Health conditions among retired professional footballers: a scoping review

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ABSTRACT

Objective To conduct a scoping review providing an overview of the health conditions occurring in retired male and female professional footballers, with an emphasis on musculoskeletal, mental, neurocognitive, cardiovascular and reproductive health conditions.

Methods In January 2022, a comprehensive systematic literature search in three databases (MEDLINE via PubMed, SPORTDiscus via EBSCOhost and EMBASE) was conducted for common health conditions among retired male and female professional footballers. Primary research studies (full text available online) which described the incidence or prevalence of a health condition (musculoskeletal, mental, neurocognitive, cardiovascular, reproductive) among retired male and female professional footballers were included for review. Case reports, qualitative research and grey literature were omitted.

Results In total, 917 eligible articles were identified from the databases, with 41 meeting the eligibility criteria. Osteoarthritis of the hip, knee and ankle were found to be common among retired professional footballers. Mental health symptoms (eg, anxiety, depression) are experienced by retired male and female professional footballers. The incidence of neurocognitive disease appears to be higher among retired male professional footballers than among matched controls. There is very limited evidence examining the presence of health conditions in retired female professional footballers.

Conclusion Osteoarthritis of the lower limb, musculoskeletal pain and mental health symptoms are common among retired professional footballers. Knowledge about the occurrence and timing of musculoskeletal, mental health and neurocognitive conditions among retired professional footballers can be used by a wide range of stakeholders to proactively intervene during and after a player’s career to mitigate risk.

INTRODUCTION

Elite athletes appear to have better long-term health outcomes than the general population. 1,2 This is likely to apply to professional footballers, although the literature has highlighted specific health conditions which may be prevalent among retired professional footballers, including musculoskeletal, 3–7 mental, 8–15 and neurodegenerative health conditions. 14–16

Professional football is known for its high injury rate compared with other sports, with an injury rate of about 1.3 injuries per player per season. 17 The management of these injuries may occasionally require surgical intervention, and this, along with the cumulative effect of repetitive microtrauma and considerable joint demands, compounds the risk of complications for professional footballers in retirement, especially early-onset osteoarthritis (OA). 3 A diagnosis of OA has implications for quality of life, function and broader health (eg, cardiovascular health) in later life. 18,19 Injury is also a stressor which may predispose a footballer to mental health symptoms, alongside decreased performance, deselection or negative media attention. 20 The onset of mental health symptoms appears to be most apparent during the transition to retirement and this may be linked to a loss of identity and the adoption of negative...
lifestyle behaviours (eg, alcohol excess). Retirement is likely to lead to reduced physical activity levels by former professional footballers and this, coupled with the aforementioned issues, may have implications for cardiovascular health. In recent years, significant attention has been given to the relationship between contact sport, concussion and subsequent neurodegenerative disease. With specific reference to professional football, the repetitive subconcussive effects of ‘heading’ is feared to place players at greater risk of conditions such as dementia in later life, although the evidence for this is limited. Initiatives to improve the management of concussion in football are underpinned by a desire to protect player welfare long-term.

The increasing participation of women in sport, especially professional football, has seen a much needed emphasis placed on understanding the influence of sex hormones and the menstrual cycle in female athlete health and performance. Nevertheless, the research appears limited with respect to understanding the long-term reproductive health status of professional female footballers.

Professional football is a highly rewarding career in many instances, and the long-term health benefits of the associated physical activity is undisputed. There is a growing evidence base examining long-term health issues in retired professional footballers, and this has focused on musculoskeletal and mental health issues—although neurodegenerative, cardiovascular and reproductive health may be avenues worth understanding further. Through better understanding, the potential influence of a career in professional football on players’ long-term health, a wide range of stakeholders may be better informed to intervene proactively during and after a player’s career in order to mitigate the risk of these conditions—without detracting from the spectacle of the sport. No scoping review, to our knowledge, has examined the extent of health conditions commonly afflicting professional footballers on retirement. A scoping review of this nature may guide the work of policymakers and other stakeholders, and inform research policy. Therefore, the aim of this study was to conduct a scoping review providing an overview of the health conditions occurring in retired male and female professional footballers, with an emphasis on musculoskeletal, mental, neurocognitive, cardiovascular and reproductive health conditions.

**METHODS**

**Search strategy**

The protocol for this scoping review was established by combining the guidelines of the PRISMA Extension for Scoping Reviews (PRISMA—ScR) with a method outlined by Peters et al. The final protocol was not published in advance but can be requested from the corresponding author.

In January 2022, a systematic search was carried out in the databases MEDLINE (via PubMed), SPORTDiscus (via EBSCOHost) and EMBASE. Search strategies were tailored according to the database being examined. The keywords (and synonyms) common to both databases were ‘football/soccer’, ‘retired’ and ‘health conditions’. For each category of health conditions examined, the keywords searched in both databases consisted of ‘musculoskeletal system’, ‘cardiovascular system’, ‘psychological disorders’, ‘neurocognitive disorders’ and ‘reproductive system’. For MEDLINE, the MeSH terms of the different keywords were used where suitable. For synonyms and key words in both databases, the title and/or abstract rather than text word to ensure that the search terms returned were the primary focus of the article. The Boolean command ‘OR’ was used in between synonyms and in between the different categories of health conditions. The Boolean command ‘AND’ was used to combine the keywords (and synonyms) with each other. A more detailed overview of the search strategies used for MEDLINE, SPORTDiscus and EMBASE is outlined in the online supplemental appendix of the article.

**Inclusion criteria**

The following inclusion criteria were defined:

1. Primary research studies which included prospective and retrospective studies, cross-sectional studies and case-control studies which aim to describe the prevalence of health conditions in a given population.
2. Studies published in peer-reviewed journals whose full-text was available online.
3. Studies written in English, French or Dutch.
4. Retired professional male and/or professional female football players included in the study population.
5. Studies which described the incidence or prevalence of health conditions related to the health categories of interest, that is, musculoskeletal, cardiovascular, neurocognitive, psychological, reproductive.

The following exclusion criteria were defined:

1. Case reports and qualitative research.
2. Grey literature, including conference proceedings (eg, poster presentations), annual reports, dissertations, unpublished and ongoing trials.
3. Duplicate articles returned in both searches were removed and the criteria stated above applied to the eligible articles. Articles were initially included based on the information detailed in the title and abstract and subsequent retrieval of the full text to confirm the basis for their inclusion. Two independent reviewers carried out this process. In circumstances where there was discordance, consensus was sought through the input of a third reviewer. Finally, reference lists for each of the studies included were assessed to ensure no relevant articles were omitted. Forward and backward citation tracking provided further reassurance that all of the relevant articles were included in the review.

**Data-charting**

A data-charting form was created by the research team in order to display the key data to extract from the selected articles. Topics that were included in the form were: article information (author, year of publication, country of origin),
purpose of the study, demographics of the study population, study design, category of health condition under study (cardiovascular, musculoskeletal, neurocognitive, psychological, reproductive), assessment method of the health condition under study and the incidence and/or prevalence of the health condition discussed. The data extraction was performed by two of the aforementioned individual reviewers—in circumstances where there was differing data submitted between reviewers, this was resolved by the contribution of a third reviewer.

RESULTS

Search strategy

We identified a total of 917 eligible articles, a figure which was reduced to 97 once duplicates were removed and the inclusion criteria were applied to titles and abstracts. This number reduced further to 33 once the inclusion criteria were applied to the full texts of each article. Prior to full-text analysis, an estimated 15 articles were excluded as they were written in a language other than those specified in the inclusion criteria. Sixty-one articles were excluded as they did not study the target population, or they did not report on a relevant health condition. Two articles were excluded as they included a duplicate data set with another study already included. A further study was removed as it did not report the results related to the health outcome in question. The reference check and citation tracking of the included articles resulted in eight additional relevant studies. Ultimately, a total of 41 studies were included in our scoping review. Several studies included in the final review reported on health conditions from more than one of the relevant health categories. The flowchart in figure 1 displays the search procedure conducted in our study. Twenty-five of the included studies had incomplete data for data-charting. The authors for 16 of the 25 studies (ie, where a correspondence email address was provided) were contacted to obtain the additional data. Two authors replied, but neither of them could provide any information on the missing data for their respective studies.

Musculoskeletal health conditions

Twenty-eight articles retrieved from the search focused on outcomes pertaining to musculoskeletal health in retired professional footballers (all studies presenting prevalence rates). Twenty-six of these studies featured retired male professional footballers, and two of these examined health conditions in retired female professional footballers. The musculoskeletal conditions and presentations assessed included OA of various joints of the lower limb, joint pain, back pain and deformities of the lumbar and cervical spine. The key data from the 29 studies are outlined in table 1.

The prevalence rate of knee OA in retired male professional football players was found in 15 articles to range from 9% to 80%. Hip OA was reported on in 12 articles and the prevalence was found to range from 2% to 14% in the majority of studies, with one study showing a prevalence of hip OA as high as 50%. Five studies investigated the prevalence of ankle OA and found it ranged from 4% to 12%. Only one study found a higher prevalence of OA in the control group compared with the group of retired professional footballers. The method used to diagnose OA in various limb joints differed across studies, with some relying on clinical assessment, or imaging findings, or in some cases through self-reporting by study participants—or in some instances, a combination of methods.

Knee pain was reported by 37%–52% of retired male professional football players, and hip pain was found in 13% of this cohort. Radiological abnormalities in the lumbar spine, specifically osteophytes, ranged from 24% to 51% with the highest prevalence of osteophytes at level L4 and the lowest at level L2. Spinal issues were identified in one study, with 58% of retired players having reduced motion of the cervical spine, 21% of players having a history of cervical pain or stiffness and 33% of players having slight to moderate scoliosis. Two studies included retired female professional footballers and assessed the prevalence of knee OA and ankle OA, knee and back pain in this population. Knee OA ranged from 14% to 60%. Based on a questionnaire distributed to retired female professional footballers, 7% reported a diagnosis of ankle OA. The same study identified that 47% of the retired female professional players had knee problems, with 9% suffering with severe knee pain. Additionally, 47% of the same cohort had back issues of some description, with 9% experiencing severe back pain.

Mental health conditions

Mental health symptoms were assessed in 9 out of the 41 articles included in this scoping review (all but one study presenting prevalence rates). Only one of the nine articles examined issues exclusively in retired female
### Table 1: Musculoskeletal health conditions in former professional football players: data extraction from included studies

<table>
<thead>
<tr>
<th>Article details (Author(s), year of publication, reference number, country of origin)</th>
<th>Study demographics</th>
<th>Study design and purpose</th>
<th>Health condition(s)</th>
<th>Assessment method(s)</th>
<th>Outcome</th>
</tr>
</thead>
</table>
| Arliani et al, 20145 (Brazil) | N=27  
G= male  
A=45.67 (SD 5.91)  
C=14.89 years  
R=not provided | Cross-sectional study  
To compare the prevalence of osteoarthritis among a group of soccer players and non-professional athletes. | Knee OA | Quantification of pain through VAS, knee radiographs  
KOOS subjective questionnaire, SF-36, knee MRI | 66.6% knee OA in dominant knee (controls: 46.7%)  
66.6% knee OA in non-dominant knee (controls: 43.3%) |
| Armenis et al, 201144 (Greece) | N=150  
G= male  
A=49.8 (SD 7.4)  
C=8–10 years  
R=not provided | Cross-sectional study  
To compare OA ankle findings in retired Greek professional footballers with those in the general population. | Foot and ankle OA | Questionnaire, clinical examinations, radiographs | 4.1% clinical OA (controls: 3.56%)  
8.8% radiographic OA (controls: 3.7%) |
| Chantraine, 198531 (Switzerland) | N=81  
G= male  
A=47.6 (SD 13.2)  
C=6–15 years  
R=not provided | Cross-sectional study  
To examine the presence of knee OA in a group of retired former footballers and to investigate a relationship between limb axis, previous meniscectomy and the presence of OA. | Knee OA | Clinical examination, radiographs | 20% clinical signs of knee OA | 56% radiographic signs of knee OA  
2% clinical signs, but no radiographic evidence of knee OA  
17% clinical and radiographic evidence of knee OA |
| Drawer and Fuller, 20014 (UK) | N=185  
G= male  
A=47.6 (SD 13.2)  
C=6–15 years  
R=not provided | Cross-sectional study  
To quantify the prevalence of osteoarthritis and the severity of pain in the lower limb joints of players retired from English professional soccer. | OA, hip OA, knee OA, ankle OA | Questionnaire | 32% medically diagnosed with OA in at least one of the lower limb joints.  
1.7% diagnosed with hip OA of the right hip  
4.6% diagnosed with hip OA of the left hip  
19.0% diagnosed with knee OA of the right knee  
21.3% diagnosed with knee OA of the left knee  
5.7% diagnosed with ankle OA of the right ankle  
63.3% diagnosed with ankle OA of the left ankle  
80% at least minor joint pain in at least one lower extremity joint during one or more daily activities  
37% knee pain |
| Elleuch et al, 200832 (France) | N=50  
G= male  
A=49.2 (SD 3.3)  
C=10.7 (SD 4.6)  
R=≥20 | Case-control study  
To study the prevalence of knee osteoarthritis in a group of former professional footballers with comparison to a control group. | Knee OA, knee pain, knee disability | Questionnaire, knee examination, functional assessment using Arabic Lequesne index, knee radiographs, KL radiological classification | 80% radiographic OA (controls: 68%)  
12% knee pain (controls 3%)  
12% knee disability (controls: 46%) |
| Fernandes et al, 201837 (UK) | N=1207  
G= male  
A=59 (SD 91.7)  
C=11 (SD 6)  
R=>20 | Case-control study  
To determine the prevalence of knee pain, RKOA, TKR and associated risk factors in male ex-professional footballers compared with men in the general population (comparison group). | Knee OA, total knee replacement | Questionnaire, knee radiographs | 52.2% knee pain (controls: 26.9%)  
28.3% diagnosed with knee OA by a physician (controls: 12.2%)  
64% signs of knee OA in radiographs (controls: 35.2%)  
11.1% total knee replacement (controls: 3.8%) |
| Gouttebarge et al, 201838 (The Netherlands—Global) | N=396  
G= male  
A=36 (SD 6)  
C=11 (SD 8)  
R=5 (SD 4) | Case-control study  
To investigate whether retired professional footballers with lower extremity OA have a lower health-related quality of life than those without OA or current professional footballers. | OA | Questionnaire | 33% OA (mostly knee OA) |
<table>
<thead>
<tr>
<th>Study</th>
<th>Name</th>
<th>Country</th>
<th>Design</th>
<th>Purpose</th>
<th>Health Conditions</th>
<th>Methods</th>
<th>Outcome</th>
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<tbody>
<tr>
<td>Carmody et al., 2022</td>
<td>Case-control study</td>
<td>To investigate the prevalence of lower extremeties clinical and radiographic OA in former elite male athletes and referents from the general population and to examine its association with the participants' demographic characteristics.</td>
<td>OA</td>
<td>Questionnaire, clinical and radiological examination</td>
<td>15.7% clinical OA, 2.4% clinical hip OA, 9.1% clinical knee OA, 4.1% clinical ankle OA, 40.6% radiographic OA, 7.4% radiographic hip OA, 16.5% radiographic knee OA, 6.6% radiographic ankle OA</td>
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<td>Iosifidis et al., 2015</td>
<td>Case-control study</td>
<td>To evaluate lower-limb explosive strength with respect to lifetime athletic activity.</td>
<td>OA</td>
<td>Interviews, clinical examinations, quantitative functional measurements, knee x-ray examination, hip MRI</td>
<td>45% knee pain, 13% hip pain, 35% knee disability, 3% hip disability, 29% knee OA, 12% hip OA</td>
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<td>Kettunen et al., 1999</td>
<td>Case-control study</td>
<td>To determine the relationship between previous lower-limb loading and current self-reported hip and knee disability.</td>
<td>Hip disability, knee disability</td>
<td>Questionnaire</td>
<td>6.5% hip disability, 16.7% knee disability</td>
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<tr>
<td>Kettunen et al., 2001</td>
<td>Case-control study</td>
<td>The purpose of this study was to examine the relationship between top-level football playing over many years and the prevalence of osteoarthritis in the hip and knee joints.</td>
<td>OA, hip OA, knee OA</td>
<td>Radiographs, clinical examination</td>
<td>52.7% OA (controls: 33.3%), 49.1% hip OA (controls: 26.3%), 14.0% knee OA (controls: 12.3%)</td>
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<td>Klünder et al., 1980</td>
<td>Case-control study</td>
<td>The aim of the study was to evaluate differences in knee injuries and osteoarthritis between the dominant and non-dominant legs of former professional football players.</td>
<td>Symptomatic knee problems (dominant vs non-dominant leg), radiographic knee OA (dominant leg vs non-dominant leg)</td>
<td>History of previous knee injury, knee operations during career, knee radiographs</td>
<td>52.5% subjectively more symptomatic knee non-dominant leg, 25% subjectively more symptomatic knee dominant leg, 57.5% radiographic knee OA non-dominant leg, 42.5% radiographic knee OA dominant leg, &gt;60% radiographic knee OA in one or both knees</td>
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<td>Koch et al., 2021</td>
<td>Cross-sectional study</td>
<td>To investigate the impact of injuries that male professional football players endure during their career, reasons for the end of their career and the postcareer phase of retirement.</td>
<td>Hip OA, knee OA, ankle OA, shoulder OA</td>
<td>Questionnaire</td>
<td>11% hip OA, 44% knee OA, 35% ankle OA, 4% shoulder OA</td>
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<td>Krajnc et al., 2010</td>
<td>Cross-sectional study</td>
<td>The aim of the study was to compare the cumulative 21-year incidence of admission to hospital for osteoarthritis of the hip, knee and ankle in former elite athletes and control subjects.</td>
<td>Admissions to hospital for OA of the weight bearing joints of the lower limb (1970-1990)</td>
<td>Public archives and hospital discharge summaries (1970-1990)</td>
<td>6% admission to hospital for OA in lower limb (controls: 2.6%), 3.2% admission to hospital for hip OA (controls: 1.4%), 2.0% admission to hospital for knee OA (controls: 1.3%), 0.8% admission to hospital for ankle OA (controls: 0%)</td>
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<td>Study demographics</td>
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| **Kujala et al., 1995**<sup>40</sup> (Finland) | N=31  
G=male  
A=56.5 (SD 5.7)  
C=not provided  
R=not provided | Cross-sectional study  
To determine the relationship between different physical loading conditions and findings of knee OA. | Knee OA  
Questionnaire, interview, clinical examination, knee radiographs | 29% knee OA  
16% patellofemoral OA  
29% knee osteophytes  
19% tibiofemoral osteophytes  
26% patellofemoral osteophytes  
23% subchondral cysts  
45% monthly knee pain  
35% knee disability  
39% extension deficiency |
| **Lindberg et al., 1993**<sup>66</sup> (Sweden) | N=71  
G=male  
A=63  
C=not provided  
R=not provided | Case-control study  
The aim of the study was to compare the prevalence of hip OA in former soccer players with a randomly selected control group. | Hip OA  
Hip radiographs | 14.1% hip OA (controls: 4.2%) |
| **Lv et al., 2018**<sup>81</sup> (China) | N=86  
G=male  
A=53 (51–58)  
C=19.8 (SD 6.3)  
R=not provided | Case-control study  
This study aimed to investigate the prevalence of radiographic KOA among retired professional football players by comparing with a control group. | Knee OA  
Questionnaire, clinical examination, knee radiographs. | 15.1% radiographic knee OA (controls: 45.3%) |
| **Öztürk et al., 2008**<sup>86</sup> (Turkey) | N=70  
G=male  
A=45.64 (SD 8.39)  
C=11.04 (SD 3.66)  
R=13.87 (SD 8.39) | Case-control study  
To examine the occurrence of radiographic changes and abnormalities of the lumbar spine in former professional football compared with a control group. | Osteophytosis of the lumbar spine  
Lumbar spine radiographs, Hannover Functional Ability Questionnaire to measure back pain-related disability | 27.1% osteophytosis at level T12 (controls: 5.4%)  
27.1% osteophytosis at level L1 (controls: 5.49%)  
24.3% osteophytosis at level L2 (controls: 7.1%)  
29.0% osteophytosis at level L3 (controls: 19.6%)  
51.4% osteophytosis at level L4 (controls: 28.6%)  
34.3% osteophytosis at level L5 (controls: 19.6%) |
| **Paget et al., 2020**<sup>86</sup> (The Netherlands—Global) | N=401  
G=male  
A=36 (25–50)  
C=13 (2–19)  
R=4 (1–17) | Cross-sectional study  
To determine the prevalence of ankle osteoarthritis among former professional football and rugby players. | Ankle OA  
Questionnaire, Health-related Qol, using PROMIS-GH | 9.2% ankle OA  
8.5% ankle OA ≤40 years of age  
12.0% ankle OA ≥40 years of age |
| **Paxinos et al., 2016**<sup>82</sup> (Greece) | N=100  
G=male  
A=46.9 (SD 5.9)  
C=20.52 (SD 7.4)  
R=not provided | Case-control study  
To investigate the prevalence of knee OA in retired professional soccer players in comparison with a group of athletically active military personnel. | Knee OA  
Questionnaire using medical and sport history, Greek language version of KOOS, clinical examination of both knees, ultrasound examination of both knees | 25% clinically evident varus (<178.5°) knee deformity (controls: 22%)  
55% knee OA (controls: 33%)  
32% knee OA after controlling for knee surgeries (controls: 17%)  
44.1% knee OA after excluding participants with history of knee surgery (controls: 25.3%) |
| **Shepard et al., 2003**<sup>87</sup> (UK) | N=68  
G=male  
A=44 (32–59)  
C=16 (5–25)  
R=not provided | Case-control study  
To compare the prevalence of self-reported, physician diagnosed OA of the hip in ex-professional footballers with that in age matched controls in the general public. | Hip OA  
Questionnaire | 13% OA hip (controls<1%) |
| **Sortland et al., 1982**<sup>87</sup> (Norway) | N=43  
G=male  
A=49.8  
C=not provided  
R=not provided | Case-control study  
To investigate the prevalence of degenerative cervical spine changes in a group of retired professional footballers compared with the general population. | Degenerative changes of the cervical spine  
Cervical radiographs, clinical examination | 32.8% slight or moderate scoliosis (controls: 37.2%)  
11.6% healed fractures (controls: 2.3%)  
4.7% moderate anterolisthesis at one level (controls: 4.7%)  
20.9% history of longstanding cervical complaints; pain and stiffness.  
58.1% reduced motion of the cervical spine  
41.1% markedly reduced range of cervical motion |
<table>
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<tr>
<th>Study details (Author(s), year of publication, reference number, country of origin)</th>
<th>Study demographics</th>
<th>Study design and purpose</th>
<th>Health condition(s)</th>
<th>Assessment method(s)</th>
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<tr>
<td>Carmody S, et al. BMJ Open Sp Ex Med 2022; 8:e001196. doi:10.1136/bmjsem-2021-001196</td>
<td>N=284 G=male A=56.1 (SD 11.8) C=13.5 (SD 5.3) R=not provided</td>
<td>Cross-sectional study To describe the long term impact of football on the HRQL of former professional footballers in the UK.</td>
<td>Surgery, joint replacement, OA</td>
<td>Questionnaire about demographics and career details, treatment experience since retirement, OA diagnosis, HRQL using EuroQol (EQ-5D)</td>
<td>26.4% had surgery since retirement 16.9% had knee surgery since retirement (10 joint replacements) 5.3% had hip surgery since retirement, (12 joint replacements, 6 players had two joint replacements) 8.5% currently awaiting surgery (13 for joint replacement operations; 7 hip, 8 knee) 48.6% diagnosed with OA in at least one anatomical site, 29.2% OA in two or more joints 16.5% bilateral knee OA 14.8% OA in three or more joints, 15.1% were registered disabled (33 of which had OA)</td>
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<tr>
<td>Turner et al., 2000</td>
<td>N=363–371 G=male A=50–93 years C=20–21 years R=1–63 years</td>
<td>Case-control study To investigate the relationship between intense exercise and subsequent risk of hip and knee OA in athletes.</td>
<td>Knee OA, hip OA, hip arthroplasty, knee arthroplasty</td>
<td>Questionnaire</td>
<td>14.2% hip OA 8.7% hip arthroplasty 18.2% knee OA 3.3% knee arthroplasty</td>
</tr>
<tr>
<td>Tveit et al., 2012</td>
<td>N=101 G=male A=36.5 (SD 5.5) C=52 R=5.3 (4.1)</td>
<td>Case-control study To establish the prevalence of clinical hip osteoarthritis in current and former professional footballers and to explore its consequences on hip function and HRQL.</td>
<td>Hip OA</td>
<td>Questionnaire assessing clinical hip OA, hip function and hip-related quality of life</td>
<td>8% hip OA</td>
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<td>van den Noort et al., 2021</td>
<td>N=401 G=male A=36.5 (SD 5.5) C=52 R=5.3 (4.1)</td>
<td>Case-control study To estimate the incidence of hip and knee arthroplasty in Italian male professional football players who have played for a minimum 10 years in the Italian major football leagues.</td>
<td>Hip and/or knee arthroplasty</td>
<td>Questionnaire-based (modified WOMAC questionnaire)</td>
<td>13.5% underwent hip arthroplasty (controls: 0%) 5.8% underwent knee arthroplasty (controls: 1%) 5.8% underwent both hip and knee arthroplasty (controls: 0%) 2.9% underwent arthroplasty in dominant leg 8.6% underwent arthroplasty in non-dominant leg 13.5% underwent arthroplasty in both dominant and non-dominant leg, 7.7% underwent ACL reconstruction and/or meniscectomy (controls: 9%)</td>
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<tr>
<td>Volpi et al., 2019</td>
<td>N=104 G=male A=36.5 (SD 5.5) C=52 R=5.3 (4.1)</td>
<td>Case-control study To assess knee health in retired female football players, using MRI and self-report.</td>
<td>Knee OA</td>
<td>Questionnaire, KOOS, knee MRI</td>
<td>24.5% of knees LFC chondral loss of grade 3 or higher 25.5% of knees MFC chondral loss of grade 3 or higher 31.6% of knees LTP chondral loss of grade 3 or higher 18.4% of knees MTP chondral loss of grade 3 or higher 30.6% of knees substantial tibiofemoral joint loss 12.2% of knees medial side facets 21.4% of knees lateral side affected 32.7% of knees substantial meniscal loss of grade 3 or higher in lateral meniscus, 32.7% of knees substantial meniscal loss of grade 3 or higher in medial meniscus, 24.5% of knees medial meniscus extrusion &gt;2mm 25.5% of knees lateral meniscus extrusion &gt;2mm 51.0% of players substantial tibiofemoral joint loss 69% of players fulfilled criterion for substantial meniscal loss 59.6% of players fulfilled criteria for substantial knee OA symptoms, 23.4% of players substantial knee OA symptoms only 17% of players substantial joint loss on MRI only 36.2% of players substantial knee OA symptoms and substantial joint loss on MRI</td>
</tr>
<tr>
<td>Prien et al., 2020</td>
<td>N=49 G=female A=9.9 (SD 5.3) C=9.9 (SD 5.3) R=9.6 (SD 4.0)</td>
<td>Cross-sectional study To assess knee health in retired female football players, using MRI and self-report.</td>
<td>Knee OA</td>
<td>Questionnaire, KOOS, knee MRI</td>
<td>24.5% of knees LFC chondral loss of grade 3 or higher 25.5% of knees MFC chondral loss of grade 3 or higher 31.6% of knees LTP chondral loss of grade 3 or higher 18.4% of knees MTP chondral loss of grade 3 or higher 30.6% of knees substantial tibiofemoral joint loss 12.2% of knees medial side facets 21.4% of knees lateral side affected 32.7% of knees substantial meniscal loss of grade 3 or higher in lateral meniscus, 32.7% of knees substantial meniscal loss of grade 3 or higher in medial meniscus, 24.5% of knees medial meniscus extrusion &gt;2mm 25.5% of knees lateral meniscus extrusion &gt;2mm 51.0% of players substantial tibiofemoral joint loss 69% of players fulfilled criterion for substantial meniscal loss 59.6% of players fulfilled criteria for substantial knee OA symptoms, 23.4% of players substantial knee OA symptoms only 17% of players substantial joint loss on MRI only 36.2% of players substantial knee OA symptoms and substantial joint loss on MRI</td>
</tr>
</tbody>
</table>

Continued
Neurocognitive health conditions

Three studies retrieved from the search presented information exclusively about the occurrence of neurocognitive health conditions in retired male professional football players (all studies presenting prevalence rates). An additional study, referred to in the musculoskeletal health section above, found that 4% of retired professional footballers suffered with neuropsychological issues (eg, memory complaints) in later life.9

Table 1 Continued

<table>
<thead>
<tr>
<th>Article details</th>
<th>Study demographics</th>
<th>Study design and purpose</th>
<th>Health condition(s)</th>
<th>Assessment method(s)</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prien et al, 2017</td>
<td>N=152</td>
<td>Cross-sectional study</td>
<td>Physical complaints, knee problems</td>
<td>Questionnaire</td>
<td>81.6% minor to very severe physical complaints in the last 4 weeks</td>
</tr>
</tbody>
</table>

A, age; ACL, anterior cruciate ligament; ACR, American College of Radiology; BMI, body mass index; C, duration of career; EQ-5D, EuroQol-5 dimension; G, gender; HRQL, health-related quality of life; KL, Kellgren and Lawrence radiological classification; KOOS, knee injury and osteoarthritis outcome score; LFC, lateral femur condyles; LFT, lateral femur tibia; LTP, lateral tibia plateaux; MFC, medial femur condyles; MTP, medial tibia plateaux; N, number of participants; OA, osteoarthritis; PROMIS-GH, Patient-Reported Outcome Measurement Information System Global Health; QoL, quality of life; R, duration of retirement; ROA, radiographic knee osteoarthritis; SF-36, 36-item short form; TKA, total knee replacement; VAS, visual analogue scale; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.
Table 2  Mental health conditions in former professional football players: data extraction from included studies

<table>
<thead>
<tr>
<th>Study Population</th>
<th>Study Design and Purpose</th>
<th>Health Condition(s)</th>
<th>Assessment Method(s)</th>
<th>Outcome (Prevalence, Incidence)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fernandes et al, 2019</strong>&lt;sup&gt;10&lt;/sup&gt; (UK)</td>
<td>Cross-sectional study To determine the prevalence of depressive symptoms and general health of male ex-professional footballers compared with general population controls.</td>
<td>Depression, anxiety, sleep issues</td>
<td>Questionnaire using HADS, SF-36, sleep scale from MOS, PANAS, comorbidities, body pain mannequin, self-reported analgesic medication</td>
<td>5.7% probable depression (controls: 5.8%) 12.0% probable anxiety (controls: 10.3%)</td>
</tr>
<tr>
<td><strong>Gouttebarge et al, 2017</strong>&lt;sup&gt;9&lt;/sup&gt; (The Netherlands—Global)</td>
<td>Case-control study</td>
<td>Distress, anxiety/depression, sleep disturbance, adverse alcohol use, ≥2 CMD symptoms</td>
<td>Questionnaire using distress screening tool (based on 4DSQ), GHQ-12, PROMIS, the 3-item AUDIT-C and total number of confirmed concussions during professional career</td>
<td>18% distress 26% anxiety/depression 28% sleep disturbance 25% adverse alcohol use 25%≥2 CMD symptoms</td>
</tr>
<tr>
<td><strong>Gouttebarge et al, 2016</strong>&lt;sup&gt;9&lt;/sup&gt; (The Netherlands—Global)</td>
<td>Case-control study To explore the relationship between sports career-related concussions and the subsequent occurrence of symptoms of common mental disorders among former male professional athletes.</td>
<td>Distress, anxiety/depression, sleep disturbance, adverse alcohol use, ≥2 CMD symptoms</td>
<td>Questionnaire using distress screening tool (based on 4DSQ), GHQ-12, PROMIS, the 3-item AUDIT-C and additional questions for smoking and eating habits</td>
<td>11.4% adverse smoking behaviour (current players: 3.8%) 24.6% adverse alcohol behaviour (current players: 9.4%) 18.4% distress (current players: 14.8%) 35.3% anxiety/depression (current players: 37.9%) 64.5% adverse nutritional behaviours (current players: 58.1%)</td>
</tr>
<tr>
<td><strong>Gouttebarge et al, 2015</strong>&lt;sup&gt;9&lt;/sup&gt; (The Netherlands—Global)</td>
<td>Case-control study To explore the relationship between level of education, employment status and working hours with symptoms of common mental disorders (distress, anxiety/depression, sleep disturbance, adverse alcohol behaviour, smoking, adverse nutritional behaviour) among current and retired professional footballers.</td>
<td>Distress, anxiety/depression, low self-esteem</td>
<td>Questionnaire using The Distress Screener, The Utrecht Burn-Out Scale, the 12-item General Health Questionnaire, Rosenberg's Self-Esteem Scale, the 3-item AUDIT-C and additional questions for smoking and eating habits</td>
<td>15% distress (current players: 10%) 16% burnout (current players: 5%) 38% anxiety/depression (current players: 26%) 5% Low self-esteem (current players: 3%) 32% adverse alcohol behaviour (current players: 19%) 12% smoking (current players: 7%) 42% adverse nutritional behaviour (current players: 26%)</td>
</tr>
<tr>
<td><strong>Kilic et al, 2017</strong>&lt;sup&gt;13&lt;/sup&gt; (Denmark)</td>
<td>Cross-sectional study To determine the prevalence of symptoms of common mental disorders among former male professional footballers and handball players.</td>
<td>Distress, burnout, anxiety/depression, low self-esteem, adverse alcohol use, smoking, adverse nutrition behaviour</td>
<td>Questionnaire using a distress screening tool, GHQ-12, PROMIS, the 3-item AUDIT-C</td>
<td>8.7% distress (current players: 14.7%) 18.7% anxiety/depression (current players: 18.1%) 11.0% sleeping disturbance (current players: 15.8%) 8.4% adverse alcohol use (current players: 2.9%)</td>
</tr>
<tr>
<td><strong>Prinz et al, 2016</strong>&lt;sup&gt;52&lt;/sup&gt; (Germany)</td>
<td>Cross-sectional study To evaluate depression symptoms during and after the career in former female football players of the German First League.</td>
<td>Depression, symptoms related to depression</td>
<td>Questionnaire using CES-D, PHQ-2 and questions on mood, reason for ending career, future life plans, problems in first 2 years after end of football career, need and use for psychotherapeutic support during/after career.</td>
<td>27.3% were bothered by injuries or physical symptoms in the first 2 years after retirement 20.7% were feeling low in the first 2 years after retirement 8.5% classified as depressed in the first 2 years after retirement 20.0% had counselling or treatment by a psychologist</td>
</tr>
</tbody>
</table>
### Table 2: Continued

<table>
<thead>
<tr>
<th>Study details (Author(s), year of publication, reference number, country of origin)</th>
<th>Study population</th>
<th>Study design and purpose</th>
<th>Health condition(s)</th>
<th>Assessment method(s)</th>
<th>Outcome (prevalence, incidence)</th>
</tr>
</thead>
</table>
| Russell et al, 2020[^2]
(UK) | N=7676
G=not provided
A=not provided
R=not provided | Case-control study
To investigate whether former professional soccer players with known high neurodegenerative mortality are at higher risk of common mental health disorders and have higher rates of suicide than the general population. | Admission to hospital for mental disorders, suicide. | Records from prewar Scottish league players and records of postwar Scottish league players. | 5.1% admitted to hospital for management of mental health disorder (controls: 6.1%)
93 (0.40%) suicides as cause of death (controls: 19 (0.25%))
27 (0.35%) admission to hospital due to anxiety and stress related disorder (controls: 222 (0.96%))
0.50% admission to hospital due to depression (controls: 0.73%)
0.31% admission to hospital due to drug use disorder (controls: 0.82%)
1.52% admission to hospital due to alcohol use disorder (controls: 2.43%)
0.27% admission to hospital due to bipolar and affective mood disorders (controls: 0.49%) |
(UK) | N=307
G=male
A=46.8 (SD 15.7)
C=6.7 (SD 3.7)
R=21.2 (SD 14.6) | Cross-sectional study
To examine associations between career-ending injury, chronic pain, athletic identity and depressive symptomology in retired professional footballers. | Depressive symptoms | Questionnaire using the SDHS, PI-NRS, AIMS, question for reason of retirement | 15.6% depressive symptoms |
(The Netherlands) | N=212
G=male
A=35 (SD 6)
C=12 (SD 5)
R=4 (SD 3) | Cross-sectional study
To prospectively explore the incidence of symptoms of CMD (distress, sleep disturbance, anxiety/depression, adverse alcohol use) in retired professional football players. | Distress, sleep disturbance, anxiety/depression, adverse alcohol use (12-month incidence) | Questionnaire using the Distress Screener, PROMIS, CHQ-12, AUDIT-C, SARRS, 5 questions on needs for medical support related to symptoms of CMD | 11% distress
28% sleep disturbance
29% anxiety/depression
15% adverse alcohol use |

[^1]: age; AIMS, Athletic Identity Measurement Scale; AUDIT-C, Alcohol Use Disorders Identification Test; C, duration of career; CES-D, Centre for Epidemiologic Studies Depression Scale; CHQ-12, 12-item General Health Questionnaire; CMD, common mental disorder; 4DSq, Four-Dimensional Symptom Questionnaire; G, gender; HADS, Hospital Anxiety and Depression Scale; MOS, Medical Outcome Survey; N/n, number of participants; PANAS, Positive and Negative Affect Scale; PHQ-2, Patient Health Questionnaire-2; PI-NRS, pain intensity numerical rating scale; PROMIS, Patient-Reported Outcome Measurement Information System; R, duration of retirement; RSES, Rosenberg Self-Esteem Scale; SARRS, Social Athletic Readjustment Rating Scale; SDHS, Short Depression-Happiness Scale; SF-36, 36-item short form; SIR, Sleep Problem Index.
were no studies found which detailed neurocognitive issues among retired female football players, while only one study explored the neurocognitive performance of retired elite female footballers. A summary of the key information from the included studies can be found in table 3.

Neurocognitive health conditions that were found included neurodegenerative disease, dementia, mild cognitive impairment (MCI) and brain atrophy. In a study by Mackay et al, mortality from neurodegenerative disease was higher and mortality from other common diseases lower among retired professional soccer players than among matched controls. More than 10% of the former players were prescribed more frequently to former players than to controls. One third of retired professional footballers in a Norwegian study found evidence of brain atrophy on neuroimaging, although it was not highlighted whether these findings were accompanied by clinical symptoms related to neurocognitive disease.

Cardiovascular health conditions
None of the retrieved articles directly or exclusively explored the occurrence of cardiovascular health conditions in retired male or female professional football players. However, some studies indirectly examined issues related to cardiovascular health in retired professional footballers. Two studies highlighted that retired footballers were more likely than current footballers to adopt behaviours which may increase their risk of cardiovascular disease; for example, smoking, alcohol misuse and poor nutritional behaviours. Another study found no difference between risk of death from ischaemic heart disease between retired professional footballers and matched-controls. A lower reporting of diabetes and heart attacks among a cohort of retired professional footballers in the UK confirmed the potential long-term physical health benefits of professional football.

Reproductive health conditions
No articles were retrieved covering the occurrence of reproductive health conditions in former professional male or female football players.

DISCUSSION
The aim of this scoping review was to provide an overview of the health conditions occurring in retired male and female professional footballers, with an emphasis on musculoskeletal, mental, neurocognitive, cardiovascular and reproductive health conditions. There was a high prevalence of OA of various lower limb joints among retired male professional footballers, with evidence of knee OA in up to 80% of this cohort, and one study suggesting the presence of hip OA in 50% of retired players. Knee and back pain were also commonly reported by retired male professional footballers. Knee OA was reported in up to 60% of retired female professional footballers. Mixed anxiety and depression was found to be as high as 39% in retired male professional footballers. The only study carried out exclusively in retired female professional footballers found that 9% met the criteria for a diagnosis of clinical depression within 2 years of retirement. Dementia was among the neurocognitive conditions found to be present in retired male professional footballers. Only one study investigated neurocognitive health conditions among retired female professional footballers. There were limited specific data on the presence of cardiovascular conditions among retired professional footballers, and no studies retrieved examined reproductive health conditions among retired professional footballers.

Perspective of the findings
This is the first scoping review of health conditions in retired professional footballers and as such comparisons are limited. The aim of this scoping review was not to compare health conditions among retired professional footballers with other populations and, as such, any comparisons are made with caution considering the unsuitability of the research question to address this. There is established evidence demonstrating that OA is associated with occupations that demand challenging and repetitive use of the knee joints. The findings of this scoping review support the notion that OA is more prevalent among retired professional footballers than the general population. Knee OA was present in up to 80% of retired professional footballers, while in comparison, 13% of women and 10% of men aged 60 years and older have symptomatic knee OA. It is reported that 18% of the general UK population have sought treatment for knee OA, and 8% have sought treatment for hip OA. The prevalence of knee OA (13%) among current professional footballers is significantly less than retired professional footballers.

The incidence of depressive symptoms among retired male professional footballers was as high as 39%, while 9% of retired female professional footballers met the criteria for a diagnosis of clinical depression within 2 years of retirement. The estimated worldwide prevalence of depression is 4.5%, with up to 25% of adults estimated to experience an anxiety disorder at some point in their life. Mental health complaints appear slightly less prevalent among current professional footballers compared with retired players; 26% of active players demonstrate evidence of anxiety/depression.

These findings indicate that musculoskeletal and mental health conditions are potentially more prevalent among retired professional footballers than age-matched controls and active footballers. The limited data on neurocognitive, reproductive and cardiovascular conditions make it challenging to draw detailed comparisons with other populations.

Gender bias
The comparative lack of female participants in the studies included in this scoping review reflects wider trends...
Table 3  Neurocognitive health conditions in former professional football players: data extraction from included studies

<table>
<thead>
<tr>
<th>Article details (Author(s), year of publication, reference number, country of origin)</th>
<th>Study population</th>
<th>Study design and study purpose</th>
<th>Health condition(s)</th>
<th>Assessment method(s)</th>
<th>Outcome (prevalence, incidence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mackay et al, 2019 (UK)</td>
<td>n=7676 G=male A=67.9 (SD 13.0) (age of death) C=not provided R=not provided</td>
<td>Case-control study To compare mortality from neurodegenerative disease among Scottish former professional soccer players with that among matched controls from the general population.</td>
<td>Mortality with neurodegenerative disease.</td>
<td>Electronic health records for death certification and medication prescribed for treatment of dementia (databases of all Scottish professional soccer players)</td>
<td>15.4% any cause of death (controls: 16.5%) 1.7% neurodegenerative disease listed as primary cause of death (controls: 0.5%) 2.9% any neurodegenerative disease listed as primary or contributory cause of death (controls: 1.0) 2.3% dementia not otherwise specified listed as primary or contributory cause of death (controls: 0.8%) 0.8% AD listed as primary or contributory cause of death (controls: 0.2%) 1.6% non-Alzheimer’s dementias listed as primary or contributory cause of death (controls: 0.6) 0.3% motor neuron disease listed as primary or contributory cause of death (controls: 0.1%) 0.4% PD listed as primary or contributory cause of death (controls: 0.2%)</td>
</tr>
<tr>
<td>Prien et al, 2020 (Germany)</td>
<td>n=66 G=female A=37.4 (SD 4.8) C=11.0 (SD 4.8) R=8.6 (SD 4.4)</td>
<td>Case-control study To compare neurocognitive performance, cognitive symptoms and mental health of retired elite female football players compared with an age and sex matched control group of retired elite non-contact sport athletes.</td>
<td>Neurocognitive performance</td>
<td>Computerised test battery CNSVS and four written tests</td>
<td>63.6% minor to severe memory problems (controls: 40.0%)</td>
</tr>
<tr>
<td>Sortland and Tysvaer, 1989 (Norway)</td>
<td>n=33 G=male A=52 C=not provided R=18 (6-39)</td>
<td>Cross-sectional study To investigate neuroimaging findings in a group of retired male professional footballers.</td>
<td>Brain atrophy, macroscopic brain injury</td>
<td>CT brain</td>
<td>27% widened ventricles 18% cortical atrophy by visual grading 33% atrophy (11 players; five purely central, 4 central and cortical, 2 purely cortical) 18.2% showing an EI higher than 0.32 33.3% showing an EI equal to or higher than 0.30 63.6% MFH exceeding the upper range of normal 78.8% exceeding normal values of median HI 0% exceeding normal 3V values. three players aged 54–66 Moderate cerebellar atrophy two players (59 and 66 years of age) septum pellucidum cyst</td>
</tr>
<tr>
<td>Vann Jones et al, 2014 (UK)</td>
<td>n=92 G=male A=67.45 (SD 6.96) C=13.84 (SD 4.67) R=not provided</td>
<td>Cross-sectional study To investigate the hypothesis that chronic low-level head trauma is associated with persistent cognitive decline.</td>
<td>MCI</td>
<td>TYM questionnaire</td>
<td>10.87% screened positive for possible MCI</td>
</tr>
</tbody>
</table>

A, age; AD, Alzheimer’s disease; BFI, bifrontal cerebroventricular index; BW, transverse width of the brain; BW, transverse width of the brain; CD, duration of career; CS, maximum width of cortical hemisphere sulci; EI, Evans Index; G, gender; HI, Hukkman Index; LSC, left septum caudate distance; MCI, Mild cognitive impairment; MFH, maximum bilateral width of frontal horns; MFH, maximum bilateral width of frontal horns; N/n, number of participants; PD, Parkinson’s disease; R, duration of retirement; RSC, right septum caudate distance; TYM, Test Your Memory; 3V, width of third ventricle.
in sports medicine research where females are underrepresented. There is increasing professionalism and interest in women’s football, and efforts should be made to better understand sex-specific issues experienced by retired female professional footballers.

Additional studies which focus on assessing the presence of OA in retired female professional footballers are required, and the impact this has on quality of life and other important health outcomes may be needed. No studies were identified which assessed the prevalence of hip OA in female athletes, and this may provide useful insight. It is likely that the type of frequency and timing of mental health symptoms faced by retired female professional footballers differs from that of males, and subsequently this may influence the approach to provision of mental health support for females during and after their careers. Only one study included in this scoping review explored mental health symptoms in retired professional female footballers, and the findings from this study warrant further investigation.

There is emerging evidence to suggest women are more at risk of concussion than men, and that current gender-neutral return to play guidelines may not sufficiently consider gender differences. Additionally, women are believed to be more at risk of neurocognitive disease than men. With this in mind, urgent studies are required to assess the risk of neurocognitive disease in retired female footballers and to improve the management of concussion in the Women’s game.

Last, there is a better understanding of the relationship between menstrual cycle and performance in female footballers. Our search could not identify any studies which examined the effects of a career in football on long-term reproductive health, and future studies of this nature may provide useful information which can improve the health of female footballers during and after their career.

Duty of care and after career consultation

Our scoping review does provide insights into health conditions encountered by retired professional footballers which may pave the way for interventions during and after a player’s career in order to mitigate risk. Through understanding the common health conditions encountered by professional footballers in retirement, we may be better placed to intervene proactively during and after their career. The specific interventions which may benefit retired footballers has yet to be established, although they may include initiatives such as improvements in the management of concussion, injury prevention programmes, workload monitoring and a better understanding of surgical options for injuries during a player’s career. A wide range of stakeholders have a duty to protect the long-term health of footballers, and this can likely be achieved without detracting from the spectacle of football.

Plausible interventions for retired players after their careers may include lifestyle education (eg, for improved mental and cardiovascular health) or the GLA:D programme for OA. There are growing calls for footballers to undergo a formal process on retirement in order to identify current health issues, signpost them to available resources and mitigate risk against future disease. Recently, an after career consultation (ACC) was developed in order to empower the sustainable physical, mental and social health and the quality of life of retired professional footballers. The ACC focusses on (among other aspects) musculoskeletal health, mental health, cardiovascular health and neurocognitive health. This review has identified that mental health problems such as anxiety and depression are as common among retired footballers as in the general population. However, retired footballers may be more at risk of issues during the transition to retirement which suggest that the timing of the ACC may be important. Through proactive support and intervention, the effects of a high prevalence of OA and pain medication usage among retired professional footballers may be reduced. It would also provide an opportunity for retired footballers to discuss any concerns they may have with respect to their long-term neurocognitive health. The ACC has primarily been developed for retired male professional footballers, and this review has highlighted that despite the limited research into retired female professional footballers, a female-specific protocol is warranted.

Strengths and limitations

This is the first scoping review to investigate the common health conditions encountered by retired professional footballers. Studies were included from 16 different countries, which indicates the limited breadth of the available data. Socioeconomic and cultural factors are likely to influence health outcomes for retired professional footballers, and in this context, studies performed in retired professional footballers from a broader range of countries would deliver a more accurate impression of the health conditions experienced by retired professional footballers. This, in turn, may improve the specificity of the health guidance that retired professional footballers receive.

The health categories emphasised during this review were chosen in order to ensure the most frequent conditions associated with retired football players were captured, although it is not unreasonable to consider that other categories or subcategories may have been worth exploring (eg, problem gambling). Given the composition of the research team, it was decided that only studies written in English, Dutch or French would be included for analysis. The impact of such language exclusion, and the omission of grey literature, is that the number of potentially excluded but relevant publications is estimated, but not known.

Scoping reviews do not formally assess the methodological quality of individual studies, and the risk of bias was not appraised systematically in this review. The interpretation of studies and their significance was assessed according to the expertise of the authors for discussion. The impact of...
this approach is that caution should be exercised when interpreting the significance of the incidence and prevalence of the included studies, as their reported rates may not be truly reflective of health conditions among retired professional footballers. A high number of studies included in this review were cross-sectional in nature, which makes interpreting the temporal relationship between exposure and health outcomes difficult. The definition of ‘professional footballer’ may have differed between studies, and not all studies included key data such as duration of career and time since retirement. Additionally, there were little data provided on playing positions, nationalities, career earnings or ethnicity—all of which may have provided improved insight into the findings. Small sample sizes and poorly matched control groups in some studies may have introduced potential errors in interpretation.

Future research examining health conditions among retired male and female professional footballers should include relevant injury history, career duration, time since retirement, playing position as well as any socioeconomic factors which may confound the findings (eg, current occupational status). A consistent definition of ‘professional footballer’ in studies is also required, for example, a retired professional footballer is defined as an individual who is remunerated for devoting several hours in all/most days (exceeding the time allocated to other types of professional or leisure activities) to playing football, and in which they competed in the highest or second highest national league.

CONCLUSION
A career in professional football is likely to confer long-term health benefits associated with physical activity. This scoping review, the first of its kind, has highlighted that musculoskeletal and neurocognitive conditions are relatively prevalent among retired professional footballers. Additionally, mental health symptoms exist among retired professional footballers, and they may be more vulnerable during the transition to retirement. Very few studies exist exploring health outcomes in retired female professional footballers, and considering the rapid growth in participation and interest in women’s football, efforts should be made to understand long-term health outcomes for female footballers. A wide range of stakeholders have a duty to protect the long-term health of professional footballers during and after their career. Potential interventions during a player’s career may include injury prevention measures, improved concussion care, better surgical decision-making and workload monitoring.

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Contributors All authors contributed to this manuscript. KA developed the search strategy in conjunction with VG and SC. SC wrote the initial draft of the manuscript, with AM, KA, GK and VG all contributing to subsequent iterations. The final manuscript was agreed and approved by all authors prior to submission.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

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REFERENCES


APPENDIX

Search Strategy Pubmed:
#1: “Soccer”[Mesh] OR Football*[tiab] OR Soccer*[tiab]
#2: “Retirement” [Mesh] OR Retire*[tiab] OR Former*[tiab]
#7: #1 AND #2 AND (#3 OR #4 OR #5 OR #6)

Search Strategy SPORTDiscus
S1: TI(Soccer OR Football*) OR AB(Soccer OR Football*)
S2: TI(Retire* OR Former) OR AB(Retire* OR Former)
S3: TI(Musculoskeletal OR Muscle OR Bone OR Tendon OR Ligament OR Cartilage OR Joint OR Osteoarthritis OR OA) OR AB(Musculoskeletal OR Muscle OR Bone OR Tendon OR Ligament OR Cartilage OR Joint OR Osteoarthritis OR OA)
S4: TI(Cardiovascular OR Heart OR Blood OR Vein OR Vessel OR Artery OR Capillary OR Cardio OR Coronary OR Arrhythmia OR Cardiac) OR AB(Cardiovascular OR Heart OR Blood OR Vein OR Vessel OR Artery OR Capillary OR Cardio OR Coronary OR Arrhythmia OR Cardiac)
S5: TI(Mental OR Cogniti* OR Psychological OR Neurocogniti* OR Neuropsychological OR Neurological OR Brain) OR AB(Mental OR Cogniti* OR Psychological OR Neurocogniti* OR Neuropsychological OR Neurological OR Brain)
S6: TI(Reproduc* OR Menstrua* OR Fertil* OR Ovulation OR Menarch OR Pregnan* OR Amenorrhea OR Oligomenorrhea OR Estrogen OR Oestrogen OR Menses OR Menorrhrea OR Folic* OR Luteal) OR AB(Reproduc* OR Menstrua* OR Fertil* OR Ovulation OR Menarch OR Pregnan* OR Amenorrhea OR Oligomenorrhea OR Estrogen OR Oestrogen OR Menses OR Menorrhrea OR Folic* OR Luteal)
S7: S1 AND S2 AND (S3 OR S4 OR S5 OR S6)

Search Strategy EMBASE
#1: soccer OR football*
#2: soccer OR football* (Title or Abstract)
#3: retirement OR retire* OR former
#4: musculoskeletal system OR musculoskeletal disease OR tendon OR bone* OR muscle OR ligament OR cartilage OR joint OR osteoarthritis OR OA
#5 cardiovascular system OR cardiovascular diseases OR cardiovascular OR heart OR blood OR vein OR capillary OR cardiac OR arrhythmia OR vessel OR coronary OR cardio*
#6 Mental Disorders OR Mental Processes OR Cogniti* OR Psychological OR Neurocogniti* OR Mental OR Brain OR Neuropsychological OR Neurological OR Mental health
#7 Reproductive Physiological Phenomena OR Reproduct OR Menstrua* OR Fertil* OR Ovulation OR Menarche OR Pregnan* OR Amenorrhea OR Oligomenorrhea OR Estrogen OR Oestrogen OR Menses OR Menorrh* OR Folic* OR Luteal
#8: #1 AND #2 AND #3 AND (#4 OR #5 OR #6 OR #7)