

# National health registries in professional German football: development and first results from the men's and women's 1st and 2nd Bundesliga

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**To cite:** Huber L, Szymiski D, Krutsch W, *et al*. National health registries in professional German football: development and first results from the men's and women's 1st and 2nd Bundesliga. *BMJ Open Sport & Exercise Medicine* 2026;**12**:e003003. doi:10.1136/bmjsem-2025-003003

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Accepted 19 March 2026



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## ABSTRACT

**Objectives** Long-term, nationwide data on injuries and illnesses in professional football, particularly in women, remain limited. This study aimed to describe injury and illness epidemiology in German professional male and female football using prospective registry data, with a focus on incidence, distribution, and return-to-play times and on sex-specific differences.

**Methods** Two prospective registries were introduced in the first and second divisions of German professional football (men: 2022/2023, women: 2023/2024). Team medical staff reported all time-loss injuries and illnesses using a standardised, pseudonymised protocol on an online platform. Data included diagnosis, injury mechanism and return-to-play data. Injury and illness match incidence was calculated per 1000 hours of match exposure.

**Results** A total of 1514 players (963 men, 551 women) from 54 teams participated. During the first season, 1185 time-loss events were recorded (men: 503 injuries, 176 illnesses; women: 362 injuries, 144 illnesses). In men, the most affected areas were the thigh, ankle and knee, whereas in women, injuries predominantly affected the knee, followed by the ankle and thigh. Ankle sprains were the most frequent injury type in both sexes. ACL ruptures were associated with the longest return-to-play times, particularly in female players. Illnesses caused 3188 absence days in total, mainly due to respiratory infections.

**Conclusion** The registries reveal clear sex-specific differences in injury distribution and time-loss in German professional football and demonstrate a substantial burden of illness-related absence. These nationwide data provide a foundation for longitudinal monitoring and future research on sex-specific prevention and return-to-play strategies.

## INTRODUCTION

Football is a sport with one of the highest incidences of injuries in male and female players, especially in professional athletes.<sup>1</sup> Hägglund *et al* reported an incidence of 28.1 injuries per 1000 hours of match exposure

## WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Injury surveillance in professional football has mainly focused on international competitions, including international club matches and national team tournaments such as World Cups and European Championships.
- ⇒ Previous studies have already shown differences in injury patterns between male and female players.
- ⇒ To date, there are no national, longitudinal data collections for injury and illness in both sexes in any professional European football league.

## WHAT THIS STUDY ADDS

- ⇒ We were able to establish the first nationwide health registries on injuries and illnesses in professional football across both sexes.
- ⇒ These registries identify sex-specific differences in injury types, locations and return-to-play dates.
- ⇒ The study highlights the underestimated role of illnesses as a cause of time loss in professional football.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ Evidence-based, sex-specific prevention strategies in professional football can be funded on the results of these long-term registries.
- ⇒ Supports the development of guidelines for medical care, monitoring and return-to-play protocols.

and 4.7 per 1000 hours of training exposure in male football.<sup>1</sup> For female players, a rate of 16.1 during match and 3.8 during 1000 hours training exposure was reported in the same season report. In both sexes, muscle strains and ligament sprains represent the most common injury types.<sup>1</sup> However, existing reports largely provide short-term, seasonal data, while longitudinal injury surveillance at the national league level remains limited.<sup>1–4</sup> Although comprehensive longitudinal

data are available for international competitions, their applicability to domestic league settings is restricted. Differences in match exposure, international duties and medical support structures limit the transferability of international injury data to national league settings and highlight the need for national registries.<sup>5–7</sup>

Besides the analysis of injuries, illnesses are also responsible for a high number of time-loss incidents in football.<sup>8,9</sup> While the focus of scientific literature is mainly on injury prevention, the research on illnesses in professional football is lacking evidence.<sup>10</sup>

The advantages of a longitudinal data surveillance are a detailed analysis of injury and illness priorities, as well as monitoring of rule changes and unexpected events on players' health. A longitudinal registry on injuries and illnesses in football offers a holistic database on players' health to identify players and situations at risk and to prevent time-loss injuries and illnesses of players.<sup>11,12</sup>

Therefore, this study aimed to describe the epidemiology of injuries and illnesses in German professional male and female football based on nationwide prospective registry data, and to compare injury patterns and time-loss characteristics between sexes.

## METHODS

These prospective health registries capture all acute and chronic injuries as well as other medical reasons for absences (eg, illnesses) in the first two leagues of professional male and female football in Germany. The design, objectives and methodology of the registries are explained to participating clubs and team physicians at the beginning of each season. At the end of each season, participating teams receive anonymised summaries of their injury statistics.

### Objectives

The objective of the present analysis was to provide a descriptive epidemiological assessment of time-loss injuries and illnesses in German professional male and female football using prospective registry data. Specifically, the analysis focused on injury and illness incidence, anatomical distribution, injury types, mechanisms and return-to-play (RTP) durations, including comparisons between sexes.

### Data collection and documentation

Registry data are collected and managed using the Research Electronic Data Capture (REDCap) system,<sup>13,14</sup> which is hosted locally at the data centre of the University Hospital Regensburg. Baseline data, as well as player-specific and season-specific master data, are curated by the data centre and study office. These data include age, anthropometric characteristics, playing position, league affiliation and season of participation. The data centre is responsible for data management, pseudonymisation, consistency checks and linkage of injury and illness reports across seasons. The data centre also generates and assigns a pseudonymised identifier (Player ID) to

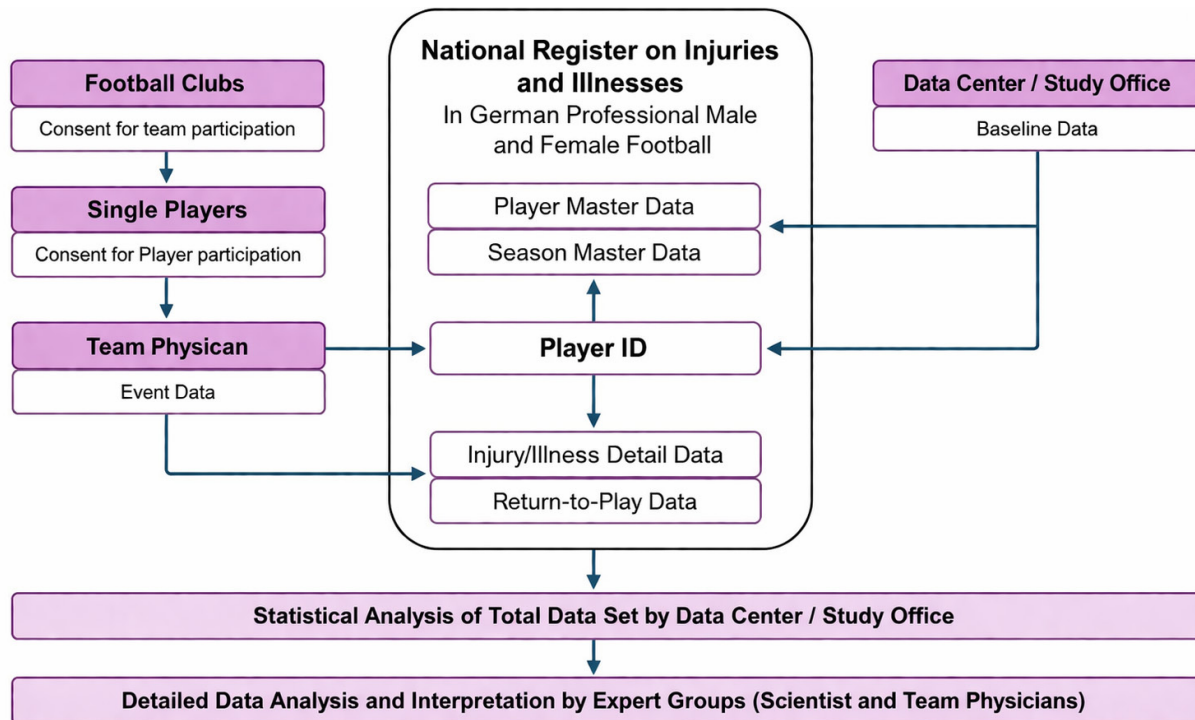
each player, which is then provided to the team physicians. In the event of a time-loss injury or illness affecting a team player, team physicians are responsible for submitting detailed reports, including both the initial injury/illness information and subsequent RTP data. Injury and illness reports are submitted monthly via a secure, web-based data entry interface (figure 1). In cases of delayed or missing submissions, the study team issues regular reminders by email or telephone. Data entry remains possible at later stages. However, submissions are closed 1 month after the end of the respective season.

Aggregated data are exported on a seasonal basis, and a comprehensive longitudinal dataset is compiled for statistical analysis conducted by the data centre and study office.

### Study data report protocols

For the online data collection, special electronic data entry forms with predefined input options were created. For the most common injury regions (eg, head, knee, ankle/foot and muscle injuries), injury-specific electronic data entry forms with predefined fields were used to facilitate structured documentation. Less frequent injuries were recorded using a general injury form. All illnesses were documented using a standardised illness-specific form. All form types captured an identical core dataset, including diagnosis, injury mechanism, context (match or training) and RTP information.

All injury and illness records are linked to a pseudonymised player-specific identifier (Player ID). This allows longitudinal follow-up of individual players across multiple seasons and across different clubs within the participating professional leagues, enabling the analysis of repeated injuries and illness-related time loss over time. Each data entry form contains item fields for the exact diagnosis, the type of injury, contact behaviour (direct, indirect, non-contact), the circumstances of the event (match/training, minute of play, body movement, foul, etc), as well as diagnostics and therapy. Diagnostic procedures included clinical examination and imaging where indicated. Treatment was categorised as conservative or surgical. Conservative treatment comprised physiotherapy, load modification, medication and injection therapy, whereas surgical treatment referred to operative interventions for the respective injury or condition, as reported by the team physicians. RTP was recorded as an outcome measure and defined as the date of medical clearance for full participation in team training and match play. RTP data were reported by the team physicians during follow-up of each injury or illness, in accordance with established consensus definitions. Acute injuries were defined as those with sudden onset due to a specific precipitating event, while chronic injuries were defined as those developing gradually over time from repetitive stress or overuse.<sup>15,16</sup> The data entry forms are identical for both the men's and women's registries to ensure optimal comparability between the sexes. However, additional items on the menstrual cycle



**Figure 1** Flow chart of study protocol.

and hormonal contraception were implemented in the women's registry.

The injury reports were adapted according to the commonly used injury report protocol in football established by Fuller *et al*<sup>17</sup> and the IOC Consensus Statement on methods for recording and reporting of epidemiological data on injury and illness in sport.<sup>18</sup>

### Data protection

Anthropometric and football-specific data are stored separately from injury data to prevent reverse identification of individuals. The data collection is performed using player codes accessible only to the respective team physicians. This pseudonymisation ensures that neither uninvolved parties nor other participating teams can trace data back to individual players. Data processing and analysis are conducted on aggregate data sets to ensure confidentiality. The registries are managed and analysed at the University Hospital Regensburg under strict adherence to confidentiality agreements and medical confidentiality regulations.

### Legal considerations

The study excludes vulnerable populations and ensures that personal data, such as names, anthropometric details and birthdates, are stored separately. All project staff handling data are bound by confidentiality and data protection laws. Data analysis is conducted exclusively by the study centre and clinical researchers bound by medical confidentiality. Results are published in a manner that ensures no identification of individuals or

clubs is possible. No conflicts of interest are reported by study personnel involved in the registries' execution.

### Statistical analysis and data assessment

Categorical data are expressed as frequency counts (percentages) and continuous data as mean±SD. Proportions between groups were compared with Fisher's exact test and continuous variables with the t-test. Match exposure data were obtained directly from official match statistics for all players. Injury and illness match incidence rates were calculated per 1000 hours of match exposure. Incidence rates are reported with 95% CI.

The study office used the REDCap system for data management and IBM SPSS Statistics, V.28.0, for data analysis.

### Equity, diversity, and inclusion statement

Our study was on both male and female football players in Germany. The research team included eleven men, who are early career (two) and senior (nine) researchers. The authors' disciplines include orthopedics, trauma, sports medicine, and biometric sciences.

### RESULTS

In the first season of data collection, 33 male teams and 21 female teams participated in the registries. This corresponds to 91.7% of all eligible clubs in the first and second divisions of German professional male football and 80.8% of all eligible clubs in female professional football. In total, 54 professional teams comprising 1514 players were enrolled. Across both cohorts, 1185 time-loss

**Table 1** Anthropometric data of included players

	Male	Female
Study population	963	551
Age in years	25.6±4.3	22.5±4.2
Weight in kg	80.2±6.3	62.9±5.3
Height in cm	184.6±6.3	165.3±26.4
Player position, n (%)		
Goalkeeper	102 (10.6)	53 (9.6)
Defender	387 (40.2)	166 (30.0)
Midfield	337 (35.0)	223 (40.4)
Forward	137 (14.2)	109 (19.6)
Level of play, n (%)		
1st division	474 (49.2)	255 (46.3)
2nd division	489 (50.8)	296 (53.7)

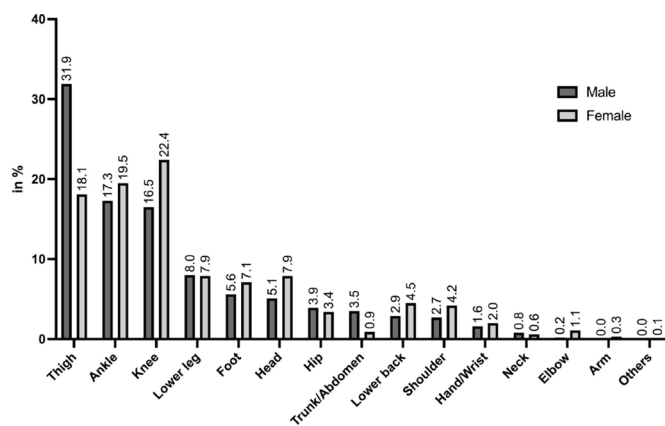
Data show mean±SD or absolute frequencies (%).

events were reported. These included 503 injuries and 176 illnesses in male football, and 362 injuries and 144 illnesses in female football. Player anthropometric characteristics are summarised in [table 1](#).

In male professional football, the most frequently injured body regions were the thigh (31.9%), ankle (17.3%) and knee (16.5%). In contrast, in female professional football, the knee was the most commonly affected region (22.4%), also followed by the ankle (19.5%) and thigh (18.1%) ([figure 2](#)).

The most frequent injury in male professional football in Germany was ankle sprains with an incidence of 3.16 per 1000 hours match exposure and a mean time-loss of 7.3 days. The longest RTP period within the ten most frequent injuries in male players was demonstrated after collateral ligament ruptures in the knee, with 38.2 days, while an incidence of 1.14 per 1000 hours match exposure was reported for this injury type ([table 2](#)).

In female professional football, ankle sprains also represented the most common injury, occurring at a rate of 2.56 per 1000 hours of match exposure and resulting

**Figure 2** Injured body regions in male and female football.

in an average time-loss of 36.4 days. The following injury, the ACL rupture, also showed an incidence of 2.56 per 1000 hours of match exposure and the longest RTP times with 392.8 days ([table 3](#)).

Injury mechanisms did not show significant sex differences regarding direct contact, indirect contact and non-contact injuries. Due to their mechanical characteristics, head injuries are predominantly caused by direct contact. Muscle injuries are typically non-contact injuries in both male and female athletes. Knee injuries are also largely classified as non-contact injuries; however, they tend to occur without contact slightly more frequently in female athletes compared with their male counterparts ([figure 3](#)).

Illnesses were responsible for 3188 days of overall time loss in male and female football, representing approximately one-eighth of the overall time loss in both sexes. Most common illnesses in male football were respiratory infections (without COVID-19) with 119 cases per season and an incidence of 8.00 per 1000 hours match exposure resulting in a time loss of mean 11.8 days. In female football, respiratory infections other than COVID-19 were also the most common, with 85 cases per season and an incidence of 8.37 per 1000 hours match exposure. They resulted in an average time loss of 10.5 days. Across both registries, COVID-19 infections were associated with longer RTP times than other respiratory infections. Detailed information on illness categories and absence durations is summarised in [tables 4](#) (male) and [5](#) (female).

## DISCUSSION

This prospective study on injuries and illnesses in male and female professional football in Germany establishes the first national health registries of this kind in professional sports. During the first season, a total of 1185 time-loss incidents were recorded in both registries, providing key insights into common causes of absence among professional athletes. While ankle sprain was the most frequent injury for both sexes, in female football, injuries of the knee were predominant, while in male football, in particular, injuries of the thigh muscles were reported.

The registries include all time-loss events—whether due to injury or illness—among all male and female professional players, offering unique insights into sex-specific patterns and characteristics in football-related health issues. By employing this longitudinal approach, trends in injuries and illnesses can be identified, and targeted prevention strategies can be developed.<sup>12</sup> Moreover, the effects of rule changes or medical interventions on time-loss incidents can be systematically evaluated.<sup>19–21</sup>

While the UEFA Elite Club Injury Study provides an established framework for international injury surveillance across European elite clubs, it does not fully capture the national context, including the specific league structures and medical conditions within a national championship.<sup>5 7 22</sup> Therefore, these national registries fill an

**Table 2** Most frequent injuries in male football

Most frequent injuries (sorted)	Cases per season	Incidence per 1000 hours match exposure (95% CI)	Return-to-play in days (mean±SD)
Ankle sprain	47	3.16 (2.26 to 4.06)	7.3±59.4
Muscle strain dorsal thigh	27	1.82 (1.13 to 2.51)	10.3±12.0
Muscle fibre rupture dorsal thigh	21	1.41 (0.81 to 2.01)	26.6±15.2
Collateral ligament rupture ankle	18	1.21 (0.65 to 1.77)	20.7±11.4
Meniscus lesion knee	18	1.21 (0.65 to 1.77)	35.8±31.8
Collateral ligament rupture knee	17	1.14 (0.60 to 1.68)	38.2±112.2
Contusion ankle	17	1.14 (0.60 to 1.68)	5.4±3.4
Muscle fibre rupture ventral thigh	17	1.14 (0.60 to 1.68)	20.9±12.6
Knee sprain	16	1.08 (0.55 to 1.61)	28.0±34.6
Muscle strain ventral thigh	13	0.88 (0.40 to 1.36)	10.2±8.2

important gap by providing comprehensive data specific to the German professional football environment.

Further studies in football often focus on seasonal reports or short-term observations. For instance, the Dutch cohort study by Stubbe *et al* reported injury patterns among professional male footballers, highlighting high rates of ankle and muscle injuries.<sup>3</sup> Similarly, the women's football review by Horan *et al* underlined a notable burden of ligamentous injuries.<sup>4</sup> However, these seasonal reports often lack longitudinal tracking and cross-comparisons between male and female cohorts remain limited. The UEFA Men's and Women's Elite Club Injury Studies introduced longitudinal study designs on an international scale, but national-level data that consider domestic league structures and sex-specific differences are still rare.<sup>5-7</sup> Additionally, the foundational 'sequence of prevention' outlined by van Mechelen *et al* emphasises the necessity of longitudinal data collections in order to develop targeted prevention measures.<sup>12</sup> Our registries close this gap by offering comprehensive, national, long-term data for both sexes and thus provide the foundation for the development of targeted prevention approaches.

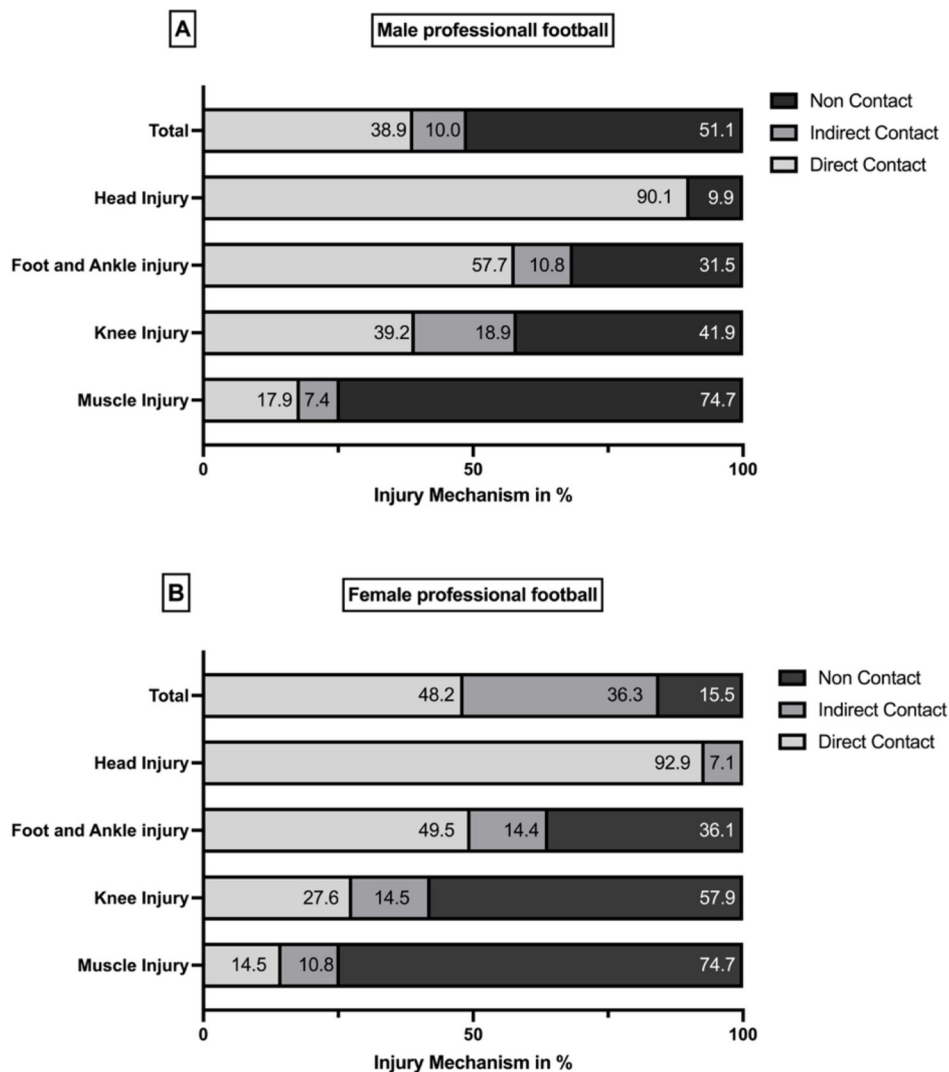
### Male versus female in football and literature

Sex-specific injury characteristics have gained increased attention over recent years. Several studies report that female players are more susceptible to ACL injuries, while male athletes more commonly sustain hamstring injuries.<sup>4 6 7</sup> This aligns with our registry findings, where ACL ruptures in female players represented the most burdensome injuries (392.8 days of time-loss). Hormonal, biomechanical and neuromuscular differences have been suggested as contributing factors.<sup>2 4 7 23</sup> Conversely, posterior thigh injuries, predominantly muscle fibre ruptures and strains, were more frequent in male players, especially during high-speed actions and in tackling situations, which is consistent with the data from Klein *et al*.<sup>24</sup>

Overall, it was also demonstrated that female athletes tend to require a longer period of absence before returning to sport. This trend was observed irrespective of the type of injury. The RTP durations in male athletes were comparable to data reported in the literature,<sup>20 25</sup> whereas female athletes showed significantly longer RTP

**Table 3** Most frequent injuries in female football

Most frequent injuries (sorted)	Cases per season	Incidence per 1000 hours match exposure (95% CI)	Return-to-play in days (mean±SD)
Ankle sprain	26	2.56 (1.58 to 3.54)	36.4±31.8
ACL rupture	26	2.56 (1.58 to 3.54)	392.8±179.8
Knee sprain	18	1.78 (0.96 to 2.60)	38.6±37.6
Contusion ankle	16	1.58 (0.81 to 2.35)	19.7±15.3
Collateral ligament rupture ankle	16	1.58 (0.81 to 2.35)	31.6±33.3
Concussion	13	1.28 (0.57 to 1.99)	12.7±9.2
Meniscus lesion knee	12	1.19 (0.52 to 1.86)	305.3±420.4
Contusion head	11	1.09 (0.45 to 1.73)	11.6±10.4
Contusion foot	10	0.99 (0.38 to 1.60)	28.0±24.2
Muscle strain ventral thigh	10	0.99 (0.38 to 1.60)	11.3±4.9



**Figure 3** Injury mechanism by injury types in male (A) and female (B) football.

times, especially when compared with the UEFA Women's Elite Club Injury Study.<sup>7</sup>

Sex-specific differences in RTP may be confounded by injury severity and by structural differences in medical and rehabilitation support between men's and women's professional football, which may influence clinical decision-making and clearance timing.

Importantly, our inclusion of menstrual cycle tracking in the female cohort enables future studies to investigate hormonal injury correlations, an area previously under-represented in injury research.<sup>7 10</sup> These findings are

further supported by recent biomechanical analyses of ACL injury mechanisms in female players<sup>19</sup> and meta-analyses on injury prevalence across sexes.<sup>20</sup>

### Clinical aspects and future

With these registries, the epidemiology of injury and illness in elite football at the national level can be investigated, and, based on this data, prevention strategies for both male and female athletes can be derived. The registries provide clinical utility by identifying high-risk injury patterns and enabling the development of targeted

**Table 4** Most frequent illnesses in male football

Most frequent illness (sorted)	Cases per season	Incidence per 1000 hour match exposure (95% CI)	Return-to-play in days (mean±SD)
Respiratory infection (without COVID-19)	119	8.00 (6.56 to 9.44)	11.8±21.4
COVID-19 infection	34	2.29 (1.52 to 3.05)	22.5±64.7
Gastrointestinal infection	19	1.28 (0.71 to 1.85)	23.8±42.8
Other illness	15	1.01 (0.50 to 1.52)	16.7±37.7

**Table 5** Most frequent illnesses in female football

Most frequent illness (sorted)	Cases per season	Incidence per 1000 hours match exposure (95% CI)	Return-to-play in days (mean±SD)
Respiratory infection (without COVID-19)	85	8.37 (6.79 to 10.32)	10.5±13.6
COVID-19 infection	22	2.17 (1.36 to 3.28)	21.0±52.2
Gastrointestinal infection	19	1.87 (1.13 to 2.92)	3.5±1.7
Other illness	18	1.77 (1.05 to 2.80)	40.7±68.9

prevention strategies. For instance, the data support refinement of neuromuscular training programmes to address non-contact knee and thigh injuries, which are highly prevalent in both sexes.<sup>6 7 26–28</sup> Furthermore, understanding illness patterns—especially respiratory infections—can influence medical protocols for hygiene, rest management and RTP decisions, as required during the COVID-19 pandemic to resume play.<sup>10 21 29 30</sup>

The standardisation and pseudonymisation of data collection through REDCap ensure data security and comparability, laying the groundwork for multi-centre collaborations across Germany.

### Limitations

In addition to its numerous benefits, the methodology of these national registries also has certain limitations due to their study design. Data on injuries and illnesses were collected through reports from team physicians or other members of the clubs' medical staff. As with other registries, the quality of the data depends on the accuracy and completeness of the reporting. To minimise weak or incomplete reports, we provided individualised injury summaries to all teams as a feedback mechanism. Furthermore, the mechanisms and circumstances of injuries are reported by the medical team and may differ from the players' perspectives or from video analysis. However, the primary aim of the registries is not to detail injury mechanisms, but rather to provide comprehensive data on the epidemiology, rehabilitation and treatment of injuries and illnesses in order to support the prevention of time-loss incidents. Video-based investigations are conducted by a separate study group within the overall registry project and will be reported elsewhere.

Although participation rates were high, with more than 90% of eligible clubs in male professional football and more than 80% in female professional football taking part, not all teams were included. This may have introduced a degree of selection bias. However, non-participation was mainly due to organisational reasons and not related to injury or illness occurrence and is therefore unlikely to have substantially influenced the descriptive epidemiological findings.

In addition, injuries and illnesses may cluster within teams due to shared training, match exposure and medical practices. As no cluster-adjusted analyses were performed, this should be considered when interpreting comparisons between groups.

No external validation using media-based databases was performed, as such sources have been shown to reliably capture mainly severe injuries, while minor time-loss injuries and illnesses are frequently under-reported.<sup>31</sup>

### CONCLUSION

These nationwide registries provide the first comprehensive data on injuries and illnesses in German professional football across both sexes. The findings demonstrate sex-specific differences in injury patterns and RTP times and highlight the substantial contribution of illnesses to time loss. The registries provide a foundation for longitudinal monitoring and future targeted prevention strategies.

**Acknowledgements** We gratefully acknowledge the financial and organisational support provided by the Deutsche Fußball Liga GmbH (DFL) and the Verwaltungs-Berufsgenossenschaft (VBG), which made the realisation of this study possible. We also wish to thank our scientific partners for their valuable expertise and guidance throughout all phases of the study. Furthermore, we would like to express our gratitude to all participating clubs and their medical teams for their voluntary involvement in this project, as well as for the time invested and their strong commitment.

**Contributors** Conceptualisation: WK, DS, LH; data curation and investigation: LH, DS, GH; formal analysis: LH, DS, FZ; all authors validated the analysis; project administration: VA; supervision: VA, WK, MP, CK; writing—original draft: LH, DS; writing—review and editing: all authors. All authors read and approved the final manuscript. LH and DS are the guarantors of the manuscript.

**Funding** We have received funding for this project by the Verwaltungs-Berufsgenossenschaften (VBG) for the male Bundesliga registry and the female health registry in football and from the Deutsche Fußball Liga GmbH (DFL) for the male Bundesliga registry.

**Competing interests** The authors declare that they have no conflicts of interest to declare.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**Patient consent for publication** Not applicable.

**Ethics approval** This study involves human participants and was approved by the Ethics Committee of the University of Regensburg (ID: 22-2919\_1-101). Written informed consent was obtained from all participating players prior to inclusion in the registry.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** All data relevant to the study are included in the article or uploaded as supplementary information.

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