

Table 1: Musculoskeletal health conditions in retired elite rugby players

Author (Year)	Population				Control Group (Yes/No); Description of Control Group	Study Design and Aim	Assessment Method (and Scoring System used where relevant)	Health condition reported on	Outcome	Comparator group
	No of participants & Age	Nationality & Gender	Rugby Union or League	Mean career duration (in years) & Years retired						
Brauge et al, 2015	N=101 40.4 (SD 2.3)	France Male	Union	C: 16.4 (SD 3.1) R: 5.8 (SD 3.5)	Yes N=85 Age: 41.6 (SD 4.5) Matched for sex, age, job, current sport training and smoking habits	Cross sectional study: To find out if retired professional rugby players experienced more serious degenerative cervical spine symptoms than the general population.	Questionnaire Neck disability Index (NDI) > 15	Neck pain Disabling neck pain	50.50% Statistically sig (p = 0.01) 2.97%	31.76% 1.18%
Davies et al., 2017	N=259 60.1 (SD 16.1)	United Kingdom Male	Union	C: NI R: NI	No	Cross sectional study: To assess morbidity and health related quality of life amongst former rugby players, compared to an age-standardised general	Questionnaire self-reported, physician diagnosed	Osteoporosis Osteoarthritis Joint replacement Hip replacement Knee replacement	4% 60% 24% 15% 9%	NI

						population sample				
Hind et al., 2020	N=83 43.4 (SD 9.4)	United Kingdom Male	League & Union	C: NI R: NI	Yes N=106 Former amateur rugby players (AR) Age: 48.3 (SD 11.0) N=65 retired non-contact sport athletes (NC) Age: 48.7 (SD 12.9)	Cross sectional study: To describe cumulative injuries and their perceived effect in retired professional rugby players compared to retired non-contact athletes.	Questionnaire	Back pain	80%	AR: 75% NC: 69%
								Severe and regular joint pain	64%	AR 53% NC: 47%
								Osteoarthritis	51% p<0.05)	AR 36% NC: 22%
Jones et al., 2019	N=127 60.4 (SD 16.0)	United Kingdom Male	Union	C: NI R: 27.7 (SD 16.0)	Yes N=127 Former professional cricket players Age: 56.4 (SD 14)	Cross sectional study: To establish the prevalence of hand and wrist osteoarthritis in retired elite rugby and cricket players	Questionnaire	Hand OA (physician diagnosed)	3.6% (95% CI 1.5-8.4%)	2.4% (95% CI 0.8-7.2%)
							Questionnaire	Wrist OA (physician diagnosed)	2.1% (95% CI 0.7%-6.5%)	1.6% (95% CI 0.4-6.2%)
							Questionnaire National Health and Nutrition Examination Survey (NHANES)	Hand pain	10.0% (CI 6.0-16.3%)	19.7% (95% CI 13.6-27.6%)
McMillan et al., 2017	N=127 53.5 (SD 13.0)	United Kingdom Male	Union	C: 22.4 (5.0)	Yes N=29 Matched for age and	Cross sectional study: To explore long term health	Self-report inventory	Chronic orthopaedic problems	14%	3%

				R: 20.3 (12.8)	social deprivation	outcomes after exposure to repeated concussions in elite level rugby union players				
Paget et al., 2020	N=152 40.0 (SD 6.0)	Inter- national Male	Union	C: 10 (2- 20) R: 8 (0- 22)	Yes N=401 Retired professional football players Age: 36 (25- 50)	Cross sectional study: To establish the prevalence of ankle osteoarthritis in former professional rugby and football players	Questionnaire	Ankle OA (physician diagnosed)	4.6% (95% CI 1.2- 8.0%)	9.2% (95% CI 6.4 – 12.1%)

N = number of participants, SD = Standard Deviation, NI = Not identified, AR = former amateur rugby players, NC = retired non-contact athletes, C= mean career duration (year), R= mean years since retirement, OA= osteoarthritis.

Table 2: Cardiovascular health conditions in retired elite rugby players

Author (Year)	Population				Control Group (Yes/No); Description of Control Group	Study Design and Aim	Assessment Method (and Scoring System used where relevant)	Health condition reported on	Outcome	Comparator group
	No of participants & Age	Nationality & Gender	Rugby Union or League	Mean career duration (in years) & Years retired						
Davies et al., 2017	N=259 60.1 (SD 16.1)	United Kingdom Male	Union	C: NI R: NI	No	Cross sectional study: To assess morbidity and health related quality of life amongst former rugby players, compared to an age-standardised general population sample	Questionnaire self-reported, physician diagnosed	Heart problems Hypertension	18% 28%	NI
Gallo et al., 2021	N=143 70	United Kingdom Male	Union	C: 15.8 (SD 5.4) R: NI	No	Cross sectional study: To assess long term association between concussions and cognitive function among retired elite rugby players	Questionnaire	Hypertension	31.5%	

McMillan et al., 2017	N=127 53.5 (SD 13.0)	United Kingdom Male	Union	C: 22.4 (5.0) R: 20.3 (12.8)	Yes N=29 Matched for age and social deprivation	Cross sectional study: To explore long term health outcomes after exposure to repeated concussions in elite level rugby union players	Self-report inventory	Cardiovascular disorder	2%	21%
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N = number participants, SD = Standard Deviation, NI = Not identified, C= mean career duration (year), R= mean years since retirement

Table 3: Neurocognitive health conditions in retired elite rugby players

Author (Year)	Population				Control Group (Yes/No); Description of Control Group	Study Design and Aim	Assessment Method (and Scoring System used where relevant)	Health condition reported on	Outcome	Comparator group
	No of participants & Age	Nationality & Gender	Rugby Union or League	Mean career duration (in years) & Years retired						
Brauge et al, 2015	N=101 40.4 (SD 2.3)	France Male	Union	C: 16.4 (SD 3.1) R: 5.8 (SD 3.5)	Yes N=85 Age: 41.6 (SD 4.5) Matched for sex, age, job, current sport training and smoking habits	Cross sectional study: To find out if retired professional rugby players experienced more serious degenerative cervical spine symptoms than the general population.	Japanese Orthopaedic Association (JOA)	Neurological abnormalities	0.99%	NI
Davies et al., 2017	N=259 60.1 (SD 16.1)	United Kingdom Male	Union	C: NI R: NI	No	Cross sectional study: To assess morbidity and health related quality of life amongst former rugby players, compared to an age-standardised general	Questionnaire self-reported, physician diagnosed	Dementia	1%	NI

						population sample				
Decq et al., 2015	N=239 52 (49-55.75)	France Male	Union	C: NI R: NI	Yes N=138 Retired sportsmen registered on "high-level" lists	Cross sectional study: To evaluate the prevalence of major depressive disorder, mild cognitive disorders and headache in retired high level sportsmen and rugby players	Self-questionnaire Telephone Interview for Cognitive Status (TICS)	Reported Neurological disease Mild cognitive disorders (TICS-m \geq 30)	2.93% 56.59%	3.68% 40.35%
McMillan et al., 2017	N=127 53.5 (SD 13.0)	United Kingdom Male	Union	C: 22.4 (5.0) R: 20.3 (12.8)	Yes N=29 Matched for age and social deprivation	Cross sectional study: To explore long term health outcomes after exposure to repeated concussions in elite level rugby union players	Self-report inventory	Parkinson's	1.92%	0.0%
Stanwell et al., 2022	N=41 NI	Australia Male	League	C: NI R: NI	Yes N=41 Healthy community controls similar in age and education	Cross sectional study: To explore the Cavum Septum Pellucidum (CSP) anatomic features and lateral ventricle size in retired elite rugby league players and controls	Magnetic resonance imaging (MRI) scan	Abnormal Cavum Septum Pellucidum (CSP)	61%	41.5%

Van Patten et al., 2021	N=133 55.0 (SD 13.9)	Australia Male	League	C: NI R: NI	No	Cross sectional study: To explore predictors and correlates of perceived cognitive decline in retired national rugby league players	Information questionnaire on Cognitive Decline in the Elder (IQCODE-Self) IQCODE-Self	Cognitive decline (cut-off = 3.88) Cognitive decline (cut-off 3.38)	7.5% 28.6%	
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N = number participants, SD = Standard Deviation, NI = Not identified, C= mean career duration (year), R= mean years since retirement

Table 4: Psychological health conditions in retired elite rugby players

Author (Year)	Population				Control Group (Yes/No); Description of Control Group	Study Design and Aim	Assessment Method (and Scoring System used where relevant)	Health condition reported on	Outcome	Comparator group
	No of participants & Age	Nationality & Gender	Rugby Union or League	Mean career duration (in years) & Years retired						
Davies et al., 2017	N=259 60.1 (SD 16.1)	United Kingdom Male	Union	C: NI R: NI	No	Cross sectional study: To assess morbidity and health related quality of life amongst former rugby players, compared to an age-standardised general population sample	Questionnaire self-reported, physician diagnosed	Anxiety Depression	7% 6%	NI
Decq et al., 2015	N=239 52 (49-55.75)	France Male	Union	C: NI R: NI	Yes N=138 Retired sportsmen registered on "high-level" lists	Cross sectional study: To evaluate the prevalence of major depressive disorder, mild cognitive disorders and headache in retired high	Self-questionnaire Patient Health Questionnaire (PHQ-9) (PHQ-telephonic)	Reported depressive episodes Depressive disorder PHQ-9 >9)	12.61% 9.55%	12.32% 6.72%

						level sportsmen and rugby players				
Gardner et al., 2017	N=16 38.3 (SD 4.6)	NI Male	League	C: NI R: 6.9	Yes N=16 Age-and education-matched controls who had no history of neurotrauma or participation in contact sports	Cross sectional study: To assess brain neurometabolite concentrations in retired league players who had a history of self-reported concussions	Alcohol use disorder identification test (AUDIT)	Alcohol use disorder: Abstainer Low Risk Hazardous level Harmful High risk	0% 23.07% 53.84% 7.69% 15.38%	7.69% 76.93% 15.38% 0% 0%
Gouttebauge et al., 2015	N=295 38 (SD 6.0)	France, South Africa, Ireland. Male	Union	C: 9 (1-18) R: 8 (1-25)	No	Cross sectional study: To establish the prevalence of symptoms of common mental health disorders among retired professional rugby union players	Four-dimensional symptom questionnaire (4DSQ) 12-item General Health Questionnaire (GHQ-12) Patient reported outcome measurement information system (PROMIS)	Distress Anxiety/ Depression Sleeping disturbance	24.8% (95CI 19.7-29.9) 28.4% (95 CI 23.1-33.7) 28.8% (95 CI 23.1-34.5)	

							AUDIT-C	Adverse alcohol behaviour	23.8% (95 CI 18.8-28.9)	
							Questionnaire	Adverse smoking behaviour	15% (95 CI 10.8-19.3)	
							Questionnaire	Adverse nutrition behaviour	61.9% (95 CI 56.1-67.7)	
Hind et al., 2022	N=83 43.4 (SD 9.4)	United Kingdom Male	League & Union	C: NI R: NI	Yes N=106 Retired Amateur rugby athletes (AR) N=65 Retired Non-contact athletes (NC)	Cross sectional study: To investigate whether there were differences in mental health, sleep, and alcohol use between retired elite and amateur rugby code players compared to retired non-contact athletes	Spielberger Anger Expression Scale	Irritability	52% ERvNC p<0.001	AR 18% NC 43%
							General Health Questionnaire (GHQ-12)	Depression	49% ERvNC p=0.001 ERvAR p=0.043	AR 34% NC 21%
							(GHQ-12)	Anxiety	42% ERvAR p=0.009	AR 23% NC 31%
							AUDIT-C	Alcohol consumption (higher risk) (≥ 5)	59%	AR 64% NC 53%
							Insomnia Severity Index	Difficulty falling asleep	17%	AR 6% NC 7%
								Waking in night and taking a long	34%	AR 19% NC 17%

								time to fall back to sleep		
								Waking up too early	35%	AR 19% NC 12%
Hume et al., 2022	N=127 43 (SD 8.5)	New Zealand Male	Union	C: NI R: NI	Yes N=271 Retired community (club or regional level) players (CR) N=72 Retired non-contact sport (cricket or hockey) players at any level (NC)	Cross sectional study: To investigate the differences in self-reported sport injury history and current self-reported health characteristics between former New Zealand rugby and non-contact sport players.	Questionnaire	Anxiety	4.7%	CR: 7.7% NC:6.9%
							Questionnaire	Depression	11%	CR: 10% NC: 9.5%
							AUDIT	Hazardous drinking	38%	CR: 40% NC25%
Iverson et al., 2021	N=141 52.6 (SD 13.8)	Australia Male	League	C: NI R: NI	No	Cross sectional study: To examine predictors and correlates of depression in retired elite level rugby league players in Australia	The Depression, Anxiety and Stress Scale (DASS-21)	Depression Normal (0-9) Mild (10-13) Moderate (14-20) Severe/extremely severe (21+)	70.9% 14.9% 9.9% 4.3%	
							DASS-21	Anxiety Normal (0-7) Mild (8-9) Moderate (10-14)	80.9% 7.8% 6.4% 5.0%	

							DASS-21	Severe/extremely severe (15+)		
								Stress	73%	
								Normal (0-14)	11.3%	
								Mild (15-18)	9.2%	
								Moderate (19-25)		
								Severe/extremely severe (26+)	6.4%	
							AUDIT	Alcohol use		
								Low-risk	55.3%	
								Risky or hazardous level	37.6%	
								High-risk or harmful level	5%	
								High-risk (likely dependence)	2.1%	
							Questionnaire	Recent cannabis use (past 6 months)	5.0%	
							Questionnaire	Recent illicit drug use (past 6 months)	12.8%	
McMillan et al., 2017	N=127 53.5 (SD 13.0)	United Kingdom Male	Union	C: 22.4 (5.0) R: 20.3 (12.8)	Yes N=29 Matched for age and social deprivation	Cross sectional design: To explore long term health outcomes after exposure to repeated concussions in elite level rugby union players	Self-report inventory	Depression	3.84%	3.44%
Van Patten et al., 2021	N=133	Australia Male	League	C: NI R: NI	No	Cross sectional study: To	DASS-21	Depression mild (10-13)	15.0%	

	55.0 (SD 13.9)					explore predictors and correlates of perceived cognitive decline in retired national rugby league players	DASS-21	Depression moderate (14-20)	10.55%	
							DASS-21	Depression severe (21+)	4.5%	
							AUDIT	Alcohol use risky or hazardous level	36.8%	
							AUDIT	Alcohol use high-risk or harmful level	4.5%	
							AUDIT	Alcohol use (likely dependence)	2.3%	
							Questionnaire	Recent cannabis use (past 6 months)	5.3%	
							Questionnaire	Recent illicit drug use (past 6 months)	12.8%	
Wright et al., 2021	N=11 37.6 (SD 5.0)	Australia Male	League	C: NI R: 6.8	Yes N=13 Age and education matched controls	Cross sectional study: Explore white matter microstructure using diffusion tensor imaging (DTI) in retired professional Australia National Rugby	AUDIT	Alcohol use Abstainer Low risk Hazardous level Harmful level Probable alcohol dependence	0% 36.4% 45.5% 9.1% 9.1%	15.38% 69.23% 15.38% 0% 0%

						League players with a history of self-reported concussions compared with age and education matched controls who have had no history of brain trauma				
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N = number participants, SD = Standard Deviation, NI = Not identified, AR = former amateur rugby players, NC = retired non-contact athletes, CR = Retired community level rugby players, C= mean career duration (year), R= mean years since retirement

Table 5: Other health conditions in retired elite rugby players

Author (Year)	Population				Control Group (Yes/No); Description of Control Group	Study Design and Aim	Assessment Method (and Scoring System used where relevant)	Health condition reported on	Outcome	Comparator group
	No of participants & Age	Nationality & Gender	Rugby Union or League	Mean career duration (in years) & Years retired						
Davies et al., 2017	N=259 60.1 (SD 16.1)	United Kingdom Male	Union	C: NI R: NI	No	Cross sectional study: To assess morbidity and health related quality of life amongst former rugby players, compared to an age-standardised general population sample	Questionnaire self-reported, physician diagnosed	Asthma Diabetes	10% 2%	
Decq et al., 2015	N=239 52 (49-55.75)	France Male	Union	C: NI R: NI	Yes N=138 Retired sportsmen registered on "high-level" lists	Cross sectional study: To evaluate the prevalence of major depressive disorder, mild cognitive disorders and headache in retired high	Head Impact Test (HIT-6 (telephonic)	Disabling headache (HIT-6 \geq 50)	15.53%	12.82%

						level sportsmen and rugby players				
Gallo et al., 2021	N=143 70	UK Male	Union	C: 15.8 (SD 5.4) R: NI	No	Cross sectional study: To assess long term association between concussions and cognitive function among retired elite rugby players	Questionnaire	Diabetes	4.1%	

N = number participants, SD = Standard Deviation, NI = Not identified, CR = Retired community level rugby players, C= mean career duration (year), R= mean years since retirement.