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Injury trends in Olympic team sports

Trendi poškodb v ekipnih olimpijskih športih

ABSTRACT

This study aimed to analyse trends in injury occurrence among athletes in Olympic team sports based on studies reporting data from established injury surveillance systems. A secondary analysis of published epidemiological data from the Olympic Games (2004–2020) was conducted using reports based on the International Olympic Committee injury surveillance system. The analysis included football, basketball, handball, volleyball, beach volleyball, water polo, and hockey. Injury incidence was expressed as the proportion of injured athletes, including time-loss injuries (≥1 day) and severe injuries, and trends were assessed using linear regression. The results indicated an overall decreasing trend in injury incidence across Olympic team sports (slope = −1.96% per Olympic cycle), although not observed statistical significance ($p > 0.05$). A statistically significant reduction was observed in basketball (slope = −2.89%; $p = 0.01$), whereas football and handball demonstrated non-significant decreasing trends. In contrast, volleyball, beach volleyball, and water polo showed non-significant increasing trends ($p > 0.05$). The proportion of athletes sustaining time-loss injuries decreased significantly over the study period (slope = −0.96%; $p = 0.02$). Contact sports demonstrated a statistically significant reduction in time-loss injuries (slope = −1.34%; $p = 0.01$), whereas non-contact sports showed a non-significant increasing tendency in overall injury incidence (slope = 1.74%; $p = 0.09$). Overall, injury trends in Olympic team sports appear heterogeneous and influenced by sport-specific characteristics, particularly the level of physical contact. These findings may support sport-specific injury prevention strategies and athlete health protection programmes. Interpretation remains limited due to methodological variability and the lack of long-term comparable data.

Keywords: sports injuries, Olympic Games, team sports, trends

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IZVLEČEK

Cilj raziskave je bil analizirati trende pojavljanja poškodb med športniki v ekipnih olimpijskih športih na podlagi študij, ki poročajo podatke iz vzpostavljenih sistemov nadzora poškodb. Izvedena je bila sekundarna analiza epidemioloških podatkov z Olimpijskih iger (2004–2020), z uporabo poročil, iz nadzornega sistema za poškodbe Mednarodnega olimpijskega komiteja. Analiza je zajela nogomet, košarko, rokomet, odbojko, odbojko na mivki, vaterpolo in hokej. Incidenca poškodb je bila izražena kot delež poškodovanih športnikov, vključno s poškodbami, ki povzročijo izpad treninga ali tekmovanja (≥1 dan), ter hudimi poškodbami. Trendi so bili ocenjeni z linearno regresijo. Rezultati so pokazali splošen padajoči trend incidence poškodb v ekipnih olimpijskih športih (naklon = −1.96 % na olimpijski cikel), čeprav statistična značilnost ni bila dosežena ($p > 0.05$). Statistično značilno zmanjšanje je bilo opaženo v košarki (naklon = −2.89 %; $p = 0.01$), medtem ko sta nogomet in rokomet izkazala neznačilne padajoče trende. Nasprotno pa so odbojka, odbojka na mivki in vaterpolo pokazali neznačilne naraščajoče trende ($p > 0.05$). Delež športnikov s poškodbami, ki povzročijo izpad, se je v obdobju raziskave statistično značilno zmanjšal (naklon = −0.96 %; $p = 0.02$). Športi s telesnim kontaktom so pokazali statistično značilno zmanjšanje poškodb z izpadom (naklon = −1.34 %; $p = 0.01$), medtem ko so nekontaktni športi izkazali neznačilno naraščajočo tendenco skupne incidence poškodb (naklon = 1.74 %; $p = 0.09$). Na splošno se zdi, da so trendi poškodb v ekipnih olimpijskih športih heterogeni in odvisni od značilnosti posameznega športa, zlasti od stopnje telesnega kontakta. Ugotovitve lahko podprejo športno-specifične strategije preprečevanja poškodb in programe za zaščito zdravja športnikov, čeprav interpretacijo omejuje metodološka variabilnost in pomanjkanje dolgoročnih primerljivih podatkov.

Ključne besede: športne poškodbe, Olimpijske igre, ekipn športi, trendi

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INTRODUCTION

Sports injuries represent one of the key challenges in modern elite sport, as they are directly associated with athletes' health, performance, and career longevity. The high intensity of contemporary competitive activity is accompanied by substantial physical and psycho-emotional demands, which increase the risk of injury and may negatively affect both short-term performance outcomes and long-term athlete health (Bahr et al., 2020; Sakanashi et al., 2024).

Injury occurrence in team sports constitutes an important issue in contemporary sports science, as these sports are characterised by a high intensity of competitive activity, complex player interactions, and considerable variability of game situations (Gilhooly et al., 2023; Junge & Dvorak, 2004). In contrast to individual sports, team sports involve high-intensity intermittent activity combined with frequent changes of direction, accelerations, decelerations, and elements of physical contact, all of which increase the risk of injury (Mohr et al., 2003; Stølen et al., 2005). Epidemiological evidence indicates that injury rates in many team sports are relatively high compared to other types of sport, particularly in contact disciplines such as football, handball, hockey, and water polo (Prien et al., 2018; Ekstrand et al., 2011).

An important factor influencing injury incidence is the nature of player interaction and the level of physical contact inherent to a given sport, which determines both the frequency and the structure of injuries (Fuller et al., 2006; Bullock et al., 2021a). Research indicates that injuries occur significantly more often during competition than in training settings, which is associated with higher intensity, unpredictability of game situations, and increased levels of physical contact (Chia et al., 2022; Schippers et al., 2026). Furthermore, injury rates vary depending on the level of competition (youth, amateur, professional) as well as the type of tournament (national leagues, international competitions, short-term tournaments), resulting in substantial differences in workload, match congestion, and recovery (Gabbett, 2016; Windt & Gabbett, 2017).

Despite the substantial body of research on injury epidemiology in team sports, the analysis of long-term trends remains limited (Ruddy et al., 2019; Bittencourt et al., 2016). Most existing studies focus on specific leagues, individual sports, or relatively short observation periods (Andreoli et al., 2018; Bullock et al., 2021b; Ekstrand et al., 2021; Chamari et al., 2025). In addition, studies employ different approaches to reporting injury data depending on their aims and data collection methodologies, which substantially complicates comparisons across studies. Notably, there is a lack of research specifically addressing injury trends in team sports across multiple Olympic cycles.

Therefore, the aim of the present study was to analyse trends in injury occurrence among athletes in Olympic team sports based on studies reporting data from established injury surveillance systems.

METHODS

Study design and data sources

The present study was conducted as a secondary analysis of published epidemiological data on sports injuries collected during the Olympic Games. The analysis was based exclusively on aggregated data reported in scientific publications and official reports. All included studies stated that data collection had been performed in accordance with the principles of the Declaration of Helsinki and had received approval from the relevant ethics committees. As no primary data collection was undertaken and no

direct involvement of human participants occurred within the framework of this study, additional ethical approval and informed consent were not required.

The analysis focused on team sports included in the Olympic Games programme, characterised by varying levels of physical contact, playing intensity, and competition structure. These sports comprised football, basketball, handball, volleyball, beach volleyball, water polo, and hockey. Other team sports were excluded for two main reasons: they were not consistently represented across all Olympic Games within the analysed period (e.g., rugby, baseball); and some sports include both team and individual formats (e.g., badminton, table tennis), which complicates the comparability of injury data within a unified analytical framework.

Sports were categorised according to the level of physical contact between participants based on established definitions in the sports medicine and epidemiological literature. Contact/collision sports were defined as those in which physical contact between players is frequent and constitutes an inherent element of the competitive interaction. This approach is consistent with classifications used in previous research (Armstrong & Van Mechelen, 2017; Howell et al., 2020), where basketball, football (soccer), handball, hockey, and water polo are considered contact or collision sports. In contrast, sports in which physical contact between players is infrequent or incidental were classified as limited or no contact sports (volleyball and beach volleyball).

Search strategy and study selection

The literature search was conducted using international scientific databases, including PubMed, Scopus, Web of Science, and Google Scholar. The search strategy was based on a combination of relevant keywords and Boolean operators related to the Olympic Games, team sports, and sports injuries (including: Olympic Games, team sports, injury, injury epidemiology, football, basketball, handball, volleyball, water polo, hockey).

At the initial stage, a broad range of publications addressing the epidemiology of sports injuries was identified. After removing clearly irrelevant records, titles and abstracts were screened to exclude studies that did not meet the inclusion criteria. Subsequently, full-text articles were assessed for eligibility.

Studies were included in the final analysis if they met the following criteria: investigation of injuries occurring during the Olympic Games; availability of data on team sports or the possibility of extracting such data; use of systematic injury surveillance, primarily within the International Olympic Committee (IOC) injury surveillance system; and reporting of key indicators, including the overall proportion of injured athletes, time-loss injuries, and/or severe injuries. Studies were excluded if they: focused on non-Olympic competitions or training settings; did not provide sufficient quantitative data to calculate injury indicators; or duplicated previously published datasets without presenting additional results or clarifications.

As a result of the selection process, reports and studies covering the Olympic Games from 2004 to 2020 were included in the analysis. Additionally, partially available data for the 2024 Olympic Games were identified; however, these were not included in the quantitative analysis due to their limited completeness and representativeness.

Statistical analysis

Descriptive statistics were used to summarise injury indicators in Olympic team sports. Injury incidence was expressed as the percentage of injured athletes relative to the total number of participants for each sport and each Olympic cycle. Injury proportions were calculated as the number of injured athletes divided by the total number of participating athletes in each edition of the Olympic Games. In addition to overall injury rates, separate analyses were conducted for injuries resulting in at least one day of time loss (≥1 day time-loss injuries) and for severe injuries (≥7 days time loss), as defined in the corresponding data sources.

Temporal trends in injury indicators were assessed using linear regression analysis. The Olympic cycle was coded as a continuous variable (1–5). For each sport, as well as for aggregated groups, the regression slope (interpreted as the change in the indicator per Olympic cycle), coefficient of determination (R^2), and p-value were calculated. Statistical significance was set at $p < 0.05$. Ninety-five percent confidence intervals (95% CI) for proportions were computed using the Wilson score method to ensure more accurate estimation for binomial data. It should be acknowledged that the regression analysis was based on a limited number of time points (n = 5 Olympic cycles), which should be considered when interpreting trend estimates. Therefore, the results should be interpreted primarily as an assessment of temporal trends rather than strict statistical inference of significance. Nevertheless, this approach is commonly used in the limited number of available data. All statistical analyses and data visualisation were performed using the Python programming language with standard scientific libraries, including NumPy, SciPy, and Matplotlib.

RESULTS

Table 1 presents a general overview of studies addressing the epidemiology of injuries in Olympic sports from 2004 onwards. It should be noted that the selection prioritised studies reporting the most comprehensive set of relevant indicators and those based on systematic injury surveillance conducted under the auspices of the International Olympic Committee. Particular emphasis was placed on studies providing data specifically for team sports.

Table 1

Characteristics of Olympic Injury Surveillance Studies (2004–2024)

Olympic Games	Authors, (year)	Sports included	Reported indicators (Number of athletes / Injured athletes / Time-loss injuries / Severe injuries)
2004, Athens	Junge et al. (2006)	Team sports only	Yes
2008, Beijing	Junge et al. (2009)	All sports *	Partial (all indicators except severe injuries)
2012, London	Engebretsen et al. (2013)	All sports	Yes
2016, Rio	Soligard et al. (2017)	All sports	Yes
2020, Tokyo	Soligard et al. (2023)	All sports	Yes
2024, Paris	Bae et al. (2025)	No sport-specific breakdown; Korean team only	Partial (time-loss and severe injuries not reported)
	Post et al. (2025)	All sports; USA team only	Partial (only severe injuries reported)

Notes. * All Olympic sports, including the team sports analysed in the present study.

The most complete set of indicators was reported in studies covering the 2012, 2016, and 2020 Olympic Games, whereas data on severe injuries were not available for the 2008 Olympic Games. For the most recent Olympic Games (Paris 2024), no comprehensive official report was available at the time of the literature search, and the existing studies were limited in scope. The lack of standardised and complete data for 2024 resulted in the exclusion of this period from the quantitative analysis.

Table 2 presents the proportion of injured athletes in Olympic team sports during the 2004–2020 Olympic Games, along with the results of the linear trend analysis. The most pronounced statistically significant decrease in injury incidence was observed in basketball (slope = –2.86% per Olympic cycle; $R^2 = 0.90$; $p = 0.01$). A decreasing trend (slope = −5.79% per cycle) was observed in football and handball (slope =–3.70% per cycle), although it was not statistically significant ($p > 0.05$).

Table 2

Proportion of Injured Athletes and Temporal Trends in Olympic Team Sports

Sport	Olympic Games, % of Athletes					Slope (% per cycle)	R^2	p-value
	2004	2008	2012	2016	2020			
Basketball	19.2	13.2	11.2	7.7	7.6	-2.89	0.90	0.01 *
Beach volleyball	0.0	8.3	12.5	7.3	10.4	1.98	0.43	0.23
Football	28.8	31.5	35.2	14.9	8.1	-5.79	0.62	0.11
Handball	35.0	17.4	21.8	14.6	17.8	-3.70	0.53	0.16
Hockey	12.5	20.4	17.0	12.2	9.8	-1.37	0.26	0.38
Volleyball	2.5	8.01	6.9	7.3	11.1	1.65	0.71	0.07
Water polo	7.1	9.65	13.1	19.4	10.9	1.75	0.35	0.29

At the same time, volleyball, beach volleyball, and water polo demonstrated an increasing trend in the proportion of injured athletes (with slopes ranging from 1.65% to 1.98% per Olympic cycle); however, these trends were not statistically significant ($p > 0.05$).

Table 3 presents the dynamics of the proportion of athletes who missed at least one day of training or competition due to injury (≥1 day time-loss injuries). A statistically significant decrease was observed in basketball (slope = –1.40% per Olympic cycle; $R^2 = 0.94$; $p = 0.01$) and handball (slope = –2.33%; $R^2 = 0.81$; $p = 0.04$). A decreasing trend (slope = −2.27% per cycle) was observed in football, although it did not reach statistical significance ($p > 0.05$).

Table 3

Proportion of Athletes with Time-Loss Injuries (≥1 Day) and Temporal Trends in Olympic Team Sports

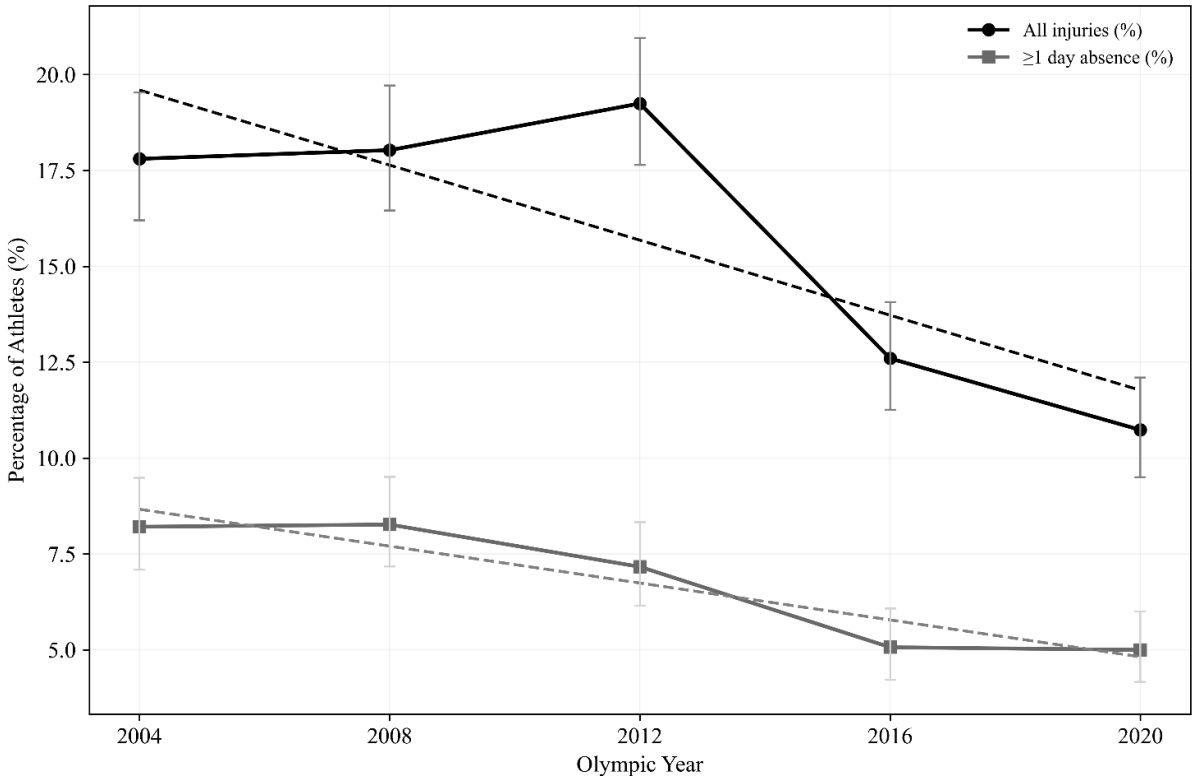
Sport	Olympic Games, % of Athletes					Slope (% per cycle)	R^2	p-value
	2004	2008	2012	2016	2020			
Basketball	7.7	5.6	3.5	2.8	2.1	-1.40	0.94	0.01
Beach volleyball	0.0	2.1	2.1	3.1	2.1	0.52	0.52	0.17
Football	13.7	16.3	13.2	7.6	6.7	-2.27	0.74	0.06
Handball	15.9	13.5	9.2	5.97	8.1	-2.33	0.81	0.04
Hockey	6.3	3.4	6.4	3.9	3.4	-0.53	0.30	0.34
Volleyball	1.8	3.5	2.4	2.8	5.9	0.76	0.56	0.15
Water polo	2.8	3.9	5.0	6.6	3.4	0.40	0.18	0.48

In the remaining sports, the slope per Olympic cycle was less than 1%, and no statistically significant trends were identified ($p > 0.05$).

Figure 1 illustrates the overall dynamics of the proportion of injured athletes and those who missed at least one day due to injury across all analysed sports. The overall proportion of injured athletes showed a decreasing trend (slope = −1.96% per Olympic cycle; $R^2 = 0.68$), although this trend was not statistically significant ($p > 0.05$).

Figure 1

Overall Trends in Injury Incidence and Time-Loss Injuries in Olympic Team Sports



In contrast, the proportion of athletes sustaining injuries that resulted in at least one day of time loss demonstrated a pronounced and statistically significant decrease (slope = –0.96% per cycle; $R^2 = 0.88$; $p = 0.02$).

The next stage of the analysis involved stratifying injury data according to the level of physical contact in sports. The analysis of temporal trends by contact type revealed fundamentally different patterns (Table 4). In contact sports, the overall proportion of injured athletes showed a decreasing trend (slope = −2.80% per Olympic cycle; $R^2 = 0.78$), although this trend was not statistically significant ($p > 0.05$). This reduction was particularly evident after 2012, contributing to a marked decline in 2016 and 2020.

In contrast, non-contact sports showed an increasing trend in overall injury incidence (slope = 1.74% per cycle; $R^2 = 0.676$), although this trend was not statistically significant ($p > 0.05$).

Table 4

Comparison of Injury Trends Between Contact and Non-Contact Olympic Team Sports

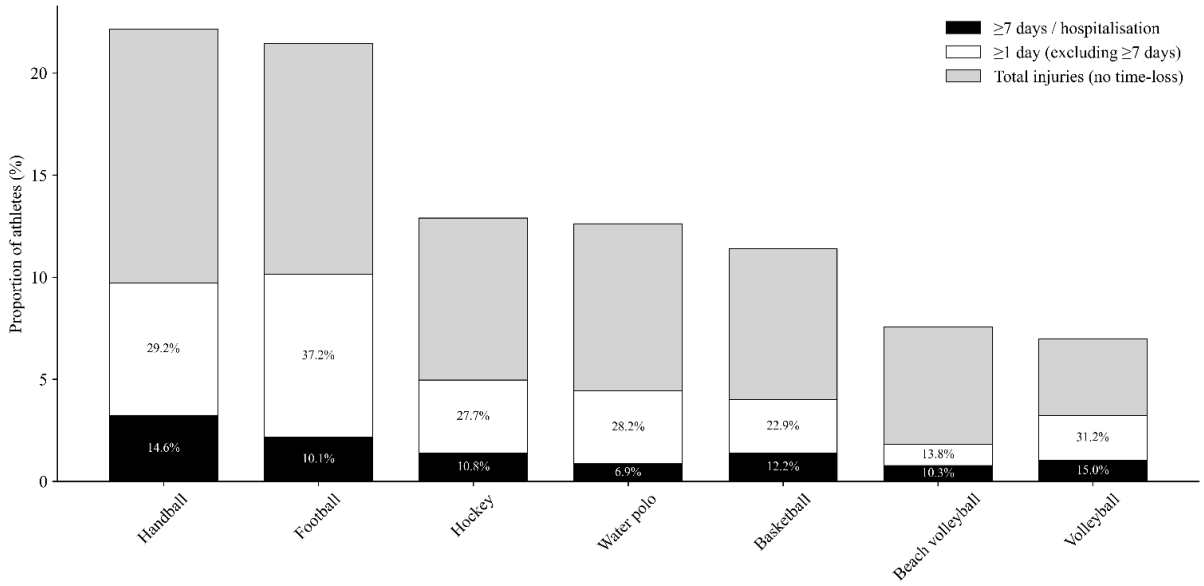
Sport	Olympic Games, % of Athletes					Slope (% per cycle)	R^2	p-value
	2004	2008	2012	2016	2020			
Contact (Total)	21.5	20.2	21.6	13.7	10.7	-2.80	0.78	0.05
No-contact (Total)	1.9	8.1	8.3	7.3	10.9	1.74	0.68	0.09
High-contact (≥1 day)	9.8	9.4	8.2	5.6	5.0	-1.34	0.93	0.01
Low-contact (≥1 day)	1.3	3.1	2.3	2.9	5.0	0.70	0.69	0.08

A similar pattern was observed for injuries resulting in at least one day of time loss. In contact sports, the proportion of time-loss injuries decreased significantly (slope = –1.34% per cycle; R^2 = 0.93; p = 0.01). In contrast, non-contact sports demonstrated a moderate increase in this indicator (slope = +0.70% per cycle; R^2 = 0.69; p = 0.08), although the trend did not reach statistical significance.

An important aspect of the analysis concerns the distribution of injury severity. Figure 2 presents the aggregated structure of injuries across sports for four Olympic cycles (2004, 2012, 2016, and 2020), excluding 2008 due to the absence of complete data on injury severity. The highest overall injury proportions were observed in handball (22.2%) and football (21.5%), whereas the lowest values were recorded in beach volleyball (7.5%) and volleyball (7.0%).

Figure 2

Distribution of Injury Severity Across Olympic Team Sports (2004, 2012, 2016, 2020)



The structural analysis of injury severity indicates that football demonstrates the highest proportion of injuries resulting in at least one day of time loss, suggesting not only a high frequency of injuries but also a substantial functional impact on athletes.

DISCUSSION

The findings of the present study indicate an overall decreasing trend in injury incidence in Olympic team sports over the period 2004–2020; however, this trend was not statistically significant across all indicators. These results are generally consistent with the conclusions of official reports from the International Olympic Committee and previous studies across all sports, including those by Junge et al. (2006, 2009), Engebretsen et al. (2013), and Soligard et al. (2017, 2023), as well as the systematic review by Torvaldsson et al. (2025), which report a relative stabilisation or gradual decrease in injury incidence during the Olympic Games.

The present study builds upon these datasets by aggregating and isolating data specifically for selected Olympic team sports. Within this context, a general decrease in the proportion of injured athletes was observed (slope = –1.96% per Olympic cycle), alongside a statistically significant reduction in the

proportion of time-loss injuries (slope = –0.96%; p = 0.02). These findings suggest that team sports broadly reflect overall Olympic trends, despite the specific characteristics of game dynamics and varying levels of physical contact.

An important factor that may have influenced the observed trends is the implementation and development of the International Olympic Committee (IOC) injury surveillance system, which has enabled the standardisation of data collection and analysis procedures, as well as improvements in injury prevention strategies (Engebretsen et al., 2013; Bahr et al., 2020). In addition, the continuous work of the IOC Medical and Scientific Commission, as well as medical commissions of international sport federations, including the development and implementation of injury prevention initiatives and evidence-based safety policies, may have contributed to the observed reductions in injury incidence at elite competitions. At the same time, findings from the systematic review by Torvaldsson et al. (2025) indicate that, within the Olympic Games, the overall downward trend in injury incidence is less pronounced compared with the Paralympic Games, while average injury rates remain relatively stable (approximately 10–11% of athletes injured).

The analysis of injury patterns according to the level of physical contact revealed different temporal patterns. The present study demonstrated a statistically significant decrease in both overall injury incidence (slope = –2.80%; $p < 0.05$) and the proportion of time-loss injuries (slope = –1.34%; p = 0.01) in contact sports. In contrast, non-contact sports showed an increasing tendency in these indicators, although this trend did not reach statistical significance. However, it should be noted that athletes in contact sports sustained injuries more frequently than those in non-contact sports. These findings are consistent with recent comprehensive studies (Torvaldsson et al., 2025), which identify football and handball among the sports with the highest injury incidence, whereas beach volleyball is among those with the lowest.

The present results are generally supported by existing literature, where physical contact is considered one of the key risk factors for injury occurrence (Junge et al., 2009; Soligard et al., 2017). In particular, long-term studies in professional football have demonstrated a gradual reduction in injury incidence (approximately 3% per season over an 18-year period), which has been attributed to improvements in preventive programmes, load management, and changes in competition structure (Ekstrand et al., 2021). Similar trends have been reported for specific types of injuries, such as ankle injuries, the incidence of which has progressively decreased in professional football (Waldén et al., 2013). At the same time, injury patterns differ across sports: in contact sports, a substantial proportion of injuries is associated with player collisions or rule violations, whereas in non-contact sports, injuries are more often related to repetitive loading and mechanical overuse (Peña et al., 2023).

At the same time, it should be taken into account that the reported findings are derived from studies conducted at different levels of competition (Olympic, international and national competitions/leagues, and youth sport), which limits the possibility of direct comparison of absolute values and requires caution in generalisation (Bullock et al., 2021a; Wong et al., 2026). Furthermore, for a considerable number of sports, particularly non-contact disciplines, there is a lack of systematic long-term studies that would allow for the assessment of the stability and direction of injury trends over time.

The interpretation of the identified trends remains complex and multifactorial. Changes in injury incidence may be influenced by multiple interacting factors (Milić et al., 2025). In most contact sports, these changes are associated not so much with modifications of official competition rules, but rather

with advancements in training processes and the implementation of targeted injury prevention programmes aimed at reducing injury risk (Stephenson et al., 2021; Sturesson et al., 2024). In particular, team sports have increasingly focused on the prevention of injuries in specific anatomical regions that are most frequently affected and have the greatest functional consequences (Åman et al., 2019). At the same time, studies examining the impact of rule changes have shown less consistent results; for example, in volleyball, rule modifications introduced in 2016 did not result in a substantial reduction in injury incidence (Uluöz, 2019). Therefore, changes in injury rates may reflect not only genuine improvements in athlete safety but also a range of other influencing factors (Engebretsen et al., 2013; Torvaldsson et al., 2025).

It should also be acknowledged that the present study has several limitations. First, data on severe injuries were not available for the 2008 Olympic Games, and for the 2024 Olympic cycle, no comprehensive IOC report was available at the time of analysis, which led to the exclusion of this period from the quantitative analysis. Second, different studies employ varying injury indicators, which complicates direct comparisons and may affect the interpretation of trends. Third, although the analysis is largely based on the IOC injury surveillance system, differences in medical provision, diagnostic practices, and injury reporting procedures over time may have influenced data completeness. In addition, the use of aggregated IOC surveillance data limited the analysis of more detailed injury characteristics, including injury type, anatomical location, sex differences, and contextual information (e.g., match versus training injuries), as these variables were not consistently reported across all Olympic cycles.

CONCLUSION

The results of the present study indicate that, in Olympic team sports, there has been an overall decreasing trend in injury incidence and in injuries resulting in at least one day of time loss over the period 2004–2020. The most pronounced changes were observed in contact sports, where a statistically significant reduction was identified in both the overall proportion of injured athletes and time-loss injuries. In contrast, non-contact sports demonstrated a less consistent pattern, with a tendency towards increasing injury incidence. It was also found that football and handball are associated with the highest injury risk, whereas volleyball and beach volleyball demonstrate the lowest rates. Overall, the findings highlight the heterogeneous nature of injury trends depending on the specific characteristics of the sport and the nature of player interaction.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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