52-1.95). Neutrophil count positively correlated (r = 0.57–0.89) with all on-field movements for both groups. Haptoglobin were 94% higher at baseline in national players (ES = 1.33) but declined ~20-40% in both groups. CK increased 4-fold in state players, and 2.5-fold in national players (ES =2.86–4.10).
[50]	Sevens	Elite (n=12)	25 ± 4 yrs, 169 ± 4 cm, 64 ± 5 kg	To determine time courses of wellbeing, TQR and neuromuscular performance within and after an elite women’s rugby sevens tournament and to assess the influence of match load indicators.	Wellbeing (self-reported wellbeing and recovery), neuromuscular (CMJ). Internal (sRPE) and external (GPS derived [JOHAN Sports]: TD and TD covered during various running intensities; video-based notational analysis derived number of physical contacts)	Wellbeing, fatigue, general muscle soreness, stress levels, mood and TQR were significantly (p≤0.005) impaired after match day 1 and did not return to baseline values until day plus two. Greater high-intensity running was related to more fatigue (r=-.60; p=.049) and a larger number of physical contacts with more general muscle soreness (r=-.69; p=.013).
[185]	Sevens	University (n=13)	22 ± 2 yrs, 162 ± 5 cm, 65 ± 5 kg	Establish the release dynamics of the muscle damage markers of the enzymes CK, LDH, and AST	Salivary CK, LDH and AST	CK and LDH did not change after match play. AST increased after match 3 (13.4 vs. 21.1; p < 0.05).
[49]	Sevens	International (n=12)	23 yrs, 169 cm, 68 kg	To characterize player core temperature across a World Rugby Women’s Sevens Series tournament day and determine the efficacy of commonly employed CWI protocols.	Tc, symptoms of exertional heat illness, perceptual scales, CWI details. GPS (EVO, GPSports) derived external load: playing minutes, average speed, high-speed running, average accelerations and decelerations	Average Tc was <i>very likely</i> lower (ES = -0.33) in game 1 than in game 2. Peak Tc was <i>very likely</i> (ES = 0.71) associated with increased playing time. CWI did not remove the accumulated Tc due to warm-up and match play activity (~1°C–2°C rise in Tc still present compared with Tc at warm-up onset for players ≥6-min match play).
[48]	Sevens	National (n=20)	24 ± 3 yrs, 170 ± 6 cm, 72 ± 10 kg	To characterise sleep quality among team sport athletes; explore sleep-associated issues; compare sleep quality between groups, and early versus daytime and evening trainers; evaluate relationship between validated sleep quality and perceived sleep quality, quality of life and daytime sleepiness.	Pittsburgh sleep quality index, Epworth sleepiness scale score, quality of life questionnaires and an OSA risk factor screen	Epworth sleepiness scale score = 9.0 ± 4.2 (a score of >10 indicates excessive daytime sleepiness), Pittsburgh sleep quality index = 8.2 ± 3.3 (a score >5 is associated with poor sleep quality). It appears women’s sevens players suffer poor sleep quality, with associated high levels of daytime sleepiness.

*Cohort, sample size and participant characteristics for women’s rugby athletes only. AST = aspartate aminotransferase; CK = creatine kinase; CMJ = countermovement jump; CWI = cold water immersion; ES = effect size; GPS = global positioning systems; LDH = lactate dehydrogenase; OSA = obstructive sleep apnoea; sRPE = session ratings of perceived exertion; Tc = core temperature; TD = total distance; TQR = total quality of recovery

Supplementary Table 2. Rugby code, participant and study characteristics, and key findings of studies within epidemiology focussed ‘injury’ evidence-based theme (n=32)

Study	Rugby Code	*Cohort, sample size (n)	Time course	Injury definition	Key findings
[51]	Union	Amateur (n=87)	1 season	Rugby-related injuries experienced in past week that either required medical attention or caused the player to miss at least one scheduled match or practice	Decrease in injury rate for females across the season (p=0.024) with an average decrease of 6.1% per week Female injury rate was generally lower than in males.
[70]	Union	Women (n=64) and schoolgirl (n=23)	1 season	All injury events that caused the player to seek medical attention or to miss at least one scheduled game or team practice	Games per person: women = 11.6, schoolgirls = 5.6 Game injuries per 100 player-games: women = 6.4, schoolgirls = 4.7 Practices per person: women = 19.6, schoolgirls = 7.3 Practice injuries per 100 player-games: women = 0.7, schoolgirls = 0 Inside backs had the highest game (12.3 per 100 player-games) and practice (1.5 per 100 player-practices) injury rate.
[69]	Union	Senior professionals, amateurs, juniors, cadets and school players (n=54340)	5 yrs	NR	28 women suffered an episode of dislocation/subluxation. ~5/10 000 women reported an episode of shoulder dislocation/subluxation per season
[57]	NR	Provincial (n=40)	1 season and 1 tournament	A rugby-related event that kept a player out of practice or competition for >24 hours or required the attention of a physician (e.g., suturing lacerations) and in addition included all dental, eye, and nerve injuries and concussions	35 injuries in 4958 player-hours and 2926 athletic exposures resulting in a rugby injury rate of 7.1 ± 0.4 per 1000 player-hours and 12.0 ± 2 per 1000 athletic exposures. 16 injuries occurred to the lower extremity, 9 to trunk and shoulders, 8 head and neck and 2 upper extremity
[54]	Union	High school (n=77)	2 seasons	An injury that occurred as a result of participation in an organized high school rugby match or practice; required medical attention; and resulted in restriction of the high school rugby player’s participation in regular school or rugby activities for 1 or more days beyond the day of injury	Girls injury rate = 4.1 injuries per 1000 total rugby athletic exposures The most commonly injured body sites for girls were the head (22.1%), ankle (13.2%), and shoulder (13.2%), with common diagnoses of fracture (16.8%), concussion (16.1%) and ligament sprain (14.9%). The mechanism of girls’ injuries were impact with another player (51.8%) or impact with surface or ground (24.4%), with the activity mostly being tackled (31.1%) or tackling (28.2%). Time loss from girls’ injuries was typically <10 days (45.1%).
[65]	Sevens	2014-15 SWS (n=197), 2015-16 SWS (n=221), 2016 Olympic (n=148)	12 tournaments over 3 yrs	Any injury sustained during the period of a Rugby-7s tournament (match or training session) that prevents a player from taking a full part in all training activities and/or match play for more than one day following the day of injury	Match injuries: 2014-15 SWS = 58, 2015-16 SWS = 56, 2016 Rio Olympics = 8 Player-match hour exposures: 2014-15 SWS = 655.2, 2015-16 SWS = 511.7, 2016 Rio Olympics = 8
[68]	Sevens	International (n=1562)	36 tournaments over 8 seasons	Any physical complaint sustained by a player during a SWS match that prevented the player from taking a full part in all training activities or match play for more than 1 day following the day of injury, irrespective of whether a match or training session was actually scheduled	Overall player-match-hour exposure = 3938 hrs Overall injury incidence = 105.6 injuries/1000 player-match-hours Overall mean severity = 53.4 days
[73]	Union	Senior and Schoolgirl (n=92)	1 yr	Any injury that required medical treatment of caused the player to miss at least one scheduled game or team practice.	59.6% of female players reported at least one injury during the 1992 season

[59]	Union	Collegiate (n=75)	1 season	Any physical damage suffered by a player	Overall injury rates = 68 and per 100 women players Disabling injuries rates = 12 per 100 women players Females sustained 14 injuries to the head, 8 to the neck, 7 to the eye and 7 to the nose
[75]	League	Rugby league ACC claimants	8 yrs	NR	320 moderate-to-serious injury claims 37.9±9.5 injury claims per year The lower limb accounted for 65% of the total female injury claims Concussion/brain injuries accounted for 3.8% of total female moderate to serious injury claims The 25–29 age group recorded 31.9% of injury claims
[76]	Union and League	Rugby league and union ACC claimants	10 yrs	Any injury that had been assessed and reported by a registered health practitioner as a result of sports participation. The injury had to have been classified and recorded as a concussion utilizing the ACC read code	Female rugby union players were responsible for an average of 3.3 per 1000 moderate-to-severe claims Female rugby league player were responsible for 0.6 per 1000 moderate-to-severe claims
[77]	Union	Rugby union ACC claimants	5 yrs	Any injury (minor, moderate-to-serious and serious injury) that had been assessed and reported by a registered health practitioner as a result of sports participation	26,070 total claims for female rugby union The 15–19-year age group recorded 40% of the total female rugby union moderate-to-serious and serious claims The knee was the most commonly recorded injury site accounting for 40.3% of moderate-to-serious claims
[53]	Union	Amateur (n=69)	2 seasons	Any physical complaint, which is caused by a transfer of energy which exceeds the ability of the body’s ability to maintain its structural and/or functional integrity, that is sustained by a player during rugby trainings, irrespective of the need for medical attention or time-loss from rugby activities	Injury incidence = 11.4 per 1000 training-hours Time loss injury incidence = 3.6 per 1000 training hours The lower limb recorded the highest total days-lost (170 days) with a mean of 7.4 ± 12.5 days per injury
[58]	Union	Provincial (n=143)	1 tournament	NR	9 injuries to female rugby players at 15.7 per 100 athletes
[60]	NR	Collegiate (n=810)	4 seasons	Any injury to the knee region that resulted in a player missing one game or two practices. All injuries had to have been diagnosed by a physician or an athletic trainer. Any intraarticular injuries had to have been confirmed by arthroscopic evaluation or magnetic resonance imaging.	76 total knee injuries in 58 296 exposures Knee injury rate = 1.3 per 1000 exposures 21 ACL tears were reported for a 0.36 incidence per 1000 exposures; other injuries included meniscal tears (n=25), MCL sprains (n=23), patellar dislocations (n=5), and posterior cruciate ligament tears (n=2) Forwards sustained 61% of MCL sprains, backs sustained 67% of ACL tears
[52]	Sevens	Amateur (n=658)	4 1-day tournaments over 2 months	Any physical complaint caused by transfer of energy that exceeded the body’s ability to maintain its structural and/or functional integrity, sustained by a player during a rugby match	Female injury rate = 10.0 injuries per 1000 playing hours No sex-difference was observed based on player position or average age of injured players For both men and women 48 injuries occurred over 4 tournaments, for an injury rate of 55.4 injuries per 1000 playing hours. Head and neck injuries were most common (33.3% of injuries), followed by upper extremity (31.3%), trunk (18.8%) and lower extremity (14.6%). The most common type of injury was ligament sprain (25.0%); followed by concussion (14.6%) and hematoma/contusion (12.5%). Tackling was the most common mechanism of injury (74.5%)

[71]	Sevens	Regional, collegiate and national (n=3876)	37 tournament days during 28 tournaments over 4 yrs	Any physical complaint caused by transfer of energy that exceeded the body's ability to maintain its structural and/or functional integrity, sustained by a player during a rugby match.		Women encountered concussions at 8.1/1000 ph, and men at 7.6/1000 ph Women missed 36.7 days absence from play The incidence of repetitive concussions was not statistically different between genders (Relative risk = 1.09, P = 0.754). Most concussions occurred from tackles (63%) and collisions (24%) (P = 0.056).
[56]	Sevens	U19 (n=39)	24 tournaments over 5 years	Any physical complaint caused by transfer of energy that exceeded the body's ability to maintain its structural and/or functional integrity, sustained by a player during a rugby match		Overall injury incidence = 85.9 per 1000 player-hours. Lower extremity injuries were most prevalent injury location (38.1%). Joint (non-bone)/ligament was the most common injury type (42.9%)
[72]	Sevens	Amateur U19 to elite/national (n=113)	26 tournaments over 3 yrs	Any physical complaint caused by transfer of energy that exceeded the body's ability to maintain its structural and/or functional integrity, sustained by a player during a rugby match		120 time-loss injuries were encountered with an injury rate of 46.3 injuries/1000 ph Injury rates in nonelite were 49.3/1000 ph, and in national level (elite) candidates, 32.6/1000 ph (RR = 1.5, p=0.130) Mean days missed: elite = 74.9 days per injury; nonelite = 41.8 days per injury The main mechanism of injury occurred when tackling players (73%) The most common type of injury seen were ligament sprains (37%, 13.9/1000 ph), involving the lower extremity (45%, 20.5/1000 ph). The most common body parts injured were the knee and head/face (16%, 7.3/1000 ph)
[55]	League	Junior (n=935)	1 season	Results in a player requiring first aid or medical attention		Incidence = 22.2 per 1000 player-hours (U13-U18 female) Severity = 13 ± 11 days Joint injuries and bruises/contusions/haematoma/cork accounted for 69.4% of female injuries
[61]	NR	Collegiate club (n=129)	5 yrs	Any new event that occurred during a rugby practice or match that required medical attention. The injury definition was not limited to time-loss injuries due to the common practice of athletes continuing to participate with minor and major injuries.		71 members of the women's team sustained 200 injuries during 68 633 athletic exposures Injuries included 9 ACL, 18 glenohumeral instability, 9 AC joint sprain, 30 concussions, 5 face lacerations, 5 eye injuries, 1 head other injuries and 6 fractures. Incidence rate 30% lower in women than men (IRR = 1.30). ACL incidence rate was 5.3 times higher in women (IRR = 5.32) than in men
[78]	Union	Rugby union ACC claimants (n=181440)	12 yrs		NR	3138 ± 925 claims were made per year by 15 120 ± 4370 female players Mean injury type claim rate per 1000 female players per year = 168 soft tissue, 20 fracture/dislocation, 6.5 for both laceration and concussion/brain injury and 2.6 for dental. For female players, the probability of making at least one injury claim increased from 0.4% per year at age 5 years through 58-64% for players aged 22 through to 40 years
[80]	Union	Rugby patients presenting to orthopaedic services (n=242)	1 yr		NR	8 fractures sustained Fractures by age group in females; 15-19 years: 3, 20-24 years: 3, 25-29 years: 1, 30-34 years: 1.
[82]	NR	Rugby patients presenting to emergency	10 yrs		NR	Women were most frequently injured in the head (23%) and shoulder (12.3%) The biggest variation for injury proportion rates between men and women was shown in the regions of the mouth (IPR 4.23), ear (IPR 3.48), face (IPR 2.62), and eyeball (IPR 2.57) which all occurred more frequently in men Women were most prone to sprain/strains (34.4%), followed by contusions (15.7%) and fractures (15.1%).

		departments (n=27824)			
[64]	Union	International (n=339)	20-day tournament	Any physical complaint, which was caused by a transfer of energy that exceeded the body's ability to maintain its structural and/or functional integrity, that was sustained by a player during a rugby match or rugby training, irrespective of the need for medical attention or time-loss from rugby activities.	Overall IIR = 10/1000 player hours, match-play IIR = 37.5/1000 player hours, practice IIR 12.5/1000 player hours IIR for forwards = 39.3/1000 player hours, IIR for backs = 42.2/1000 The front row had the highest injury rate (62.5/1000 player hours). 63.6% of injuries occurred during the tackle. Most injuries occurred to the neck, knee and head/face. Most injuries were sprains, muscle injuries and contusions
[62]	League	Club (n=90)	NR	NR	% of injury = 53.3 Facial injuries = 30.0% 26.7% of women's league players reporting having observed a dental injury Women's league players had the lowest percentage of dental injuries (4.4%).
[66]	Sevens	Youth Olympic (n=71)	13-day tournament	Received medical attention, regardless of the consequences with respect to absence from competition or training	Number of female rugby sevens injuries = 26 Five of these injuries were estimated to have a >7 day time-loss 36.6% of female rugby sevens players were injured (greatest in all female sports) IIR = 43% (both male and female rugby players)
[67]	Union	International (n=285)	1 tournament	Any physical complaint, which was caused by a transfer of energy that exceeded the body's ability to maintain its structural and/or functional integrity, that was sustained by a player during a rugby match or rugby training, irrespective of the need for medical attention or time-loss from rugby activities.	Incidence of match injury = 35.5/1000 player-hours Mean severity = 55 days, median severity = 9 days One training injury was reported. Knee-ligament injuries were the most common (15%) and resulted in most days lost (43%). The tackle was the cause of most injuries.
[63]	Sevens	International (n=35)	2 yrs	A medically diagnosed physical complaint sustained while undertaking rugby training or rugby competition that resulted in loss or abnormality of bodily structure or functioning, irrespective of time loss from rugby activities.	27 women's squad players sustained 152 injuries at an incidence of 40.8 per 1000 player hours. Female injuries commonly occurred in the lower limb (63.2%). The knee (13.2%) and the ankle (12.5%) were the most injured sites. The nature of injuries were typically joint sprains (24.3%) or muscle injuries (20.4%).
[74]	NR	Rugby patients presenting to emergency departments (n=443)	10 yrs	NR	Tackling phase of play accounted for the highest number of injuries in females (155/443; 35%) 21% of injuries sustained from collision and 14.9% from contact on ground. 34.8% of injuries were sprains and strains
[79]	NR	Adolescent fracture patients	1 yr	NR	3 female rugby injuries. Females were responsible for 5% of 20 (male and female) clavicle fractures and 14% of 7 (male and female) distal radius/ulna fractures.
[81]	NR	Rugby patients presenting to emergency departments (n=30217)	26 yrs	NR	Females presented with more knee injuries (IPR = 1.67), more contusions/abrasions (IPR = 1.48) and strains/sprains (IPR = 1.39) than males (p<0.001) Females were most often treated for injuries to the knee (12.6%), ankle (11.9%), shoulder (11.4%), face (11.2%), and head (11.1%). Females were diagnosed with a greater proportion of knee injuries than males (12.6 vs. 7.5%).

*Cohort and sample size characteristics for women’s rugby athletes only. AC = acromio-clavicular; ACC = Accident Compensation Corporation; ACL = anterior cruciate ligament; IIR = injury incidence rate; IPR = injury proportion ratio; IRR = incidence rate ratio; MCL = medial collateral ligament; NR = not reported; RR = relative risk; SWS = Sevens World Series

Supplementary Table 3. Rugby code, participant characteristics, aims, outcome measures and key findings of studies within ‘injury risk, management, prediction’ focussed evidence-based theme (n=16)

Study	Rugby Code	*Cohort, sample size (n)	*Participant characteristics: age (yrs), height (cm), body mass (kg)	Study aims	Study outcome measures	Key findings
[94]	Union	University (n=64)	20 ± 2 yrs; 167 ± 11 cm; 74 ± 21 kg	To determine whether the FMS components can predict injury in female and male rugby union players and whether differences exist in the FMS scores of injured and non-injured players.	FMS scores, injury type, location, mechanisms, severity, playing exposure	Female training injury rate: 5.80 injuries/1000 hours Female match injury rate: 55.56 injuries/1000 hours FMS individual components predicted 37.4% of the variance in total days injured in females.
[90]	Union	High school (n=170)	16.5 yrs	To provide reference scores for high school rugby union players on the SCAT5, including immediate memory using the 10-word list, and examine how age, sex, and concussion history affected performance.	SCAT5 scores, including total number of symptoms, symptom severity, 10-word immediate memory, delayed memory, modified Standardized Assessment of Concussion, and balance examination.	Median symptom severity was highest in females with a concussion history (13, range = 0–45). Median total scores on immediate memory were 21 for females. Being female was associated with a higher total symptoms score, higher total symptom severity score, and lower number of errors on the balance examination 172 potential concussive events were verified. Static balance performance was worse at post-season (p≤0.03). Dynamic postural performance improved after the season (p<0.01). Spinal cord excitability did not change, but deviated from normative values at baseline.
[95]	NR	Collegiate varsity (n=13)	21 ± 2 yrs; 167 ± 7 cm; 73 ± 6 kg	To investigate subtle underlying neurological deficits that may accompany recurrent mild head impacts in female rugby	Centre of pressure, time to target and time to centre during static and dynamic balance tasks; Soleus H-reflexes; concussive events	46-68 players reported contact breast injuries (code dependant) 48% of female contact football codes perceived that injury affected performance 63% female rugby union players reported sustaining breast injuries caused by contact with another player
[97]	Union, Sevens, League	Sub-elite and elite	NR	To investigate the occurrence, causes and perceived performance effects of contact breast injuries sustained by female contact football players; how the occurrence injuries varied among codes, positions and competition levels; and the awareness and perceptions of coaches and medical professionals about contact breast injuries.	Questionnaire assessing self-reported breast injury occurrence and cause, and perceived performance effects	Players with 12-month concussion history had the highest head acceleration (females = 48.6g, males = 68.3g, p<0.05) with lower trapezius (6.9–11.7%, p<0.05) and splenius capitis (3–12%, p<0.05) amplitudes compared to athletes with no-concussion.
[92]	Union	Club (n=13)	NR	To explore the effect of concussion history on head control during front on rugby tackles in non-professional male and female Rugby Union players.	Concussion history, triaxial accelerometer (CSx): linear and rotational head acceleration, normalized Surface EMG amplitude of the bilateral sternocleidomastoid, upper trapezius and splenius capitis.	33 (male and female) patients returned to rugby after a mean 22.1 ± 10 days. Post-concussive syndrome lasted a median of 15 days in women and 4 in men (p=0.04). Return to sport delay was longer in women than in men (30 vs. 21 days; p = 0.19)
[98]	NR	High level and professional (n=5)	NR	To evaluate a standardized management of brain concussion among rugby players to prevent the recurrence	Time to return to play, concussion recurrence rate, Cantu Grading system for concussion, SCAT2, Trail Making Test, CT or MRI,	107 total injuries. Match injury rate = 4.4 per 100 matches. Practice injury rate = 0.2 injuries per 100 practices 16.5% of players admitted to perpetrating foul play without an assessed penalty. 13.8% of players had been penalised for foul play 24.3% of injured players believed they had been injured as a result of foul play
[101]	NR	Varied quality/levels (n=258)	27 ± 7 yrs	To describe the patterns of injury among USA female rugby players, to assess the players’ perception of foul play and the referee response to foul play, and to evaluate the association between players’ perception of foul play and injury.	Questionnaire assessing injuries, perceived history of foul play	Mouthguards use = 90.8% < 15% of players reported having always worn other types of protective equipment. Mouthguards, padded headgear, and shoulder pads were worn ‘to prevent injury’, ankle braces,
[100]	NR	Varied quality/levels (n=234)	26 ± 6 yrs	To assess the prevalence of protective equipment-use among a sample of USA female rugby players and to evaluate their motivation for using different types of protective equipment	Questionnaire assessing rugby participation and protective equipment use	

						neoprene sleeves, and athletic tape on joints were worn ‘to protect a current/recent injury.’
[89]	Union	Community (n=425)	29 ± 8 yrs	Identify the association between diagnosed concussion and injury in a group of rugby players and the risk of injury between males and females	Online questionnaire assessing injury history	Diagnosed concussion = 278 Lower extremity musculoskeletal injury = 396 Females had significant associations for concussion and lower extremity musculoskeletal injury (OR = 2.49)
[88]	Union	Amateur (n=69)	27 ± 7 yrs; 165 ± 7 cm; 87 ± 16 kg	To investigate the use of the King-Devick test for the sideline assessment of concussive injuries in an amateur women's rugby union team	Match and training exposure, concussion incidence, King-Devick test scores	There was good to excellent reliability of the King-Devick test for baseline (ICC:0.84 to 0.89), post-injury (concussion) sideline screening (ICC: 0.82 to 0.97) and post-season evaluation (ICC:0.79 to 0.83).
[91]	Union	Rugby schools	NR	To ascertain the extent of injury surveillance and prevention practices currently in operation and the availability of qualified personnel across Rugby playing schools in the Republic of Ireland.	Questionnaire assessing school demographics, personnel access, strength and conditioning, injury monitoring and prevention	Respondents = 93 schools [356 (97% male, 3% female) teams] Schools monitoring rugby injuries = 86% Schools providing physiotherapy = 28% Schools providing medical doctors = 14% Schools providing strength and conditioning coach = 44% Schools not implementing injury prevention measures = 31%
[96]	NR	University (n=20)	22 ± 2 yrs; 168 ± 5 cm; 71 ± 9 kg	Examine lumbar multifidus characteristics in male and female university rugby players and their possible associations with low back pain and lower limb injury	Ultrasound measurements of lumbar multifidus cross-sectional area, thickness, and % change in thickness during contraction, in prone and standing positions. Dual-energy x-ray absorptiometry body composition. Self-reported low back pain and lower limb injury history	Prone CSA (cm ²): Left = 7.8; Right = 7.5 Standing CSA (cm ²): Left = 9.0; Right = 8.7
[99]	Union	Women and schoolgirl (n=87)	NR	To describe the level of usage of protective devices and equipment in a cohort of New Zealand rugby players	Percentage of all player-weeks of follow-up for which each equipment item was used	Women = mouth guards 58.9%, shin guards 8.7%, padded head gear 1%, taping (body joints) 13.4%. Schoolgirls = mouth guards 55.0%, shin guards 0.5%, padded head gear 0%, taping (body joints) 3.6%.
[93]	Sevens	University (n=14)	20 ± 1 yrs; 161 ± 4 cm; 53 ± 5 kg	To investigate injury incidence and the influence of physical fitness parameters on the risk of severe injuries in players on rugby sevens university teams	Injury: location, type, new or recurrent, mechanisms, contact vs. non-contact, diagnosis, treatment, and number of days lost Physical fitness: YYIRT, push-up test, IMTP, single leg bridge test, vertical jump test, 40-m speed test, Illinois agility test, Y balance test, sit and reach test and Thomas test	4 female players injured Match incidence (male and female): 59.3 per 1000 player-hrs Training incidence (male and female): 3.3 per 1000 player-hrs Female (HR = 8.35), slower (HR = 3.51, and less agile (HR = 2.22) players as well as those with hip flexors tightness (HR = 1.12) were at significantly greater risk for sustaining severe injuries.
[84]	Union	International (n=764)	NR	Compare SCATS baseline performance in large groups of professional men’s and women’s rugby players to determine whether reference limits used for the management and diagnosis of concussion should differ between sexes	SCATS scores	Women endorse more symptoms than men, report symptoms with a higher severity than men, and perform better than men in orientation and concentration, and balance sub-modes (p<0.05)
[87]	Union	Amateur (n=24)	Forwards: 170 ± 4 cm; 87 ± 14 kg Backs: 166 ± 7 cm; 70 ± 11 kg	To investigate intrinsic and extrinsic risk factors associated with injury in amateur male and female Rugby Union players.	Hamstring flexibility, dorsiflexion range of movement, adductor muscle strength and foot position, sleep quality, coping skills, support levels. Injury: nature, the timing of injury during the match and the event surrounding the injury, diagnoses and total days absence from rugby.	18 female players sustained one or more injuries Female time loss injury incidence rate = 45.2/1000 player hours Male and female players with weaker adductor muscle strength had a higher injury incidence (injury rate = 1.57).

*Sample size and participant characteristics for women’s rugby athletes unless otherwise specified. CT = computerized tomogra phy; FMS = Functional Movement Screen; HR = hazard ratio; IMTP = isometric midthigh pull; MRI = Magnetic resonance imaging; NR = not reported; OR = odds ratio; SCAT = Sport Concussion Assessment Tool; YYIRT = Yo-Yo Intermittent Recovery Test

Supplementary Table 4. Rugby code, participant characteristics, aims, outcome measures and key findings of studies within physical characteristics focussed ‘match characteristics’ evidence-based theme (n=21)

Study	Rugby Code	*Cohort, sample size (n)	*Participant characteristics: age (yrs), height (cm), body mass (kg)	Study aims	Number of matches (n)	Study outcome measures	Key findings
[117]	Union	Premier division forwards (n=68) and backs (n=61)	Forwards: 25 ± 5 yrs; 173 ± 6 cm; 79 ± 7 kg Backs: 25 ± 6 yrs; 165 ± 8 cm; 66 ± 5 kg	To determine the match demands of elite English women's rugby union, identify positional differences, and between-player variability.	14	GPS (Catapult Minimax S4): TD, distance in various speed zones, maximum speed, PlayerLoad, RHIE	Mean TD = 4982 m, relative distance = 54.8±9.1 m·min ⁻¹ , PlayerLoad = 531±97 Backs <i>moderately</i> > forwards for maximum speed, high-intensity running, sprinting (p<0.05). Forwards <i>moderately</i> > backs for time spent jogging (p<0.05) Average TD = 5720±921 m
[114]	Union	Provincial (n=20)	24 ± 4 yrs; 170 ± 6 cm; 79 ± 11 kg	To quantify running demands in female rugby union players during Farah Palmer Cup matches (New Zealand).	7	GPS (VX Log, VX Sport): TD, high-intensity running, meters per minute, maximum speed	Backs were faster than forwards (26±2 vs. 22±3 km·h ⁻¹) and covered greater high-intensity running distance (651±252 vs. 252±229) (p<0.05)
[124]	Sevens	Junior (n=13), senior (n=22), elite (n= 11)	Junior: 164 ± 7 cm; 64 ± 12 kg Senior: 170 ± 7 cm; 70 ± 9 kg Elite: 169 ± 2 cm; 69 ± 4 kg	To quantify the game running movement patterns, anthropometric and physical characteristics of male and female rugby sevens players across 3 playing levels.	6	GPS (SPI HPU GPSports) derived: TD, max speed, max acceleration, number of impacts >10 g, relative TD, total and percent distance covered >3.5 m·s ⁻¹ and >5 m·s ⁻¹ , total and percent sprint distance, and mean sprint duration. Physical characteristics: height, body mass, and sum of 7 skinfold sites, 40m sprint, vertical jump test, YYIRT-1	In females, elite players had more favourable on- (max speed = 8.05±0.55, distance >5 m·s ⁻¹ = 120±41) and off-field performance measures than juniors (max speed = 7.08±0.83, distance >5 m·s ⁻¹ = 89±52) and seniors (max speed = 7.40±0.52, distance >5 m·s ⁻¹ = 102±44)
[102]	Sevens	International (n=12)	23 ± 4 yrs; 169 ± 2 cm; 69 ± 4 kg	To assess the ability of automated collision detection software in GPSports units, compared to manually coded video notational analysis, in men's and women's rugby sevens.	1 men's, 1 women's	Video-derived notational analysis for collision events Accelerometer (SPI HPU, GPSports) derived collisions >3.5G GPS (SPI PRO X): distance, speed, impacts HR	Precision (men's and women's) = ~0.72 (scale: 0.00–1.00) 62% of collisions for women were incorrectly labelled
[109]	Sevens	International (n=16)	23 ± 2 yrs; 166 ± 7 cm; 66 ± 7 kg	To determine the effectiveness of a commercially available energy drink on the running activity profiles of elite female rugby sevens players during an international tournament.	2	Urine analysis (Agilent Technologies HPLC 1200): caffeine, paraxanthine, theobromine, and theophylline concentrations Physical characteristics: 15 sec maximal jump test, 6 x 30-m sprint test	Energy drink increased muscle power output during the jump series, running pace during the games and pace at sprint velocity (ps0.05). Energy drink did not affect maximal running speed during the repeated sprint test but did increase mean HR during games (p<0.05).
[112]	League	Elite (n=17)	25 ± 6 yrs; 171 ± 5 cm; 74 ± 7 kg	To investigate the validity of the Catapult algorithm to automatically detect and differentiate tackles when compared with video-coded tackles	1	Video-derived notational analysis for tackle events GPS (Optimeye S5) derived tackle	Players engaged in 512 tackle events (30 ± 17 per player) Sensitivity = 76%; Precision = 83%
[122]	League	International and domestic (n=58)	NR	To describe the whole match and peak duration-specific locomotor characteristics at international and domestic levels	4 international, 5 domestic	GPS (Otpimeye S5): TD, high-speed distance, sprinting, average speed, average acceleration	International forwards <i>most likely</i> > domestic forwards for peak 1-min average acceleration and peak 3-min acceleration (0.79 and 0.60 vs. 0.70 and 0.54). International backs <i>likely</i> > domestic backs for peak 1-min average acceleration and <i>possibly</i> for high-speed distances (0.78 and 241 vs. 0.73 and 190).

[105]	Sevens	International (n=20)	24 ± 4 yrs; 168 ± 6 cm; 69 ± 5 kg	To evaluate the effects of contextual game factors on activity and physiological profiles of international-level women's rugby sevens players	5 tournaments	GPS (Minimax S4): TD, distance in different speed zones, PlayerLoad (relative and absolute). HR	TD (776±118 vs. 640±180m), high-speed distance (154±57 vs. 124±59m), PlayerLoad (84±18 vs. 69±20AU) > 1 st half vs. 2 nd half (p<0.05) TD (1455±294 vs. 1312±290m), moderate-speed distance (964±204 vs. 913±208m) and very high-speed distance (133±59 vs. 104±42m) > losses vs. wins (p<0.05)
[103]	Sevens	International (n=24)	24 ± 5 yrs; 168 ± 5 cm; 68 ± 6 kg	To quantify the movement patterns and compare sessions of preparation training camps for international women's rugby sevens players	28 training sessions	GPS (SPI Pro, GPSports): TD, sprint distance, accelerations, decelerations, sprints and repeated sprints sRPE	Women's sevens players median TD = 3823 m (relative distance of 44 m·min ⁻¹) Average session duration 91 mins 0.47 sprints·min ⁻¹ ; 0.17 repeated sprints·min ⁻¹
[116]	League	Domestic (n=21)	29 ± 8 yrs	To quantify impacts to the head via an instrumented patch worn behind the ear for women rugby league players over one season	9	Accelerometer and Gyroscope (XPatch): linear acceleration and angular velocity	1659 impacts to the head >10g were recorded (range: 10g–91g) Impacts per match = 184±18 Impacts per player per match = 14±12 Highest median peak resultant linear acceleration = 16g 120 total head impacts ≥15 g (18.1 g – 78.9 g) and 4 concussions with 1199 total athlete exposures
[115]	League	Collegiate (n=23)	20 ± 1 yrs	To describe head impact kinematics and subsequent concussive events in a collegiate level women's rugby team throughout one competitive season including both practices and games.	47 practices, 8 matches	Smart Impact Monitors (Triax Technologies): frequency, magnitude and location of head impacts	67 match head impacts; mean rate of 0.40±0.22 hits per-player per-match, median peak linear acceleration = 32.2 g, and peak rotational velocity = 13.5 rad·sec ⁻¹ 53 practice head impacts; mean rate of 0.05±0.04 hits per-player per-practice, median peak linear acceleration = 29.8 g and peak rotational velocity of 15.7 rad·sec ⁻¹
[106]	Sevens	International (n=27)	24 ± 2 yrs; 168 ± 7 cm; 68 ± 4 kg	To report the running and physiological demands of women's rugby sevens match-play with respect to halves of play and positions of play.	36	GPS(Statsports Viper Pod): distance in various speed zones, number of sprints, average maximal sprint distance, average minimal sprint distance, accelerations in various zones, and maximal velocity. HR	Mean distance = 1 625 ± 132 m (116.1 ± 9.4 m·min ⁻¹) High-speed distance = 199 ± 44 m (14.2 ± 3.1 m·min ⁻¹) Reductions in high-speed running (p = 0.003) and increases in lower speed running were observed across halves of play (p = 0.04) Players spent >75% of the time >80% of HR maximum
[113]	Sevens	Professional forwards (n=5) and backs (n=7)	Forwards: 27 ± 3 yrs; 170 ± 3 cm; 70 ± 2 kg Backs: 25 ± 5 yrs; 167 ± 5 cm; 62 ± 4 kg	Quantify absolute and max velocity-relative speed characteristics, establish if max velocities are reached, investigate importance of max velocity to game outcomes	6	GPS (JOHAN Sports): distance in different speed zones, number of sprints at different intensities Sprint influence on a visual-analogue scale	Mean peak velocity per game = 90.6 ± 7.9% Vmax TD per game = 1,556 ± 233 m
[121]	Sevens	National (n=10) and international (n=10)	International: 26 ± 4 yrs; 167 ± 7 cm; 65 ± 5 kg National: 32 ± 6 yrs; 167 ± 3 cm; 66 ± 5 kg	To investigate the distance and speed demands and HR responses of female rugby sevens players competing at international and national levels.	4	GPS (SPI Pro X): distance in various speed zones, accelerations and impacts. HR	International > national players for TD (1642±171 vs. 1363±222 m), average speed (6.0±0.3 vs. 5.2± 0.6km·h ⁻¹), number of sprints (6.1±3.1 vs. 1.9±1.4), sprint distance (119± 61 vs. 47± 39 m) (p<0.01). Work-rest ratio was different (p<0.01) between international (1:0.3) and national players (1:0.4)
[104]	League	International (n=18)	26 ± 4	To describe the movement patterns of the Australian Women's Rugby League team during international competition.	7	GPS (SPI Pro X): mean speed, high-intensity running in various speed zones	TD was greater in the 1 st half (3333 m vs. 3249 m), as well as TD at speeds >15 km·h ⁻¹ (p < 0.05). Players covered greater TD speeds <6 km·h ⁻¹ in the 2 nd half (p = 0.005). Backs travelled further at speeds <6 km·h ⁻¹ (p = 0.002) and >15 km·h ⁻¹ (p = 0.007) compared to forwards. Mean speed reduced across the 1 st and 2 nd halves (p < 0.05)
[107]	Sevens	International (n=15)	24 ± 4 yrs; 168 ± 7 cm; 68 ± 6 kg	To determine whether the score differential of a match outcome influences the physical demands of match play in women's rugby sevens.	15	GPS (VX sport 220): distance in various speed zones Video derived notational analysis for ball carry, ball taken into contact, pass, own ruck attended, opposition ruck attended, tackles, missed tackle,	TD covered were <i>moderately</i> greater in high score differential games (87.8±8.9 vs. 91.6±9.7 m·min ⁻¹ ; mean difference:3.8) <i>Moderately</i> greater numbers of missed tackles (0.5±0.6 vs. 0.4±0.7; count ratio: 0.7) and lineouts (1.1±0.9 vs. 0.6±1.3; count ratio 0.54) in low score differential versus high score differential games

				scrum, lineout. Performance: low (<21) and high (>= 21) score differentials			
[111]	Union	International (n=29)	24 ± 3 yrs; 167 ± 4 cm; 75 ± 11 kg	To profile distances covered during women's rugby union match-play and assess WCS locomotor demands over 1-10min epochs, whilst comparing the FIXED vs ROLL methods and assessing positional influences.	8	GPS (Optimeye S5): TD and high speed running	TD = ~5.8 km per match, with reduced distances in the 2 nd vs 1 st half (p < 0.001). FIXED underestimated ROLL WCS total and high-speed distance (p<0.001). In ROLL, WCS relative total and high-speed distances reduced from ~144-161 m·min ⁻¹ and ~30-69 m·min ⁻¹ over 60-s, to ~80-89 m·min ⁻¹ and ~5-16 m·min ⁻¹ in the 600-s epoch, respectively. Forwards < backs for high-speed running and TD during 60-s, 180-s, 420-s and 480-s epochs (p<0.001)
[186]	Sevens	International (n=12)	28 ± 4 yrs; 166 ± 6 cm; 64 ± 5 kg	To examine the match running demands and exercise intensity associated with elite women rugby sevens.	5	GPS (SPI GPSports): distance in various speed zones. HR	Average distance per game = 1 556±189 m % of time spent: standing and walking = 30; jogging = 33; cruising = 12; striding = 16; high-intensity running = 4; sprinting = 5 Average maximal sprint distance = 25.8±16.1 m; mean sprint distance = 17.2±8.8 m; # of sprints = 5.3±3.2 Work-to-rest ratio = 1:0.4
[110]	Union	International (n=8)	Backs: 27 ± 3 yrs; 170 ± 2 cm; 68 ± 4 kg Forwards: 27 ± 2 yrs; 174 ± 6 cm; 77 ± 10 kg	To describe locomotive activities and exercise intensity during international female rugby union and compare playing positions.	1	GPS (SPI Pro X, GPSports): distance in various speed zones, accelerations, body impacts. HR	TD = 5820 ± 512 m TD for backs > forwards (6 356 ± 144 vs. 5 498 ± 412 m; p=0.01) % time spent: standing or walking = 43; jogging = 35; low intensity running = 10; medium intensity running = 10; high-intensity running = 2; sprinting = 1 Mean sprint count = 4.7±3.9; Mean max sprint distance = 20.6±10.5 m; Mean sprint distance = 12.0±3.8 m
[123]	Sevens	International (n=22) and developmental (n=25)	NR	To examine locomotor, metabolic power and HR demands across standards. To determine the match demands and physical performance associations.	5 per playing standard	GPS (SPI Pro): running at various intensities. HR, metabolic power, YYIRT1, 35/40m sprint test	International > developmental players for TD (1468±88m vs. 1252±135m), high-intensity running (224±55m vs. 131±44m), sprint distance (128±67m vs. 57±44m) and more distance in high (264±36m vs. 210±54m), elevated (118±17m vs. 76±20m) and maximal (69±17m vs. 30± 15m) metabolic power categories Developmental > international for peak (187±6bpm vs. 194±5bpm) and mean (172±7bpm vs. 180±9bpm) HR International > developmental for YYIRT1 (1160±191m vs. 781±129m) and maximal sprint speed (27.3±0.7 vs. 26.0±1.5km·h ⁻¹).
[118]	Union	Premier division (n=38)	24 ± 4 yrs; 169 ± 7 cm; 73 ± 11 kg	To determine and quantify movement patterns through time–motion analysis and to assess the physical demands during competition	10	Notational analysis: standing, walking, jogging, striding, sprinting, ruck/maul/tackle, pack down, scrum, lift, kick, jump, open field tackle. HR	Backs spend more time sprinting (37±12 vs. 25±16) and less time in ruck/maul/tackles (25±11 vs. 61±12) compared to forwards (p<0.05) Forwards > back for mean HRs (173±10 vs. 161±10) and time above 80% of maximum HR (81±14 vs. 63±20) (p<0.05)
*Cohort, sample size and participant characteristics for women's rugby athletes only. HR = heart rate; FIXED = fixed epoch; NR = not reported; RHIE = repeated high intensity efforts; ROLL = rolling average; sRPE = session rating of perceived exertion; TD = total distance; WCS = worst-case scenario; YYIRT = Yo-Yo intermittent recovery test							

Supplementary Table 5. Rugby code, participant characteristics, aims, outcome measures and key findings of studies within technical-tactical focussed ‘match characteristics’ evidence-based theme (n=5)

Study	Rugby Code	*Cohort, sample size (n)	*Participant characteristics: age (yrs), height (cm), body mass (kg)	Study aims	Number of matches (n)	Study outcome measures	Key findings
[128]	Sevens	International	NR	To analyse variables associated with winning teams in knock out Cup games, and to illustrate if winning characteristics are valid across genders.	30	Notation analysis: possessions, restarts, gaining possession, set piece, penalties, offensive options, defensive statistics, scoring.	Winning women’s teams gained more possession from handling turnovers, utilised more quick lineouts, had less ineffective set lineouts, threw more passes and made more ball-jolting-tackles than losing women’s teams (p<0.05) Winning men’s teams utilised non-contested restarts more frequently, won a higher percentage of contested restarts, had more scrum feeds and made more effective tackles than losing men’s teams (p<0.05)
[126]	Sevens	International	NR	To examine link between coupling at the ruck, phase momentum and success	35	Notation analysis: Ruck type and frequency, winning and losing team	Winning women’s teams had a higher percentage of positive phases (p<0.01) Positive phase momentum is associated with four or more passes (p<0.001) Winning women created significantly more positive phases from 4&0 rucks than losing teams (p<0.05). Winning women’s teams scored significantly more tries from 2&2 rucks (p<0.05).
[127]	Sevens	International	NR	To identify and understand any relationships between ruck actions and ruck success in rugby sevens	65	Notation analysis: player numbers in the ruck, the actions of the first players to the ruck, ball placement, the body height, weight distribution and position of the attacking player in the ruck, ruck outcome	Attacking teams maintained ball possession: men = 69.2%; women = 72.5% Women’s and men’s successful ruck actions were similar; 1 vs. 1 rucks were most commonly formed. If an attacking player arrived first, there was a greater chance of maintaining possession (p<0.001). An early jackal was most successful at producing turnovers (p<0.001)
[130]	Union	International	NR	To compare performance indicators in elite men’s and women’s rugby union and identify those that discriminate winning and losing teams	8	Notation analysis: of tries, penalty kick success, conversion success, drop goals lineout success, scrum success, ruck frequency, kick in play, tackle completion, carries, breaks, visit to opponents 22, turnover conceded, penalty conceded, ball possession.	Successful women’s teams displayed frequency of greater breaks, higher tackle completion, less pick and go’s, less rucks in the opposition 22-50m, more rucks in own 22-50m, less kicks in opposition 22-50m and less penalties conceded in their own 22 (p≤0.038)
[129]	Sevens	International (n=16)	23 ± 2 yrs; 166 ± 7 cm; 66 ± 7 kg	To determine the effects of caffeine on the technical performance of female elite rugby sevens players and to assess whether caffeine improved the number of body impacts.	2	Notational analysis: tackle, ruck, pass, pass receive, ball carry Accelerometer (GPSports): impacts in various zones	Frequency or the quality of any rugby-specific technical actions during the games were not affected by caffeine (p>0.05). The ingestion of the caffeinated energy drink increased the rate of body impacts in zones 1-3 and 5 (p<0.05)
*Cohort, sample size and participant characteristics for women’s rugby athletes only. N/A = not applicable; NR = not reported							

Supplementary Table 6. Rugby code, participant characteristics, aims, outcome measures and key findings of studies within ‘physical performance’ evidence-based theme (n=32)

Study	Rugby Code	*Cohort, sample size (n)	*Participant characteristics: age (yrs), height (cm), body mass (kg)	Comparisons between	Intervention duration	Study aims	Study outcome measures	Key findings
Anthropometrics								
[141]	NR	Semi-professional (n=16)	25 ± 5 yrs	Non-athletic women	N/A	To compare and quantify with USI the thickness of the TrAb, EO, IO, RA, and IRD in female rugby players versus non-athletic women.	Ultrasound imaging (Logic S7): thickness of TrAb, EO, IO, RA, and IRD	There were statistically significant differences for the ultrasound evaluation thickness of the right TrAb (p=0.011), EO (p=0.045), IO (p=0.003), and RA (p=0.001) showing a thickness increase for the rugby group with respect to the control group.
[142]	NR	University (n=NR)	28 ± 4 yrs; 161 ± 7 cm; 54 ± 6 kg	Badminton, Volleyball, Basketball, Futsal	N/A	To examine the Q angle values of female athletes in different branches.	Q angle, pelvic width, femur length	Q angle = 21.5±7.1 ° Pelvic width = 28.9±4.7 cm Femur length = 41.3±9.4 cm
[137]	Union	Club and university (n=30)	21 ± 2 yrs; 167 ± 5 cm; 73 ± 11 kg	Netball players, distance runners, sedentary controls	N/A	To determine local, regional and segmental DXA measurements of BMD among female rugby union, netball, and distance running participants and sedentary controls and to compare body composition measures.	Whole-body, lumbar spine, and total left hip areal bone mineral density Fat mass, fat free soft tissue mass, and fat percentages	Total body BMD = 1.26±0.17 Body fat (%) = 29.5±4.7 Rugby players had greater body mass, FFM and fat mass compared to controls, runners and netball players (p<0.001). Rugby players has greater total body BMD compared to controls (p<0.001).
[143]	NR	Collegiate (n=99)	NR	Collegiate athletes (cross country, gymnastics, dance, swim & dive, synchronized swimming, wrestling, olympic weightlifting, track & field, basketball, ice hockey, lacrosse, volleyball, water polo)	N/A	To report sport-specific norms for FFM index in a diverse sample of female athletes, to determine whether these values differ between sports, and to identify a naturally-attainable threshold for FFM index in female athletes.	FFM index, fat mass, FFM, BMD, bone mineral content, body fat %	FFM index = 20.09±2.23 FFM was significantly higher (p<0.05) in rugby than in gymnastics, ice hockey, lacrosse, swim & dive, and volleyball.
[138]	Union	Div 1 Collegiate (n=101)	20 ± 2 yrs; 166 ± 7 cm; 74 ± 15 kg	Positions	N/A	To report anthropometrics in female collegiate rugby union players and to identify between-position differences in these variables.	BMI, body fat percentage, fat mass, FM index, FFM, FFM index, lean soft tissue, bone mineral content, bone mineral area, and bone mineral density	Significant differences (p < 0.014) were identified between forwards and backs for every anthropometric variable, with forwards displaying greater height (167.7 ± 7.2 cm), body mass (81.5 ± 15.1 kg), and body fat percentage (28.2 ± 6.1%) relative to backs (164.5 ± 5.1 cm; 64.5 ± 7.7 kg; 21.9 ± 3.7%)
[139]	Union	Elite (n=30)	26 ± 4 yrs; 171 ± 8 cm; 84 ± 14 kg	Positions	N/A	Investigate the anthropometric and body composition characteristics of New Zealand elite female rugby union players	Body mass, Sum of 8 skinfolds, lean mass, fat mass, fat %, bone mineral content, and bone mineral density	Sum of 8 skinfolds (mm): backs = 94.4, forwards = 128.2 Fat (%): backs = 20.8, forwards = 26.5 Bone mineral content (kg): backs = 2.7, forwards = 3.1 (all p<0.05)

[140]	Union	Elite (n=958)	Forwards = 80 kg; Backs = 67.5 kg	Position, sex, tier, time	N/A	To document the body mass of elite international men's and women's players at Rugby World Cups from the emergence of professionalism (early 1990s for men, 2010 for women) to the present day	Body mass	Women's forwards mass increased by 4.8% in Tier 1, with no changes in Tier 2 or backs from either tier
Biomechanics								
[145]	Union	Amateur (n=31)	24 ± 3 yrs; 168 ± 5 cm; 69 ± 9 kg	Positions, control group, pre- and post-test	8 weeks	To observe the effect of 8 weeks of sled training with optimal loading for maximal power output production sprint performance	5 and 20 m sprint time and sprint mechanical outputs: index of balance between force and velocity, max force, max velocity, PPO, Rfmax and Drf	Both forwards and backs significantly improved (p ≤ 0.05) in 5 and 20 m sprint performance, and in the mechanical properties related to the horizontal Power-Force-Velocity profile.
[144]	Sevens	International (n=18)	24 ± 4 yrs; 172 ± 7 cm; 69 ± 7 kg	N/A	N/A	To characterise asymmetry of the main running mechanical variables (with special reference to horizontal force production) during repeated treadmill sprints in elite female Rugby Sevens players.	Symmetry angle Step kinematic variables: contact time, aerial time, swing time, step frequency and step length. Peak braking and peak propulsive forces, duration of braking and propulsive phases, absolute and relative net braking and propulsive impulses.	Symmetry angle remained mostly constant (~1-8%) across sprint repetitions for 20 gait variables
[146]	Union	Club (n=16) and international (n=16)	NR	Playing level	N/A	To describe the forces developed during machine scrummaging as a factor of playing level and evaluate the magnitude and characteristics of the force load on players may represent an issue for potential injury	Peak compression, average sustained push, drop from peak to sustained force, rise from minimum to sustained force, positive and negative impulse. Range of lateral force, average sustained lateral push	Women's peak compressive force = 8.7 kN Sustained compression forces spanned between 8.3 kN (International men) and 4.8 kN (Women)
Performance								
[157]	Union and Sevens	Inter-provincial, U20 International, Senior International (n=114)	18 ± 3 yrs; 67 ± 7 kg	Top and bottom 50% of SLJ and STJ performance	N/A	To determine whether horizontal jumping can differentiate sprinting ability, to evaluate relationship between horizontal jumping and speed, to determine whether horizontal jumping and anthropometrics can predict kinematics variables	SLJ, STJ, ISS, MSS, initial sprint momentum, and maximal sprint momentum	When categorized by SLJ there was a <i>very large</i> ES for top and bottom 50% SLJ and STJ (p<0.001) and a <i>large</i> ES for MSS (p<0.001). When categorized by STJ there was a <i>very large</i> ES for top and bottom 50% SLJ and STJ (p<0.001) and a <i>large</i> ES for ISS and MSS (p<0.001). A linear regression developed from STJ and body weight adequately predicted ISS (r = 0.645, p<0.001) and MSS (r = 0.761, p<0.001).
[152]	Sevens	International backs (n=13) and forwards (n=11)	Backs: 21 ± 4 yrs; 166 ± 6 cm; 66 ± 3 kg Forwards: 24 ± 4 yrs; 171 ± 4 cm; 73 ± 5 kg	Positions	N/A	To describe the anthropometric and physical qualities of international level female sevens athletes and determine whether positional differences exist.	Sum of 7 skinfolds, 0-10 and 30-40m speed and momentum, SLJ, STJ, 1RM power clean, front squat, bench press, and neutral grip pull-up, 1600m average speed	The backs and forwards had significant differences in body mass (66±3 vs. 73±5 kg; p=0.019) and initial sprint momentum (367±20 vs. 399±22 kg·m·s ⁻¹ ; p=0.028). No other measures showed positional differences.

[155]	League	Amateur (n=41)	15 ± 1 yrs; 163 ± 12 cm; 59 ± 13 kg	Sex	N/A	To examine the force-velocity profiling generated by adolescent rugby players in the squat and bench exercises and to compare sex-related differences.	Bench press and squat 1RM, power (W) and velocity (m·s ⁻¹)	1RM squat (115±41 vs. 104±31) and bench (46±17 vs. 47±14) were not different between females and males. Females demonstrated greater bench press power than males (326±196 vs. 190±151; p<0.001). No differences between females and males for squat power (591±353 vs. 522±299).
[153]	Sevens	International (n=18)	23 ± 5 yrs; 167 ± 6 cm; 64 ± 7 kg	Sex	N/A	To investigate differences in COD ability and speed- and power variables between male and female players; examine COD deficit differences; and analyse the relationships between COD deficit and COD speed.	Squat jump, CMJ, 45cm depth jump, horizontal jump, triple horizontal jump, 40m sprint, Pro agility (5-10-5) test, L-drill, zig-zag test, 1RM back squat	Women demonstrated <i>likely to almost certainly</i> lower performances than men in all speed-power assessments and COD tasks (ES range 0.61-2.09; p<0.05), except for the Zig-zag drill (ES=0.24; p>0.05). Women displayed lower COD deficits in all tests and lower sprint momentum (ES range 0.78-2.95; p<0.05).
[154]	Sevens	International (n=24)	23 ± 4 yrs; 168 ± 6 cm; 69 ± 5 kg	High and low minutes played	N/A	To examine which, if any, physical qualities differentiate playing minutes in international women's rugby sevens players.	Sum of 7 skinfolds, 40m sprint, STJ, STJ, 1RM strength, 1600m speed, playing minutes	High-playing-minute players (≥70 min) were older (24±3 vs 21±4 yrs, p=0.05), had greater experience in a national-training-centre (2.4±0.8 vs 1.7±0.9 yrs, p=0.03), had faster 1600-m time (375±20 vs 394±30 s, p=0.09), greater 1RM strength (bench press 68±6 vs 62±8 kg, p=0.07, pull-up 84±8 vs 79±5 kg, p=0.12) than athletes who played fewer minutes.
[147]	Union	International (n=32)	Forwards: 165 ± 7cm; 79 ± 13 kg Backs: 161 ± 6 cm; 63 ± 6 kg	Positions	N/A	To investigate the physical fitness characteristics of elite female rugby union players	Sum of 7 skinfolds, sit and reach, vertical jump, 10 and 40m speed, 1RM bench press, pull-up and push up endurance, multistage shuttle run	Forwards had a greater sum of skinfolds than backs (137±31 vs. 107±19, p < 0.01). Backs demonstrated superior vertical jump (44±5 vs.38±5), 10 (1.9±0.1 vs. 2.1±0.1) and 40 m (6.0±0.2 vs. 6.5±0.3) speed and push up endurance (25±9 vs. 16±9) than forwards (p<0.001).
[156]	League	Elite International (n=27)	Backs: 24 ± 4 yrs; 163 ± 4 cm; 66 ± 7 kg Forwards: 26 ± 6 yrs; 167 ± 7 cm; 81 ± 14 kg	Positions, relationship between physical variables	N/A	To present the characteristics of elite female rugby league players by playing position and investigate the relationships between the measured variables.	Body composition: DXA; total and percentage body fat and lean mass, BMC, and regional fat and lean mass Speed and agility: 5, 10, 20, 30, 40 m sprint, and 505 agility Running endurance: YYIRT-1 Lower-body power: CMJ, 20 kg jump squat, and 30 cm drop jump	Forwards were significantly taller (ES=0.79), heavier (ES=1.34), with a greater total fat mass (ES=1.31), total lean mass (ES=0.96), and percentage body fat (ES=1.12) (p ≤ 0.05). Backs were significantly (p ≤ 0.05) quicker than forwards over 5, 10, 20, 30, 40 m (ES = 1.03–1.17), and 505 agility (ES = 0.85–0.92). Backs jumped higher than forwards (ES = 1.00-1.50; p ≤ 0.05). Relationships were observed between total body fat and all fitness variables (p ≤ 0.05).
[148]	Union	Collegiate (n=8)	22 ± 2 yrs; 160 ± 6 cm; 68 ± 10 kg	Other team sport athletes (basketball, soccer, softball), relationship between physical variables	N/A	To provide an introductory investigation of the relationships between lower-body power and multidirectional speed in collegiate female rugby players.	SLJ, vertical jump, 505 test, 5, 10 and 20m sprint	For the rugby players, the vertical jump correlated with the 0-20 m interval (r = -0.73). The SLJ correlated with the 0-5 and 0-10 m intervals, and the left-leg 505 (r = -0.71 to -0.88) and predicted 0-5 m and left-leg 505 time (r ₂ = 0.50-0.58).
[149]	Union	Division 1 College (n=17)	22 ± 2 yrs; 161 ± 5 cm; 64 ± 9 kg	Relationship between physical variables	N/A	To evaluate the relationship between linear speed (0-5 m, 0-10 m, and 0-20 m sprint), and COD ability. To determine if the COD deficit identified a different metric of COD ability for individuals when compared to the traditional 505 time.	5, 10 and 20-m sprint and 505 tests	The COD deficit did not correlate with the sprint interval times (r = -0.370 to -0.045). Right-leg 505 time did correlate with the 0-10 and 0-20 m intervals (r = 0.483-552).

[1]	Union	Senior and schoolgirl (n=92)	Senior forwards: 22 yrs; 167 cm; 76 kg Senior backs: 20 yrs; 164 cm; 61 kg Schoolgirl forwards: 16 yrs; 166 cm; 67 kg Schoolgirls backs: 16 yrs; 159 cm; 55 kg	Positions, grades	N/A	To document the size, shape, and physical performance characteristics of a cohort of New Zealand rugby players drawn from various grades, and to make comparisons between grades and positional categories	Neck circumference, somatotype, agility and turning ability test, CMJ, modified repeated high intensity endurance test, rolling and static 30-m speed, push up capacity, fatigue index	Female forwards were taller and heavier than backs (p<0.02), senior players were heavier than schoolgirls (p<0.001). Forwards possessed larger neck circumferences across grades and were more endo-mesomorphic and less ectomorphic than backs (p<0.001). Backs generally performed better than forwards in physical assessments. <i>Large</i> differences on the aerobic shuttle test, the vertical jump, the sprint from a rolling start, and momentum were found (p<0.002).
[158]	NR	University (n=19)	21 ± 3 yrs; 165 ± 5 cm; 64 ± 11 kg	Positions	N/A	To describe the body composition and performance characteristics of collegiate women rugby players and to compare the forwards to the backs regarding these variables	Body composition: % body fat, bone density Physical qualities: isometric knee extension, elbow flexion, maximal alactic anaerobic power, agility, heart rate.	Forwards were significantly heavier (p<0.05) than the backs. Backs had significantly less relative fat and fat mass than the forwards (p<0.05). The forwards had significantly greater anaerobic power than the backs (p<0.05).
[150]	Union	National All-Star Championship (n=24)	30 ± 4 yrs; 167 ± 6 cm; 68 ± 9 kg	Positions	N/A	To represent fitness levels for elite world-class women rugby players.	Body mass, body fat, vertical jump, squats, seated press, 40yard speed, 100m speed, bleep test, 300m speed	Backs had greater vertical jump, squat and seated press performances compared to forwards. Backs performed better on all running tests compared to forwards.
[151]	Union	University beginners (n=10) and experienced (n=8)	Beginners: 19 ± 1 yrs; 165 ± 5 cm; 68 ± 12 kg Experienced: 20 ± 1 yrs; 164 ± 3 cm; 67 ± 10 kg	Sex, experience level, ball-carrying technique	N/A	To assess sprint times with different ball-carrying techniques and to examine the effects of experience and sex.	10m and flying 20m (10m build) speed	10m sprint speed was slower for female beginners carrying the ball vs without the ball (p<0.01); there was no difference for experienced females or males. Flying 20m sprint speed was slower for males carrying the ball with two hands and beginner females (p<0.05) but was not different for experienced females.
Physiology								
[165]	NR	NR (n=19)	24 ± 1 yrs	Relationships between variables	N/A	To investigate in female rugby players the relationships between these specific aspects of body composition and blood rheology.	Hemorheological in vitro measures: apparent viscosity of whole blood at native hematocrit, plasma viscosity, and blood viscosity at corrected hematocrit, RBC aggregation. Physical/physiological qualities: isometric handgrip, VO ₂ max, adductor isometric strength Anthropometry: Fat mass, FFM	VO ₂ max was not related to blood rheology (hematocrit: p=0.770; plasma viscosity: p=0.9533). Isometric handgrip strength was negatively correlated to red blood cell aggregability (Myrenne M: r = -0.57839; p=0.00948; M1 r = -0.58910; p=0.00795). Adductor isometric strength was negatively correlated to red blood cell aggregability Myrenne M (r = -0.5033; p=0.0280). Fat mass is a major determinant of VO ₂ max either measured by a field test (r = -0.766; p=0.00013) or exercise test (r = -0.575; p=0.00994).
[159]	Sevens	International (n=22)	25 ± 5 yrs; 168 ± 6 cm; 69 ± 7 kg	Relationship between physical and physiological variables	N/A	To compare a field-based critical velocity running test to routine laboratory and field-based tests of aerobic fitness in women's rugby 7's players.	YYIRT-1, VO ₂ max, critical velocity running test GPS (SPI Pro X, GPSports): total distance, average speed, high-intensity running and sprinting distance	The critical velocity test was <i>highly</i> correlated with the YYIRT1 test (r = 0.86). Average speed correlated <i>largely</i> with the YYIRT1 (r = 0.62) and critical velocity (r = 0.51) tests. Total game distance correlated <i>moderately</i> with the YYIRT1 (r = 0.49) and critical velocity (r = 0.36)

[160]	Sevens	International (n=12)	24 ± 5 yrs; 168 ± 4 cm; 68 ± 8 kg	Relationship between physiological variables	N/A	To establish a physiologically defined threshold for the analysis of high-intensity running. To explore game movement patterns using individualised speed thresholds, as well as the industry-used threshold.	VT _{2speed} (m·s ⁻¹), velocity at VO2max (vVO2max;m·s ⁻¹) and relative VO2max (mL·kg ⁻¹ ·min ⁻¹); GPS (SPI HPU, GPSports): distance covered at various intensities, VT2speed, maximal velocity	Compared to the mean VT _{2speed} threshold (3.5 m·s ⁻¹), the industry-used threshold of 5 m·s ⁻¹ underestimated the absolute amount of high-intensity running completed by individual players by up to 30%. Using an individualised threshold, high-intensity running could over- or underestimating high-intensity running by up to 14% compared to the mean VT _{2speed} threshold.
[164]	NR	International (n=15)	25 ± 6 yrs	N/A	N/A	To explore athletes' past and current experiences and perceptions of the menstrual cycle in relation to its impact on sporting performance.	Questionnaire assessing menstrual cycle symptoms, perceptual impact, perceptual resolution and support	Almost all athletes (93%) reported menstrual cycle-related symptoms. 33% perceived heavy menstrual bleeding and 67% considered these symptoms impaired their performances. Two-thirds of athletes self-medicated to alleviate symptoms. Thematic analysis 4 general dimensions: symptoms; impact; resolution and support.
[163]	NR	Sub-elite and elite (n=36)	26 ± 5 yrs; 168 ± 6 cm; 73 ± 10 kg	RMR prediction equations	N/A	To determine the accuracy of 7 equations in predicting RMR of female rugby athletes, and in addition to explore biomarkers of muscle damage and LEA.	Body composition, RMR, risk of LEA, and CK	Measured RMR (indirect calorimetry) = 1651±167 kcal·d ⁻¹ . The Cunningham, Ten Haaf, and Watson (body mass) predicted values did not differ from measured (p>0.05), while all other predicted values differed significantly (p<0.001)
[162]	NR	Varsity (n=95)	20 ± 2 yrs	N/A	N/A	To determine the prevalence of urinary incontinence among female university varsity rugby player	Self-administered questionnaire including demographics, Urogenital Distress Inventory short form, rugby related activities, degree of bother, previous treatment, desire for treatment and coping strategies	Urinary incontinence prevalence = 54% 90% leaked urine when competing in a rugby game. Most players reported they were not bothered or only slightly bothered by their urinary leaking.
[187]	Sevens	Olympic (n=14)	27 ± 5 yrs; 169 ± 5 cm; 68 ± 5 kg	High and low power production	N/A	To analyse the relationship between skeletal muscle properties measured through TMG and the peak power output production capacity.	TMG: vastus lateralis, rectus femoris, vastus medialis 30s Wingate	High power presented an <i>almost certainly</i> higher PPO (ES = 3.00) than low power, as well as a <i>very likely</i> lower radial displacement (ES = 1.68) and velocity of deformation (ES = 1.87) of the vastus lateralis. PPO was <i>very largely</i> related to the radial displacement (r = −0.75) and velocity of deformation (r = −0.70) of vastus lateralis.
Training								
[188]	Sevens	Elite (n=12)	24 ± 4 yrs; 169 ± 6 cm; 70 ± 5 kg	N/A	6 weeks	To evaluate weekly changes in CMJ performance in elite female rugby sevens players over the course of a 6-week training block of progressively increasing training load.	CMJ variables: power, force, velocity, height, displacement and mechanistic characteristics; training load, wellness	Training load increased from weeks 2-6 (ES = 2.47). CMJ flight time, peak displacement, time to peak force and force at zero velocity displayed multiple changes indicative of diminished neuromuscular function.
[167]	Sevens League Union	Women's rugby S&C coaches	NR	N/A	N/A	To explore a comprehensive approach to physical preparation practices currently utilized in female rugby codes	Questionnaire assessing participant characteristics, pre-season, in-season and off-season physical preparation, recovery, monitoring and sport science technology, and unique aspects in female rugby	National or regional/state level female athletes = 78% Performance testing frequency = pre- (97%) and in-season (86%), off-season (23%) Menstrual cycle monitoring = 22% Unique considerations = psycho-social, menstrual, physical

*Sample size and participant characteristics for women’s rugby athletes only. 1RM = one repetition maximum; BMD = bone mineral density; BMI = body mass index; CK = creatine kinase; CMJ = countermovement jump; COD = change of direction; Drf = rate of decrease in the ratio of force; DXA = dual-energy X-ray absorptiometry; EO = external oblique; ES = effect size; FFM = fat-free mass; IO = internal oblique; IRD = interrecti distance; ISS = initial sprint speed; LEA = low energy availability; M1 = red blood cell facilitated aggregation at low shear rate after shearing at 600 s-1; MSS = maximal sprinting speed; Myrenne M = red blood cell aggregation during stasis after shearing at 600 s-1; N/A = not applicable; NR = not reported; PPO = peak power output; r = correlation coefficient; RA = rectus abdominis; Rfmax = maximal value for the ratio of force; RMR = resting metabolic rate; SLJ = standing long jump; STJ = standing triple jump; TMG = tensiomyography; TrAb = transversus abdominis; VT2speed = speed at the second ventilatory threshold; W = watts

Supplementary Table 7. Rugby code, participant characteristics, aims, outcome measures and key findings of studies within 'nutrition' (n=6) and 'psychology' (n=5) evidence-based themes.

Study	Rugby Code	*Cohort, sample size (n)	*Participant characteristics: age (yrs), height (cm), body mass (kg)	Study aims	Study outcome measures	Key findings
Nutrition						
[131]	Sevens	International (n=23)	24 ± 5 yrs; 172 ± 5 cm	To quantify haematological changes in male and female rugby sevens players over a competitive season, and to quantifying the incidence of iron deficiency in female players.	Biochemical analysis: iron, ferritin, transferrin Contraceptive use	Female pre-season ferritin concentrations = 51±24 µg·L; which declined substantially (~20%) by mid-season, but recovered by end-season 23% female players were classified as iron deficient (ferritin <30 µg·L); greatest deficiency incidence occurred in mid-season (30%). Oral contraception and dietary iron intake had unclear influence on female players' ferritin concentration, while age was largely positively correlated (r=0.66±~0.33).
[134]	League	International (n=10)	25 ± 6 yrs	To establish hydration status, determine sweat loss, fluid intake, sweat, and Δblood sodium during training and match-play in female rugby league.	Urine osmolality, body mass, blood sodium concentration	Urine osmolality on arrival to match-play (382 ± 302 mOsmol·kg ⁻¹) and training (667 ± 260 mOsmol·kg ⁻¹) were indicative of euhydration. Players experienced a body mass loss of 0.50 ± 0.45 and 0.56 ± 0.53% during match-play and training, respectively. During match-play, players consumed 1.21 ± 0.43 kg of fluid and had a sweat loss of 1.54 ± 0.48 kg. During training, players consumed 1.07 ± 0.90 kg of fluid, in comparison with 1.25 ± 0.83 kg of sweat loss.
[135]	Union	University (n=16)	21 ± 2 yrs; 158 ± 40 cm; 78 ± 15 kg	To observe the hydration status, in male and female university rugby union players over 3 training sessions and to examine changes in sweat loss estimations.	Body mass, urine specific gravity, and self-reported thirst scores	Mean body mass changes did not exceed 2% lost for either gender on any of the three training sessions. Females significantly underestimated sweat loss by ~64% on day one (p<0.01), and improved estimations to ~60% on day three, however, still significantly underestimated (p<0.01). This finding was similar in males.
[136]	NR	Professional and amateur (n=61)	24 ± 5 yrs; 168 ± 6 cm; 68 ± 11 kg	Analyse the dietary supplementation consumption pattern in federated rugby players, including possible differences based on sex and competitive level	Questionnaire on dietary supplementation consumption	43% of female players consumed sports bars 39% of female players consumed caffeine 38% of female players consumed sports drinks 25% of female players consumed whey protein
[133]	Sevens	Elite (n=17)	24 ± 3 yrs; 170 ± 4 cm	To describe hepcidin concentrations in conjunction with serum ferritin amongst elite female rugby sevens players.	Iron, SF, soluble transferrin receptor, high sensitivity C-reactive protein and hepcidin	18% were iron deficient (SF<30 µg·L) with 29-35% of players with sub-optimal iron stores at some point during the study (SF<45 µg·L) Serum hepcidin was strongly correlated with SF (r=0.61, P=0.0001).
[132]	Sevens	Elite (n=43)	25 ± 4 yrs; 168 ± 6 cm; 68 ± 7 kg	To assess the vitamin D status of elite Irish athletes participating in high-profile sports and establish if travel, supplementation and/or sunbed-use predict vitamin D status	25-hydroxyvitamin D, plasma parathyroid hormone, serum calcium concentrations lifestyle questionnaire	Total 25-hydroxyvitamin D was 66.20 ± 24.44 nmol·L which was less than in boxing and cricket (p<0.05). On average, women's rugby seven athletes were vitamin D sufficient.
Psychology						
[171]	NR	International (n=18)	NR	To identify early maladaptive schema elements, that stimulate a "repair and healing game", leading to high level athletic performance	Young's Schemas Questionnaire	An average of 5 early maladaptive schemas per rugby player were identified. This included a wide variety (17 of 18). 83.3% of players showed self-sacrifice, 77.8% unrealistic standards/hypercriticism, 55.6% punishment, 50% entitlement/grandiosity and 50% approval seeking. Rugby players were deemed to have stronger emotional distress in comparison to handball players.

[168]	Union	International (n=10)	32 yrs	To examine the participant motivation of Canadian women players by identifying positive influences on participation and what it is about rugby that motivates women to start and continue playing to an elite level.	Open-ended, semi-structured interviews	Participant motivation was multifaceted, encompassing motives which changed and evolved over time. As these players progressed from lower level teams to elite level, their motivation developed from their initial motivation to participate in rugby to focussing on achievement. Players’ rugby experiences were generally positive. Four major participation motivation themes comprised were identified: Getting started with rugby; Physical aspects; Achievement and success; and On- and off-field player interaction.
[169]	Union and Sevens	Collegiate and national (n=122)	20 ± 1 yrs	To investigate the role of mental toughness in injury response and coping with female athletes in rugby and roller derby.	Self-reported mental toughness, hardiness, optimism, coping with injury and psychological response to injury	Rugby players had positive associations between mental toughness and adaptive responses such as problem-focused, emotion-focused coping and feeling reorganized (p<0.05). Rugby players who would play through injury reported higher mental toughness than those who would not play through injury.
[172]	NR	Varsity (n=10)	20 ± 1 yrs; 168 ± 7 cm; 72 ± 15 kg	To identify the effects of sport-specific training on avoidance strategies during a head-on (180°) collision course with an approaching person.	Time to contact	Rugby athletes avoided significantly later than non-athletes (0.94±0.30s vs. 1.52±0.14s, p<0.001).
[170]	NR	University (n=221)	20 ± 2 yrs	To test the four-stage sequence of relationships between coaches’ perceived interpersonal coaching styles, to athletes’ basic psychological needs, self-determined motives, and performance.	The Coach Interpersonal Scale, Basic Needs Satisfaction in Sport Scale, three of the six subscales from the Behavioural Regulation in Sport Questionnaire, A revised version of the seven-item Game Performance Assessment Instrument	All basic psychological needs were perceived to be highly fulfilled. Of the three interpersonal coaching styles, athletes’ perception of the autonomy support and involvement provided by their coaches were more strongly correlated with all three basic needs than structure.
*Cohort, sample size and participant characteristics for women’s rugby athletes only. NR = not reported; SF = serum ferritin						