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Sports Injuries in Germany – A Pilot Study

Sportverletzungen in Deutschland – Eine Pilotstudie

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Summary

- › **Problem:** Sports accidents are omnipresent in all areas of sport. However, due to a lack of data, conclusions cannot be drawn about how many sports accidents occur in Germany each year. This study aims to provide an initial overview of sports injuries and the types of sports involved, serving as a foundation for a larger survey.
- › **Methods:** From September 12th-16th, 2022, a representative survey was conducted via telephone (forsa.omniTel[†]), interviewing 2002 individuals in Germany aged 14 and older about their sports activities and injuries in the past 12 months. Results were analyzed using 95% confidence intervals (CI) and logistic regression to assess the impact of age and gender on injury probability ($\alpha=0.05$). The distribution of injuries across sports was calculated using an iterative proportional fitting method and Bonferroni correction for significance levels. The original document was internally reviewed, contains no personal data, and is approved for publication, with no further ethics committee review required, as forsa, a member of ADM, complies with all legal and ethical standards, including GDPR.
- › **Results:** It is estimated that 12.2% (CI=10.5 to 14.0%; CI_{adj}=9.8 to 14.7%) of athletes in Germany have been injured during sport in the past 12 months, requiring medical treatment or a break from sport. Younger and male athletes were more likely to be injured than older and female athletes (age: $p<0.001$, $p_{adj}<0.001$; gender: $p<0.001$, $p_{adj}<0.01$). Most injuries occurred during running/walking/hiking (16%) and cycling (14%). Soccer (11%) and tennis (4%) had the highest injury rates among sports games.
- › **Conclusion:** This pilot study offers crucial insights into sports injury prevalence in Germany. Future studies should include detailed injury types, severity and exposure times for more individualized preventive programs.

KEY WORDS:

Injury Prevalence, Epidemiology, Representative Survey, Self-Organized Sport, Club Sports

Introduction

The positive health benefits of sport and physical activity are undisputed (8, 11). However, sport can also have undesirable side effects, particularly sports injuries, which diminish the positive aspects of physical activity. A variety of prevention strategies are used to reduce the number and severity of injuries and thus increase the health benefits of physical activity. Measures to prevent sports injuries should be implemented as specifically as possible to maximize the benefits. To this end, it is necessary to record and analyze the frequency of injuries and their development mechanisms in different settings, populations and age groups (16).

In Germany, regular surveys and analyzes are carried out in selected areas. The VBG (Verwaltungs-Berufsgenossenschaft) collects annual data on sports accidents in mens' professional sports in the 1st and 2nd Bundesliga in basketball, ice hockey, soccer and handball (6). The incidence of sports accidents in non-professional club sports was re-

corded from 1987 to 2017 by the Department of Sports Medicine and Sports Nutrition at Ruhr University Bochum and ARAG (Allgemeine Rechtsschutz-Versicherungs-AG), with around 220.000 sports accidents (4). In addition, the DGUV (Deutsche Gesetzliche Unfallversicherung) collects data on sports accidents in school and university sports every year (2).

Henke et al. (3) were the first to estimate, based on various research projects, that around 2 million of the 36 million people in Germany (including pupils in school sports) who regularly take part in sport are injured every year.

Previous surveys on sports injuries in Germany are inadequate, as they are often based on unrepresentative and overlapping data or only focus on individual settings. The aim of this study is to provide a representative assessment of the prevalence of sports injuries across all settings and to identify the sports with the most frequent injuries.



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Table 1

Sample-based relative distribution of injured sports participants by gender, age and the top 4 accident sports. (*n=Observations in the sample).

	PERCENTAGE OF ALL INJURIES	MALE	FEMALE	14-29 YEARS	30-44 YEARS	45-59 YEARS	60+ YEARS	N. A.
Running/walking/ hiking	19.7% (n*=30)	50.0% (n = 15)	50.0% (n=15)	13.3% (n=4)	3.3% (n=1)	23.3% (n=7)	60.0% (n=18)	-
Cycling	18.4% (n=28)	82.1% (n=23)	17.9% (n=5)	3.6% (n=1)	21.4% (n=6)	21.4% (n=6)	50.0% (n=14)	3.6% (n=1)
Fitness/strength training	12.5% (n = 19)	73.7% (n=14)	26.3% (n=5)	31.6% (n=6)	21.1% (n=4)	36.8% (n=7)	10.5% (n=2)	-
Soccer	10.5% (n=16)	87.5% (n=14)	12.5% (n=2)	31.3% (n=5)	18.8% (n=3)	31.3% (n=5)	18.8% (n=3)	-
In total (Top-4)	61.1% (n = 93)	71.0% (n=66)	29.0% (n=27)	17.2% (n=16)	15.1% (n=14)	26.9% (n=25)	39.8% (n=37)	1.1% (n=1)
In total	100% (n=152)	68.4% (n=104)	31.6% (n=48)	23.7% (n=36)	16.4% (n=25)	27.6% (n=42)	31.6% (n=48)	0.7% (n=1)

Material and Methods

In the period from September 12th to 16th, 2022, forsa conducted a multi-topic survey (forsa.omniTel[®]) on behalf of the Ruhr University Bochum using computer-assisted telephone interviews (CATI) to ask 2002 German-speaking people aged 14 and over (female: n=973; male: n=1029; 14-95 years (\bar{x} =56 years; SD=18 years)) throughout Germany about their sporting activity and sports injuries in the last 12 months. The study was not subjected to any additional review by the local ethics committee, as forsa, as a member of the Arbeitskreis Deutscher Markt- und Sozialforschungsinstitute e.V. (ADM), is bound by the association's rigorous ethical and data protection standards. The sample is representative of this population (German-speaking people aged 14 and over living in Germany). For a representative sample, forsa uses a dual-frame method (landline and mobile numbers). The interviews took place on weekdays from 5:00 PM to 09:00 PM. Unreachable telephone numbers were contacted several times (up to ten contact attempts) at different times and days. The rolling sample design of forsa.omniTel[®] enables the selection of telephone numbers contacted for the first time and those already contacted several times on each day of the survey. Due to this design, there is no finalized gross sample, so it is not possible to calculate a response rate. Figure 1 provides an overview of the methodology.

In addition to the usual personal questions regarding age, gender, region, employment, highest educational qualification or net household income, questions were asked about sporting activity, the number of sports injuries and the type of sport practiced at the time of the accident. Participants were asked the following questions:

- 1) In the last 12 months, have you played one or more sports at least once in a while - whether as a recreational or competitive sport, alone or in a group, unorganized or, for example, as part of company sports, school sports, in a club or gym?
- 2) How often have you been injured during sport in the last 12 months so that you had to receive medical treatment or take a break from sport?
- 3) In which sport(s) have you injured yourself in the last 12 months?

The first two questions acted as filter questions, where the survey was cancelled if the first question was answered in the negative or if no sports injury was stated in the second question.

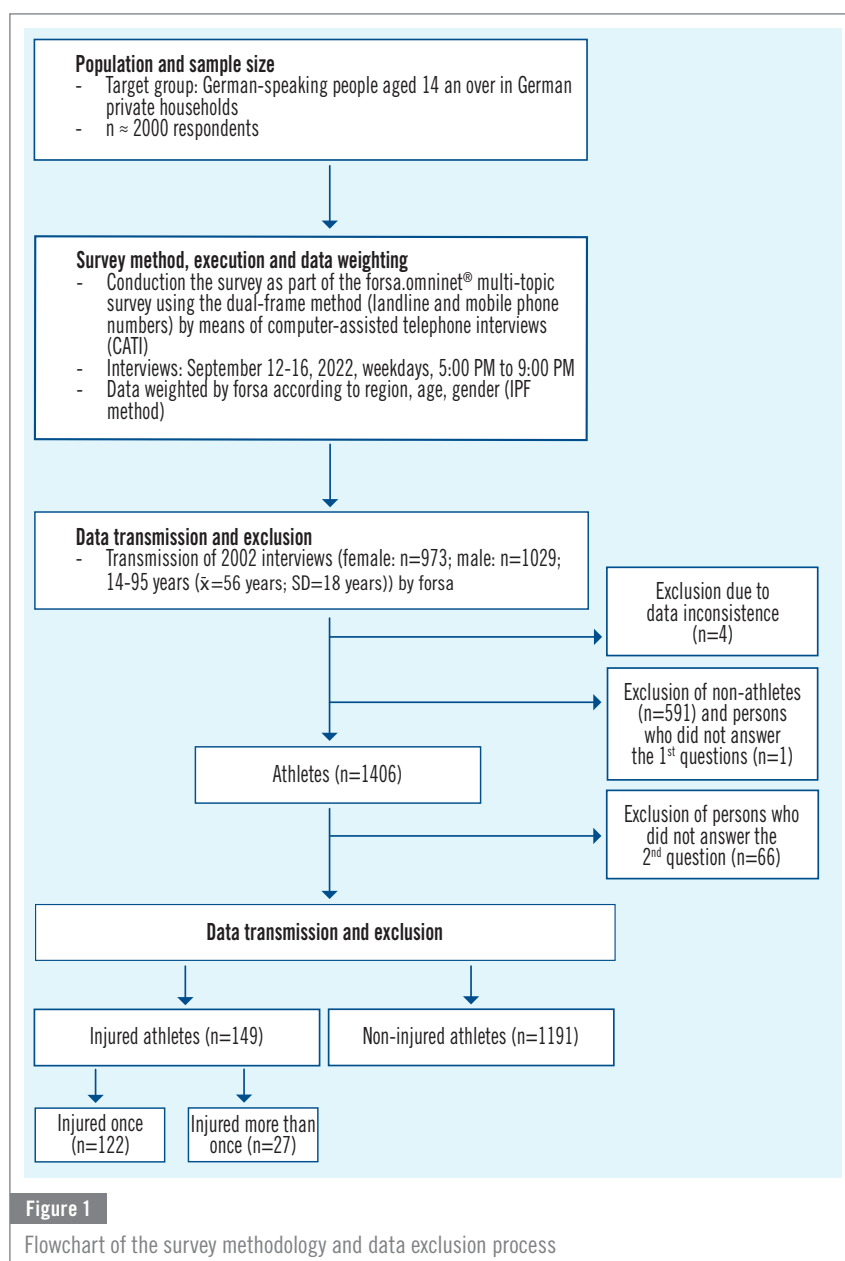
An approximate 95% confidence interval (CI) was used to calculate the number of athletes, the prevalence of injured athletes and the injury rates differentiated by age and gender (12). The weighting was based on age and gender. The calculation of prevalence was based on a total number of 56 million people aged 14 and over who play sport (77.8% of all people aged 14 and over) (14). This study included all people who had taken part in a sporting activity at least once in the last 12 months and were therefore exposed to a potential risk of injury. According to the VuMA Touchpoints survey 2023 (14), this includes every person who has been involved in sport at least infrequently.

In addition, the hypotheses were tested as to whether there is a correlation between gender and a sports injury and between age and a sports injury. The hypotheses were tested using logistic regression (Wald test). Odds ratios (OR) were calculated as a measure of effect sizes to analyze the influence of gender and age on the risk of sports injuries.

Due to the repeated application of CI and statistical significance tests, the significance levels ($\alpha=0.05$) were adjusted using the Bonferroni correction (CI_{adj} and p_{adj}). As part of the correction, a total of two statistical tests and seven CIs were taken into account. The seven CIs for sporting activity were not taken into account, as these were only set up descriptively for comparison with the VuMA Touchpoints survey and are therefore not essential for answering the primary research question and hypotheses.

The 20 most frequently occurring accident sports were recorded in the survey. All other sports were summarized under the category "other". For athletes who suffered injuries in different sports, each individually listed injury was categorized as a separate observation. This calculation is therefore based on a total of 152 observations for 149 injured athletes in the sample. The sports were weighted using the iterative proportional fitting method (IPF). The weightings, based on age, gender and region, were carried out by the market and opinion research institute forsa and made available to the authors exclusively for further calculations.

The statistical analyzes were carried out using the statistical software R (13). The graphical illustration was carried out using the OriginPro 2022 programme (10). >



Results

Four people from the sample size of 2002 respondents were excluded from the data analysis due to inconsistencies in their responses. Of the remaining 1998 people, a total of 1406 people (70%) had practiced one or more types of sport in the settings listed under question one (leisure, competitive sport, etc.) at least occasionally in the past 12 months (70% of all men and women, 89% of all people aged 14-29 years, 78% of all people aged 30-44 years, 76% of all people aged 45-59 years and 61% of all people aged 60 years and over) (see figure 1).

In the further analysis, all participants who had not been active in sports in the last 12 months (n=591) and those who did not respond to the first (n=1) or second question (n=66) were also excluded. Of the remaining 1340 participants, 122 people were injured once, 27 people more than once and 1191 people not at all during sporting activity in the reference year (see figure 1). Overall, 14% of all men, 8% of all women, 23% of all people aged 14-29, 11% of all people aged 30-44, 11% of all people aged 45-59 and 8% of all people aged 60 and over were injured at least once during sporting activities.

The third question relating to the type of accidental sport was designed as a filter question and was only asked of those who had suffered a sports injury (n=149). Among these respondents, five participants did not specify the type of accidental sport. In addition, six athletes stated that they had suffered injuries in two different sports, while another athlete stated that he had suffered injuries in three different sports. This results in a total of 152 observations, including 149 injured athletes. Among the injured athletes, the following distribution of sports-related accidents was found: 19.7% in running/walking/hiking, 18.4% in cycling, 12.5% in fitness/strength training, and 10.5% in soccer (see table 1).

After weighting the sample, 74.0% (CI=72.1 to 75.9%) of people aged 14 and over are active in sport (cf. VuMA Touchpoints survey (14): 76.1% (CI=75.1 to 76.7%)). In the present study, 74.3% (CI=71.7-76.9%) of men, 73.7% (CI=71.0-76.5%) of women, 88.6% (CI=84.0-93.2%) of 14-29-year-olds, 78.4% (CI=73.8-83.0%) of 30-44-year-olds, 76.3% (CI=72.7-80.0%) of 45-59-year-olds and 61.1% (CI=58.1-64.2%) of those aged 60-year-olds and older are active in sport (cf. VuMA Touchpoints survey: 77.2% (CI=76.5-77.9%) of men, 75.1% (CI=74.4-75.9%) of women, 88.3% (CI=87.4-89.3%) of 14-29-year-olds, 81.4% (CI=80.4-82.4%) of 30-44-year-olds, 73.8% (CI=72.7-74.8%) of 45-59-year-olds and 67.4% (CI=66.2-68.5%) of 60-year-olds and older). The CI was calculated independently here, based on the data provided by VuMA Touchpoints (14).

Around 12.2% (CI=10.5 to 14.0%; $CI_{adj}=9.8$ to 14.7%) of active people who participate in sports in Germany have been injured so severely at least once during sport in the last 12 months that they have received medical treatment or had to take a break from sport. Extrapolated to the total population, 15.3% (CI=12.6 to

18.0%; $CI_{adj}=11.5$ to 19.1%) of all men and 9.2% (CI=7.0 to 11.4%; $CI_{adj}=6.1$ to 12.3%) of all women had an accident. In terms of age, 22.5% (CI=16.0 to 29.0%; $CI_{adj}=13.3$ to 31.7%) of 14-29-year-olds (extrapolated) and 10.0% (CI=6.2 to 13.9%; $CI_{adj}=4.6$ to 15.4%) of 30-44-year-olds have injured themselves, among 45-59-year-olds 10.7% (CI=7.6 to 13.8%; $CI_{adj}=6.3$ to 15.1%) and among 60-year-olds and older 7.6% (CI=5.4 to 9.9%; $CI_{adj}=4.5$ to 10.8%) (see figure 2). Extrapolated, this means that 6.9 million (CI=5.9-7.9 million; $CI_{adj}=5.5$ - 8.3 million) people aged 14 and over have been injured in sports in Germany in the last 12 months.

Both age ($p<0.001$; $p_{adj}<0.001$) and gender ($p<0.001$; $p_{adj}<0.01$; in favor of women) have a significant negative influence on the probability of injury. This means that younger and/or male athletes were significantly more likely to be injured than older and/or female athletes. Thus, on the one hand, the odds ratios of being injured during sport decrease by a factor of 0.98 (CI=0.98 to 0.99; $CI_{adj}=0.98$ to 0.99) per year with increasing age. On the other hand, the odds ratios for men increase by a factor of 1.9 (CI=1.33 to 2.76; $CI_{adj}=1.14$ to 3.20).

Sports enthusiasts in Germany were most frequently injured while running/walking/hiking (16%), followed by cycling (14%) and fitness/strength training (13%). In sports games, athletes

were most frequently injured while playing soccer (11%), tennis (4%), volleyball (4%) and basketball (2%) (see figure 3). Most injuries (around 50%) occurred in self-organized sport and around 30% in club sports.

In the sports/forms of exercise running/walking/hiking, which include around one sixth of all injured persons, the injury rates tend to be similar for men (47% of injured persons) and women (53% of injured persons). However, in this category, people aged 60 and over are most affected by accidents (43% of those injured). In contrast, significantly more men (81% of those injured) than women (19%) were injured while cycling. In terms of age, people aged 60 and over are particularly susceptible to injury in this sport (37% of those injured), with only slight deviations from the 30-44 age group (32% of those injured). In the area of fitness/strength training, it is predominantly male athletes (80%) who suffer the highest proportion of injuries, followed by young people up to the age of 29 (45%).

In addition to the gender- and age-specific distributions within the three sports with the most accidents, it is also possible to show which sports within the gender and age groups have the strongest predisposition for injuries. Accordingly, cycling proves to be the predominant activity with the highest injury frequency among men and 30-44-year-olds, while running/walking/hiking comes first among women and people aged 60 and over. Fitness/strength training, on the other hand, has the highest injury frequency in the 14-29 and 45-59 age categories (see table 2).

Discussion

The results provide the first representative and cross-setting findings on the epidemiology of sports injuries in Germany.

There were no significant differences in the proportion of physically active participants in the analyzed sample compared to the representative VuMA Touchpoints survey, except marginally in the over 60s (present sample (60+-year-olds): 61.1% (CI=58.1 to 64.2%), VuMA (60+-year-olds): 67.4% (CI=66.2 to 68.5%)) (14). There is therefore no bias with regard to too low or too high a prevalence of physically active people in sports in this sample.

The VuMA Touchpoints survey 2023 (14) was used to quantify the prevalence of injured athletes, as it provides detailed and reliable information on sporting activity by gender and age. This enabled an adjusted prevalence estimate, taking into account the various forms of sporting activity depending on gender and age.

The population included all people who were at least rarely (less than once a month) active in sports, which accounts for 17.5% of all people. However, more frequent sporting activity increases the risk of injury (1, 7). Infrequently active people are therefore less at risk, which distorts the result in terms of prevalence.

In addition, the exposure times, which are of essential

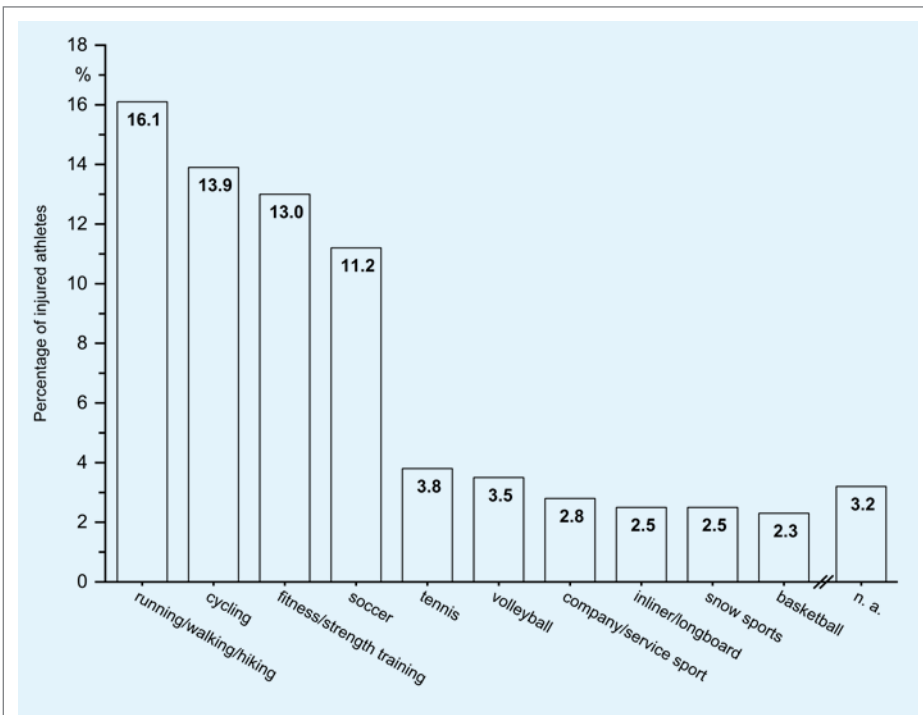


Figure 3 Top 10 sports with the highest percentage of injured athletes in Germany.

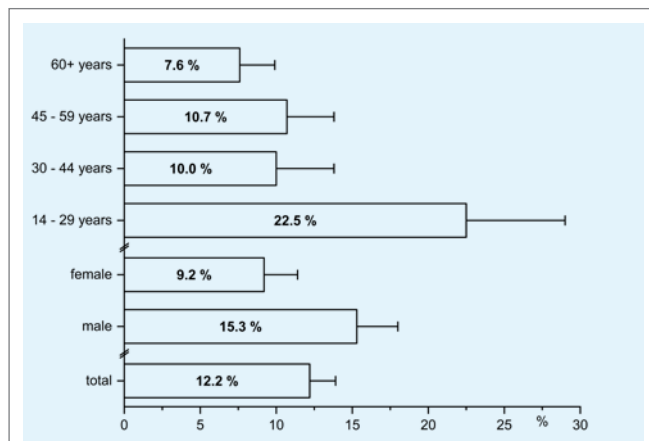


Figure 2 Injury rate in the last 12 months (95% Confidence Interval).

Table 2

Top 3 accident sports by gender and age group in Germany.

		1. SPORT	2. SPORT	3. SPORT
Gender	Male	Cycling	Fitness/strength training	Soccer
	Female	Running/walking/hiking	Fitness/strength training	Cycling
Age (years)	14-29	Fitness/strength training	Soccer	Running/walking/hiking
	30-44	Cycling	Fitness/strength training	Soccer
	45-59	Fitness/strength training	Running/walking/hiking	Cycling
	60+	Running/walking/hiking	Cycling	Soccer

importance for calculating the risk of injury, were not taken into account. Therefore, it cannot be ignored that the observed differences in the risk of injury in the individual groups could be due to potential confounding effects. For example, it is apparent that women and older people engage in sporting activities less regularly than men and younger age groups (14), which means that they are less likely to injure themselves during sporting activities (1, 7).

Furthermore, the estimated number of sports injuries needs to be critically analyzed due to a certain limitation in connection with retrospectively conducted surveys. In this context, there is another possible source of systematic error, known as recall bias. This leads to an increased extent of so-called underreporting of sports injuries when a longer recall period (>3 months (9)) is required (5, 9). As the study results are based on retrospective self-reports, they may contain biases, which would affect the accuracy of the results.

The identification of risk factors for sports injuries enables targeted preventive measures to be taken to minimize the risk of injury. The study shows that younger men in particular have an increased risk of injury. Most injuries occur during running/walking/hiking, cycling, fitness/strength training and soccer. These sports are mostly self-organized, with the exception of soccer, which is mostly played in clubs. The results show absolute values and not relative values in relation to the frequency of sporting activity, as the total populations of those active in these sports in Germany are not systematically recorded. Therefore, the four most common sports may have the most injuries in absolute terms, but do not represent a significantly increased risk in relative terms (3, 15).

The present study and the above-mentioned aspects form a basis for future research. The study does not provide any information about the severity or type of injuries or the exact setting in which the injuries occurred. These aspects, in addition to the consideration of exposure times, are important elements for the expansion of the epidemiology of sports injuries in Germany and enable the development and implementation of targeted and effective prevention strategies. By identifying injury risks more precisely, preventive measures can be better targeted at the relevant target groups in order to effectively reduce potential injuries.

Conclusion

The study contains the first representative and cross-setting figures on sports accidents in Germany for German-speaking people aged 14 and over. In addition to the prevalence of injured athletes in Germany, the survey also shows for the first time the sports in which sports accidents occur most frequently.

The results of the survey show that young male athletes are injured significantly more often than older or female athletes. More specifically, men have almost twice the risk of injury compared to women (OR: 1.9). In addition, the probability of injury per year decreases by a factor of 0.98 (OR) with increasing age. The analysis of the data also shows that the top 4 sports/forms of exercise (running/walking/hiking, cycling, fitness/strength training and soccer) account for more than half of all sports accidents.

It should be noted that due to the limited number of people surveyed in this study, only the prevalence of injured athletes was estimated and the absolute number of sports injuries was not determined. This survey was conducted as a pilot study in order to better estimate the number of cases for a more comprehensive survey. The planned follow-up study aims to provide representative data in order to record the prevalence of sports

injuries differentiated by setting and type of sport and to be able to calculate the associated economic health costs of sports injuries in Germany. ■

Conflict of Interest

The authors have no conflict of interest.

Acknowledgement

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The first author's doctoral thesis is financed by third-party funds from the Safety in Sport Foundation, which is involved in the project in cooperation with us. Schulz D, a board member of the foundation, is also listed as a co-author.

Ethical Approval

The original document was internally reviewed and contains no personal data, thereby approved for publication. According to the statement from Forsa, as a member of the "Arbeitskreis Deutscher Markt- und Sozialforschungsinstitute e.V." (ADM), adheres to the strict ethical standards and data protection regulations set by the association. ADM's code of conduct ensures that all research carried out by its members complies with national and EU data protection laws, including the General Data Protection Regulation (GDPR). Consequently, no further review by the local ethics committee was deemed necessary, as Forsa's procedures fully meet all legal and ethical requirements for the protection of personal data and the responsible conduct of research involving human participants.

Summary Box

This study is the first to provide representative and cross-setting data on the prevalence of sports injuries in Germany. It shows that around 12.2% of people who are active in sport are injured so severely every year that they require medical treatment or a break from sport.

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