



Injury Incidence Among Polish Firefighters Related to Firefighting Sports Activities from 2014 to 2022

Urazowość polskich strażaków związana ze sportem pożarniczym w latach 2014-2022

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Finansowanie: Brak

Konflikt interesów: Nie zgłoszono

Abstract

Key words: firefighter injuries, health hazards, firefighting sports, Polish State Fire Service, firefighting sports competitions

Introduction and objective: Service in a firefighting and rescue unit (FRU) involves rescuing injured people, limiting and controlling the spread of fire, eliminating local hazards, and carrying out rescue and firefighting operations during weather, industrial, construction, and road hazards. During these interventions, firefighters risk their own lives and health to save other people, animals, or property. The profession is associated with high psycho-physical loads due to a large number of risk factors, time pressure, and variable and adverse conditions. This study is aimed to analyse injuries related to firefighting sports during service in the Polish State Fire Service from 2014 to 2022 across Poland.

Material and methods: The research involved the analysis of data sourced from the Personnel Office and the Department of Safety, Hygiene, and Health Prevention of the Main Command of the Polish State Fire Service (MC SFS). The department gathered data from across Poland in the form of an annual accident rate analysis. Reports included the number of injured firefighters, their age and service tenure, cause and circumstances of the accident (injury), with a distinction between individual and collective accidents, and location (voivodeship).

Results: Over the study period, there were 630 events (Mean 70.1; SD 36.3) leading to firefighter injuries related to firefighting sports. These incidents constituted 10.9% of all sports-related injuries, ranking below team sports such as football (61% of sports injuries) and volleyball (19% of sports injuries).

Conclusions: Firefighting sports approximate the nature of many incidents that firefighters encounter during their service. Competitions in firefighting sports simulate the combat tasks of firefighters. Occupational Safety and Health (OSH) reports did not allow for the analysis of data regarding the age and service tenure of the injured firefighters. Firefighters' training related to participation in competitions may positively influence their psychophysical state during rescue and firefighting tasks.

Streszczenie

Słowa kluczowe: kontuzje strażaków, zagrożenia zdrowotne, sport pożarniczy, Państwowa Straż Pożarna, zawody sportowo-pożarnicze

Wprowadzenie i cel: Służba strażaków w jednostce ratowniczo-gaśniczej (JRG) obejmuje ratowanie poszkodowanych osób, ograniczanie i kontrolowanie rozprzestrzeniania się pożaru, eliminacji miejscowych zagrożeń, działań ratowniczo-gaśniczych podczas zagrożeń pogodowych, przemysłowych, budowlanych, drogowych. Podczas tych interwencji strażacy ryzykują własne życie i zdrowie, ratując innych ludzi, zwierzęta lub mienie. Wykonywanie tego zawodu wiąże się z wysokimi obciążeniami psychofizycznymi ze względu na dużą liczbę czynników ryzyka, pracy pod presją czasu, zmiennych i niekorzystnych warunkach. Celem jest analiza urazów związanych ze sportem pożarniczym podczas służby w Państwowej Straży Pożarnej w latach 2014-2022 w całej Polsce.

Materiał i metody: Badanie obejmowało analizę danych pochodzących z Biura Kadr, Wydziału ds. Bezpieczeństwa i Higieny Pracy i Profilaktyki Zdrowotnej Komendy Głównej Państwowej Straży Pożarnej (KG PSP). Wydział ds. BHP i Profilaktyki Zdrowotnej, gromadziło dane z całej Polski w postaci rocznej analizy stanu wypadkowości. Raporty obejmowały liczbę poszkodowanych strażaków, wiek i staż służby poszkodowanych, przyczynę i okoliczności zaistnienia wypadku (urazu), z uwzględnieniem podziału na wypadki indywidualne i zbiorowe, oraz lokalizację (województwo).

Wyniki: W okresie objętym analizą wystąpiło 630 zdarzeń (Mean 70,1; SD 36,3), które doprowadziły do urazów strażaków związanych ze sportem pożarniczym. Zdarzenia te stanowiły 10,9% wszystkich urazów związanych ze sportem, ustępującą dyscyplinom drużynowym: piłka nożna 61% urazów sportowych, siatkówka 19% urazów sportowych.

Wnioski: Sport pożarniczy przybliża charakterystykę wielu zdarzeń, z którymi strażacy mierzą się podczas służby. Konkurencja w zawodach sportowo-pożarniczych symuluje zadania bojowe strażaków. Raporty BHP nie umożliwiły analizy danych dotyczących wieku i stażu służby kontuzjowanych strażaków. Trening strażaków związany z uczestnictwem w zawodach może wpływać korzystnie na stan psychofizyczny podczas realizacji zadań ratowniczo-gaśniczych.

Otrzymano: 17.11.2023

Zaakceptowano: 12.12.2023

Opublikowano: 12.01.2024

Introduction

Service in a Firefighting and Rescue Unit (FRU) involves rescuing injured individuals, limiting and controlling the spread of fire, eliminating local hazards, and carrying out rescue and firefighting operations during weather, industrial, construction, and road hazards. In the course of these interventions, firefighters willingly expose themselves to risks, safeguarding lives, animals, and property. The profession demands high psycho-physical resilience due to an array of risk factors, time pressure, and frequently changing and challenging conditions [1].

The musculoskeletal system holds paramount importance in maintaining the physical fitness of firefighters. Insufficient fitness and endurance can negatively impact their operational performance. The demands of the profession require firefighters to uphold elevated fitness and strength levels, enabling them to lift and carry heavy objects across challenging terrains, ascend stairs, and evacuate injured individuals from danger zones using their muscle strength [2].

The specific nature of firefighting and rescue operations necessitates swift responses from firefighters, transitioning rapidly from rest to intense psycho-physical activity when dispatched to an incident. Physical fitness requirements are crucial even during recruitment (fitness tests) and continue throughout their service. The professional development of firefighters within FRU is achieved, among other means, through participation in sports activities and competitions organized, as outlined by the sports events calendar of the Polish State Fire Service (SFS) [3, 4, 5].

Physical education sessions during a firefighter's service aim to prepare them for their duties, such as honing psychomotor skills and preparing for tasks requiring maximum physical effort (carrying equipment and individuals, managing thermal stress). Sports activities within the SFS serve as an element of health prevention, developing overall physical fitness. The most renowned Polish firefighter is Zbigniew Bródka, who – even though does not represent firefighting sports – stands out as a professional athlete and as an Olympic medallist in speed skating. His accomplishments, including winning an individual gold medal in the 500 m event and a bronze medal in the team competition, exemplify international sports success while serving in the Polish State Fire Service [6, 7].

Injuries associated with sports activities pose inherent risks, regardless of whether the sport is played professionally or recreationally (regularly or occasionally). In the realm of the fire service, injuries resulting from sports contribute to the extensive array of health hazards associated with this profession. Accident prevention is one of the primary objectives in safety and hygiene initiatives within the SFS, including the execution of rescue and firefighting operations, exercises, training, and other tasks [8].

Firefighting sports take the form of competitions at various

levels, ranging from local to national and international. Firefighters preparing for these competitions undergo professional training cycles, focusing on strength, endurance, motor skills, and mental preparation. They are expected to exert significant physical effort, and demonstrate quick reflexes, composure, and teamwork skills. Firefighting sports showcase the specifics of service in conditions similar to real firefighting and rescue operations for spectators. The competitions demand significant physical effort, quick action, reflexes, composure, and teamwork skills.

Firefighting sports competitions include four disciplines:

1. Firefighting obstacle course – a 100-meter running competition involving the simultaneous execution of tasks simulating real actions: climbing a wall, deploying and connecting two sections of a fire hose, crossing a balance beam, and connecting one end of the hose line to a distributor and the other to a nozzle.
2. Climbing a wall simulating a building using a hook ladder – the competitor, holding a hook ladder, runs to the climbing wall and, by hooking the ladder onto the window sill at various floors, climbs to the third floor (Fig. 1).



Figure 1 Visualization of the "climbing using a hook ladder" competition. Source: own archive. a - safety net preventing the firefighter from falling; b - window of the climbing wall; c - hook ladder; d - metal hook (top part of the ladder).

3. 4x100m Relay with Obstacles - each of the 4 competitors runs 100m, navigating through various obstacles; competitor no. 1 crosses a house by running on the roof, no. 2 climbs a wall, no. 3 runs across a balance beam, connects two hoses into a hose line and attaches it to the distributor, and no. 4 uses a powder extinguisher to extinguish a burning liquid. The baton in this relay is symbolized by a piece of firefighting water equipment – a nozzle.
4. Combat exercise (the most prestigious competition) – the task is performed by seven firefighters equipped with firefighting gear. The task requires competitors to build a suction line to the tank, create a main line and two firefighting lines, and fill a 10-liter tank with water supplied through the filling holes in the targets [9].

Objective

The study aims to assess the risk of injuries related to firefighting sports among firefighters by conducting a nationwide analysis of data spanning the years 2014-2022.

Material and Methods

Study Design

The research involved an analysis of data sourced from the Personnel Office, Department of Safety and Hygiene at Work (SHW), and Health Prevention of the Main Command of the State Fire Service. The SHW and Health Prevention Department collected nationwide data in the form of an annual accident rate analysis in Poland. The reports included details such as the number of accidents, injured firefighters, age and service tenure of the injured, the cause and circumstances of the accident (injury), considering both individual and collective accidents, as well as the duration and type of treatment. Events related to the sports activities of the officers were selected from the available databases.

Research Setting

This was an observational, retrospective descriptive study, wherein several variables considered during injuries in firefighting sport were analysed. The study examined the overall number of accidents in this discipline, the year and month of accidents, including references to the COVID-19 pandemic, and geolocational data based on voivodeships.

Ethical Considerations

Approval was obtained from the Chief Commander of the SFS for data access in October 2022. The described cases are completely anonymous, and the analysis is consistent with the principles of the Helsinki Declaration, thereby did not require approval from an ethics committee.

Limitations

The occupational health and safety (OHS) obtained data did not facilitate the correlation of age and service tenure among firefighters injured in fire sport, thus not providing significant data on the personal profile of the observed firefighters. It is caused by the fact that the OHS reports present numerical data on the cause of injury and the overall population of firefighters who sustained injuries, including age and tenure.

Furthermore, the absence of detailed information on the number of firefighters injured during training for fire sport competitions and direct participation in these competitions represents another limitation. The observations exclusively focused on the officers of the State Fire Service; excluding incidents involving civilian employees of SFS organizational units and Volunteer Fire Brigade (VFB) firefighters who also participate in fire sport competitions [10].

Statistical Analysis

The database was compiled using Microsoft Excel with the MS Office 2016 package for Windows 10. Descriptive statistics were used to characterize the variables. For quantitative variables, the following measures were calculated: mean (M) and standard deviation (SD). For categorical variables, the following measures were calculated: number (n) and frequency (%).

Given the dependence of total injury numbers on local conditions in voivodeship, it was impossible to compare them directly. Instead, the rank of the number of injuries was used for comparison. The Friedman test [11] was conducted as the optimal method for comparing ranks between groups, and the ranks were the position of voivodeship in given year. The direct comparison of year to year was performed in post-hoc analysis using Wilcoxon signed test- ranks in two years were compared for each of 16 voivodeships. The results were obtained in Python [12] using packages `scipy.stats` and `scikit-posthocs` packages [13].

Results

During the analysis period, 630 incidents (Mean 70.1; SD 36.3) resulted in injuries among firefighters participating in firefighting sports (refer to Table 1 for detailed results). These events constituted 10.9% of all sports-related injuries, falling behind team sports: football accounted for 61% of sports injuries, and volleyball 19%. The overall number of injuries in firefighting sports is not proportionally equivalent to the number of officers serving in a given voivodeship. Voivodeships with a larger number of officers (e.g., Mazowieckie, Śląskie) do not exhibit the highest number of injuries in firefighting sports. Besides the number of officers, the popularity of the sport and traditions also influence the number of officers training in firefighting sports.

Year	Firefighting Sport	General Sports	Total Injuries	Firefighting Sport per 1000	Employment (thousands)
2014	108	914	1670	3,3	32,1
2015	102	664	1801	3,4	29,9
2016	98	708	1859	3,2	29,8
2017	78	648	1767	2,6	29,7
2018	83	705	1783	2,7	30,2
2019	88	754	1678	2,9	30,3
2020	8	357	1122	0,2	29,9
2021	23	472	1312	0,7	30,2
2022	42	508	1266	1,3	30,3
SD	36,3	167	273,9	-	0,72
Mean	70,1	636,6	1584,2	-	30,2
Total	630	5730	14258	-	-

Table 1 Injury rate related to sports in the firefighter population from 2014-2022

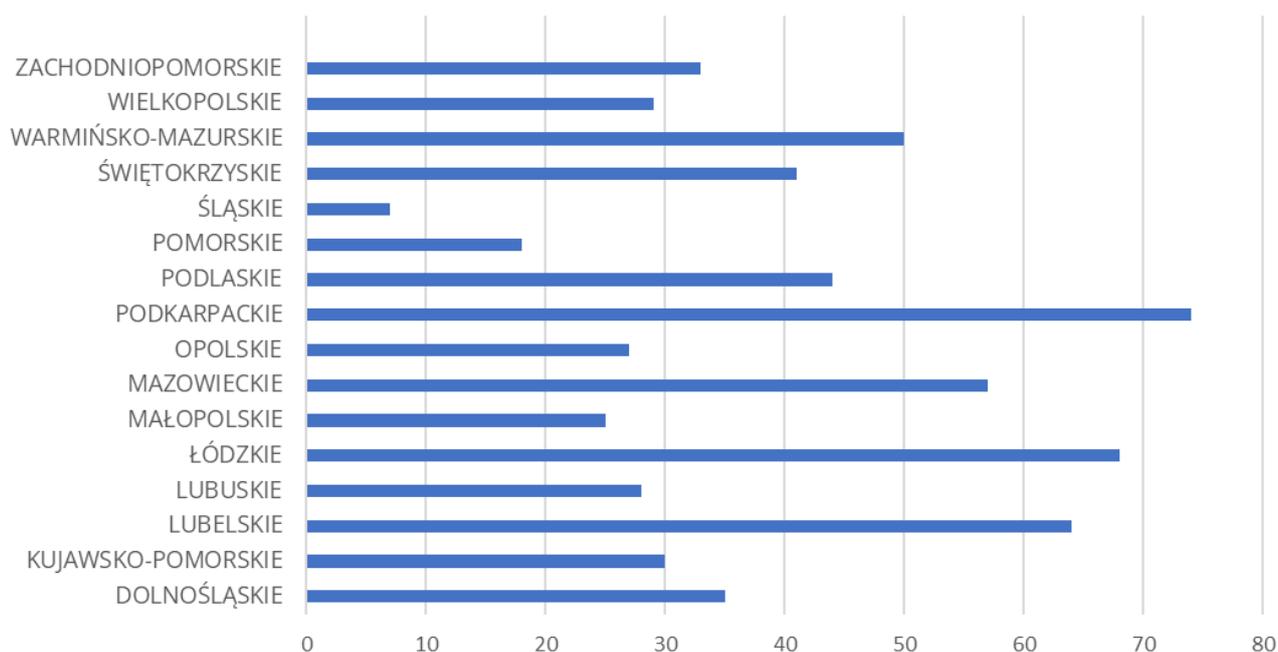


Figure 2 Injury rate of firefighters related to firefighting sports from 2014-2022 – by voivodeship

The significance of Friedman test justified the need for the post-hoc analysis using Wilcoxon test. The values of Wilcoxon signed rank test are provided in Table 2. The analysis shows that we have two epochs: before 2014-2019 and 2020-2022, i.e. separated by the pivotal year 2020, during which most COVID-related regulations were introduced and strictly enforced. Prior to 2019, the ranks in number of accidents did not differ at all except for 2014 and 2017, 2014 and 2018 which differ at $p < 0,05$.

In the years 2021 and 2022, encompassing the Covid-19 pandemic period, no statistically significant differences were observed in the positions (number of events) between voivodeships. A general decline in injuries is noticeable, likely related to the restrictions caused by the pandemic. While a significant change in the rate of injuries related to firefighting sports in individual voivodeships occurred in 2020, the number of these injuries remained stable in the subsequent years 2021-2022.

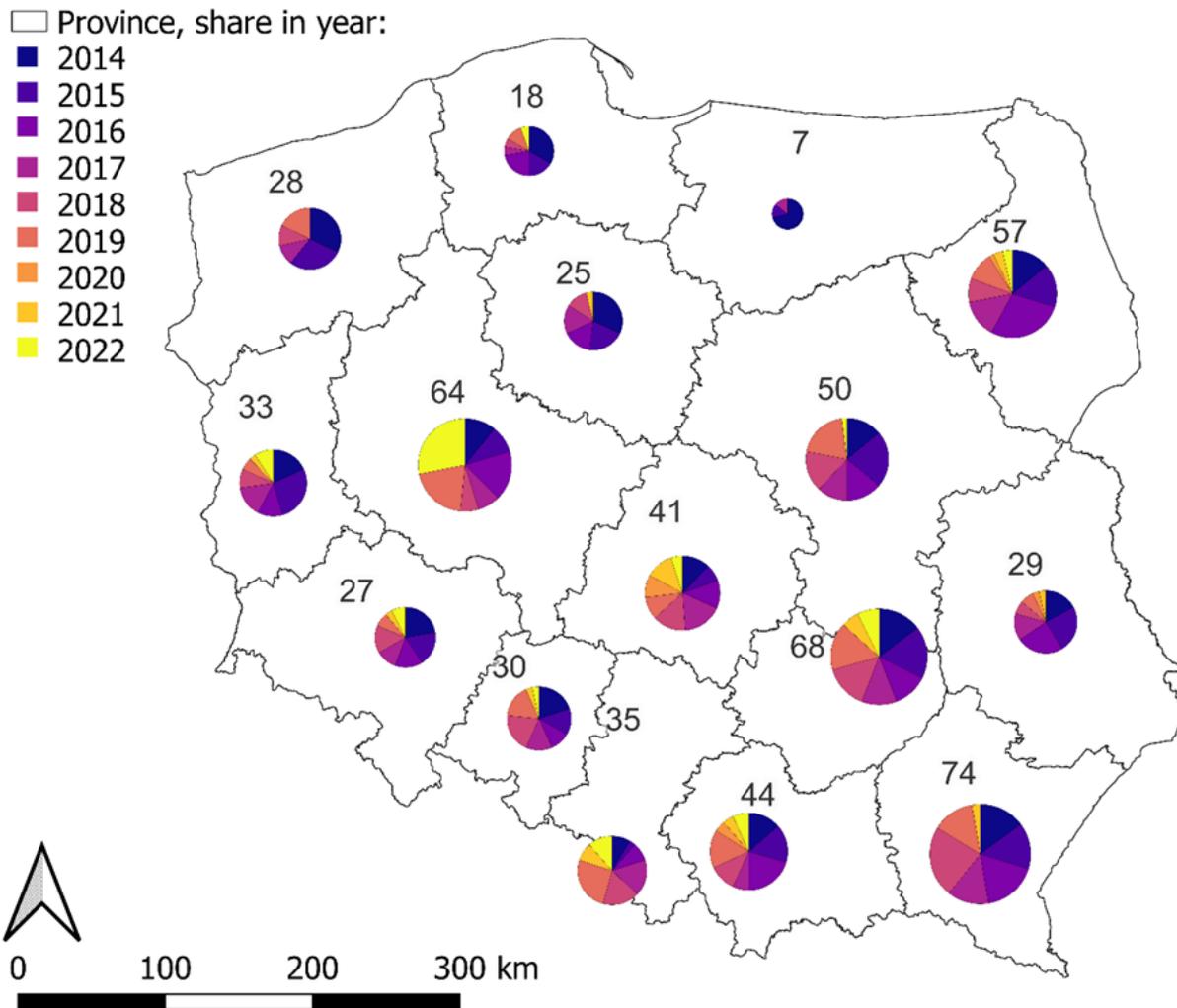


Figure 3 Illustration of injuries in firefighting sports among firefighters, categorized by voivodeships from 2014-2022. Source: own elaboration from Decision Support System (DSS) SFS. Map was created using QGIS software, v 3.22 Białowieża

	2014	2015	2016	2017	2018	2019	2020	2021	2022
2014	>0.05	>0.05	>0.05	<0.05	<0.05	>0.05	<0.0001	<0.001	<0.001
2015	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	<0.0001	<0.001	<0.05
2016	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	<0.001	<0.05	<0.05
2017	<0.05	>0.05	>0.05	>0.05	>0.05	>0.05	<0.0001	<0.0001	<0.05
2018	<0.05	>0.05	>0.05	>0.05	>0.05	>0.05	<0.001	<0.001	<0.05
2019	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	<0.05	<0.05	<0.05
2020	<0.0001	<0.0001	<0.001	<0.0001	<0.001	<0.05	>0.05	<0.05	<0.05
2021	<0.001	<0.001	<0.05	<0.0001	<0.001	<0.05	<0.05	>0.05	>0.05
2022	<0.001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	>0.05	>0.05

Table 2 The results of Wilcoxon signed rank test in analysis years

Discussion

Accidents involving firefighters are analysed by relevant departments within the organizational units of the State Fire Service (SFS). These analyses serve as the foundation for determining risks associated with specific positions, improving protective measures for firefighters, and conducting periodic training, especially following any accident. The training regimen focuses on safe behaviours, risk factors, and, in the case of sports, adherence to OSH regulations during sports activities, proper preparation for sports activities, warm-up routines, sports footwear, appropriate attire, and exercise infrastructure. Improvements in OSH can be achieved through regular training, analysis of recorded events, and supervisory oversight by management in the implementation of activities and training [14, 15].

Due to the limited number of studies on firefighter injuries related to sports and the uniqueness of firefighting sports in other countries, the authors focused on discussing the relationship between sports participation, maintenance of fitness among firefighters, and injuries sustained during service.

In cases of injuries during sports activities, the ability of firefighters (participating in training or securing competitions) to provide qualified first aid is crucial. Firefighters perform rescue operations based on qualified first aid procedures and well-equipped rescue kits [16].

Poston undertook the topic of examining the prevalence of overweight and obesity among firefighters, based on the analysis of the Body Mass Index (BMI). High indices of BMI (overweight and obesity) were found among professional firefighters at a level of 79.5%. The frequency of overweight and obesity surpassed that observed in the general population of the USA [17].

Jahnke indicates a high rate of injuries, especially in the musculoskeletal system, which is related to demographic characteristics, body composition, physical fitness, and concludes that firefighters with high BMI are 5.2 times more likely to suffer an injury [18].

According to Stone, strengthening and conditioning programs are beneficial for improving the physical fitness of firefighter trainees, and increased fitness can help to reduce the known risk of workplace accidents in this population and improve task performance. The authors underscored that musculoskeletal injuries at the firefighter's workplace are most often caused by bending, lifting, and straining muscles (bending, working in non-ergonomic positions related to activities). The injury mechanism fits the observed population, given that a significant part of the competitions in firefighting sports is a representation of the loads in real actions [19].

Andrews' observations on the impact of physical exercise on improving health and fitness of firefighters confirm improved performance at work and a reduced risk of injuries and car-

diovascular diseases [20].

Heart diseases leading to death among American firefighters were the subject of observation by Kales. Deaths due to coronary heart disease were associated with 32% of firefighting activities. During these activities, firefighters are exposed to significant effort, exposure to fire gases, heat stress, which may determine the occurrence of symptoms related to cardiac ischemia [21].

Injuries related to sports are a significant cause of unavailability among firefighters. However, practicing sports both on and off duty, combined with maintaining a high level of physical fitness, are essential for performing emergency service. Firefighters operate in situations requiring alertness, prudence, quick response, and high psychophysical endurance. The results presented in Table 2 showed that the number of injuries related to firefighting sports during the pandemic (years 2020-2021) differed from other (earlier) years. The authors attribute this difference to pandemic-related restrictions, as confirmed by documents and orders affecting the sports events calendar:

- among civilian athletes - Regulation of the Council of Ministers [22],
- professional firefighters - Order of the Chief Commander of the SFS [23].

Conclusions

Firefighting sports approximate the characteristics of many events that firefighters face during their service. Competitions in firefighting sports simulate the combat tasks of firefighters. Health and Safety reports did not provide data for the analysis of age and length of service of injured firefighters. Despite the inherent risks, training of firefighters involved in competitions may have a positive impact on the psychophysical state during the execution of rescue and firefighting tasks. While firefighting sports do carry a risk of injuries, it appears to be lower compared to team sports and contact sports. The number of firefighters in voivodeships does not proportionally relate to injury rates in this discipline. Notably, COVID-19 restrictions positively influenced the number of injuries, related to the cancellation of most competitions. Maintaining high physical fitness among firefighters, despite the risk of injuries, seems to be uncompromising to ensure the effective execution of rescue and firefighting tasks.

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