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Research article

Epidemiology and Risk Factors of CrossFit®-Related Injuries: A Cross-Sectional Study Among Athletes in the Czech Republic

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Abstract
CrossFit®, a high-intensity functional training program, places considerable physical demands on athletes and may contribute to musculoskeletal injuries. Understanding injury patterns and risk factors is essential for developing prevention strategies. This study investigated injury prevalence, types, and associated risk factors among Czech CrossFit® practitioners and examined the impact on training routines. A cross-sectional online survey was distributed to athletes training for at least six months at licensed affiliates across the Czech Republic. Descriptive statistics summarized participant characteristics and injuries. Chi-square and t-tests compared groups, and logistic regression estimated odds ratios (ORs) for risk factors including age, sex, CrossFit® experience, and weekly training volume. Of 456 athletes (214 men and 242 women), 36.4% reported at least one injury in the past six months. The most injured areas were the spine (30.7%), shoulder (28.3%), and palm (14.5%). Snatches, box jumps, deadlifts, cleans, and pull-up variations accounted for most injuries. Overuse injuries were most prevalent (49.2%). Injured athletes were younger ($p = 0.008$) and trained more hours per week ($p = 0.046$). Logistic regression showed that increasing age (OR = 0.97; 95% CI: 0.94–0.99; $p = 0.032$) and absence of competitive participation (OR = 0.61; 95% CI: 0.39–0.96; $p = 0.039$) reduced injury risk. These findings highlight the substantial impact of injuries on training and support targeted prevention strategies—such as skill progression, load management, and appropriate scaling—to promote safer long-term participation in CrossFit®.

Key words: Sport injury, overuse, shoulder, functional training.

Introduction

CrossFit® is a popular form of high-intensity functional training that combines weightlifting (e.g., deadlifts and snatches), gymnastic movements (e.g., pull-ups and handstand push-ups), and aerobic exercises (e.g., running, rowing, or cycling) into diverse, constantly varied workouts. Typical sessions—commonly referred to as "workouts of the day" (WODs)—last approximately 60 minutes and usually feature one or more short, intense bouts of 5 to 20 minutes, often performed at intensities exceeding 85–90% of maximal heart rate (Claudino et al., 2018; Glassman, 2006). Performed at near-maximal effort with minimal recovery, sessions typically challenge multiple domains of fitness — strength, power, endurance, flexibility, and coordination — with athletes often completing 3 to 6 sessions per week (Meier et al., 2023). The group-training environment, which can involve classes of 8 to 20 athletes per session, combined with its competitive yet supportive atmosphere, has been shown to enhance motivation, adherence, and sense of community (Schlegel and Krehky, 2022; Simpson et al., 2017), fueling CrossFit's global growth to more than 10,000 affiliated gyms worldwide (CrossFit, LLC, 2025).

Epidemiological evidence indicates that injury rates in CrossFit® typically range between 2 and 5 per 1,000 hours of training, with the most frequently affected areas being the shoulder, spine, and knee (Cheng et al., 2020; Moran et al., 2017; Tafuri et al., 2016). Reported injury prevalence in CrossFit® ranges from 19.4% to 73.5%, while injury incidence rates vary between 12.8% and 66.2% (Brandsema et al., 2022). Multiple factors appear to contribute to these injuries, including athletes' level of experience, technical skill, training volume and intensity, and history of prior musculoskeletal complaints (Mehrab et al., 2017; Nicolay et al., 2022; Summitt et al., 2016). Novices, especially those practicing for less than six months, seem to face a substantially higher injury risk, likely due to underdeveloped movement patterns and insufficient adaptation to the high training loads (Chachula et al., 2016). Moreover, competitive athletes may be more prone to injuries due to increased psychological pressure to perform at higher intensities or attempt complex exercises beyond their current skill level (Aune and Powers, 2017).

Despite this growing body of research, findings across studies remain inconsistent. Some authors highlight insufficient technique and excessive training intensity as primary risk factors (Nicolay et al., 2022; Summitt et al., 2016), while others have failed to establish significant relationships between injuries and variables such as age, gender, or weekly training volume (Feito et al., 2018; Szajkowski et al., 2023). These contradictions may be explained by the diverse CrossFit® practices across countries and training environments, as well as variations in research design, injury definition, and methods of data collection. Such variability complicates direct comparisons and underscores the need for further context-specific investigations.

More detailed research is therefore needed to better understand how individual characteristics—such as age, CrossFit® experience, and training habits—influence the risk of injury. In particular, little is known about these relationships in the context of Czech CrossFit® athletes, who practice under a wide range of training conditions. Accordingly, the aim of this study was to examine the prevalence

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and types of injuries, identify key risk factors associated with injury occurrence, and evaluate the impact of injuries on athletes' training routines in a sample of CrossFit® practitioners in the Czech Republic.

Methods

This cross-sectional study was conducted using an anonymous online questionnaire distributed to CrossFit® athletes across the Czech Republic. Recruitment targeted all officially licensed CrossFit® affiliates (CrossFit® boxes) in the country. Gym owners and coaches were contacted via email and social media platforms and invited to share the survey link with their athletes.

Individuals aged ≥18 years who had practiced CrossFit® regularly for at least six consecutive months were eligible to participate in the study. There were no restrictions based on sex, fitness level, competitive status, or nationality, ensuring a diverse and representative sample of the CrossFit® community. To ensure consistency in training conditions, participants were required to be active members of an officially licensed CrossFit® affiliate in the Czech Republic and to train either in structured classes or individually within these facilities. The questionnaire was self-administered in Czech; therefore, participants were required to be proficient in Czech to ensure accurate understanding of the questions. Athletes were included regardless of their prior athletic background, frequency of participation in competitions, or specific training goals. Participants provided informed consent prior to starting the questionnaire.

Data were collected between January and March 2025. The self-administered questionnaire was hosted on a secure online survey platform and included items on demographic characteristics (age, sex, body mass, height), training habits (training experience, weekly training frequency and duration, competition participation), and history of musculoskeletal injuries sustained during CrossFit® training. Injury was defined as any musculoskeletal complaint sustained during CrossFit® training that resulted in restriction of training or need for medical attention.

The front page of the e-survey explicitly described the study's objectives and background, data protection measures, anticipated use of the results, inclusion criteria, and other important information before respondents started the survey. The survey was completed anonymously, and all personal identifiers were excluded during data collection. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. The study was approved by the Ethics Committee of the University of Hradec Králové (No. 16/2025).

In this study, an injury was defined according to the criteria outlined by Feito et al. (2018) as any muscle, tendon, bone, joint, or ligament injury sustained during CrossFit® training that resulted in consultation with a physician or healthcare provider and caused the participant to stop or reduce their usual physical activity, typical participation in CrossFit®, or required surgical intervention.

Questionnaire

The questionnaire was designed as a structured, self-administered, online survey tool aimed at collecting data on the epidemiology and characteristics of injuries sustained during CrossFit® training and competitions. The instrument was constructed based on a thorough review of the current literature, including similar instruments published in sports injury epidemiology research (e.g. Lenz et al., 2024; Feito et al., 2018; Szajkowski et al., 2023). A formal pilot or pre-test with a representative sample was not conducted. Instead, the development process involved multiple rounds of expert consultation with experienced researchers in sports science and physiotherapy to ensure that all items were relevant, clearly formulated, and comprehensive with respect to the research objectives.

The questionnaire was divided into multiple sections, utilizing both closed- and open-ended questions to enable a balanced collection of quantitative data and qualitative details. The first section focused on demographic characteristics (e.g. age, sex, height, weight), training history (e.g. years and hours per week dedicated to CrossFit®), background in other sports, motivation for training, and injury prevention strategies. The second section inquired about the occurrence of injuries in the past 6 months, including detailed information about the injury type (e.g. tear, overuse, fracture), anatomical location, mechanism of occurrence, impact on training (e.g. interruptions and modifications), and the treatment sought (e.g. physiotherapy, surgery, injections, prescription medication). Response options were carefully constructed to minimize ambiguity, and branching logic was incorporated so that only respondents who experienced an injury were directed to further questions about their injuries.

In some cases, particularly for questions related to the type of injury sustained, an open-ended response format was used rather than a closed list of predefined options. This methodological choice was intended to avoid restricting participants' answers to a limited set of categories and to allow them to describe their experience in their own terms. Following data collection, these free-text responses were carefully reviewed and systematically grouped into thematic categories. This approach was especially important because respondents could typically identify the general location of pain or discomfort, but without a formal clinical assessment they were not able to provide a definitive diagnosis or specify the affected tissues.

Statistical analysis

Descriptive statistics were used to summarize participant characteristics and injury data. Continuous variables are presented as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Differences between groups were analyzed using Chi-square tests for nominal and categorical variables. Assumptions were checked (≥80% of cells with expected counts >5, none with zero), and the test was chosen for its suitability in assessing associations between categorical variables. To identify potential risk factors for injury, binary logistic regression analyses were conducted. Injured versus non-injured status (yes/no) served as the dependent variable. Independent variables included age, sex, training experience (categorized as <6 months, 6–12 months, 12–24 months, and >24 months), and weekly training volume (1–3, 3–5, 6–9, and

>9 h/week). Reference categories were: female sex, training experience of 12–24 months, weekly training volume of 1–3 h/week, and participation in competitions. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for each predictor. Model stability was assessed using the events-per-variable ratio, which exceeded the recommended minimum threshold. Model fit was evaluated using the model χ^2 test ($p = 0.005$) and Nagelkerke R^2 ($R^2 = 0.054$). Statistical analyses were performed using IBM SPSS Statistics (Version 29.0), and the significance level was set at $p < 0.05$.

Results

The study sample consisted of 456 individuals (12 excluded due to incomplete data), including 214 men and 242 women. The male participants had a mean age of 33.23 ± 7.10 years, mean weight of 89.63 ± 11.28 kg, and mean height of 181.71 ± 6.43 cm. Female participants had a mean age of 30.64 ± 8.05 years, mean weight of 67.76 ± 10.19 kg, and mean height of 168.55 ± 6.37 cm. The most common CrossFit® experience level was more than 24 months of training. Detailed demographic and training characteristics of the respondents are provided in Table 1. In the past 6 months, 36.4% reported sustaining an injury during CrossFit® training. There was no significant difference in injury occurrence between men and women ($\chi^2 = 0.014$; $p = 0.907$), indicating that the risk of injury is comparable for both sexes.

As shown in Table 2, snatches, box jumps, deadlifts, cleans, and pull-up variations were the most common movements associated with injuries, together accounting for a substantial proportion of all reported cases. Gymnastic movements such as handstand push-ups, rope climbs, and GHD sit-ups, were less frequently involved. Across most exercises, the proportion of female participants reporting injuries was slightly higher, especially for movements like snatches and pull-up variations.

The most common injury locations were the spine (30.7%), shoulder (28.3%), and palm (14.5%), with women representing a greater proportion of injuries across most body regions. The detailed breakdown of injury sites is shown in Table 3.

Among the participants who sustained injuries in the last six months, 75.3% reported that the injury forced them to interrupt their training (45.6% male, 54.4% female). Nearly as many (74.7%) indicated that they had to modify their training routines due to the injury (50.0% male, 50.0% female). The most common period for training interruption was between one day and one week (52.4%). Furthermore, 60.2% sought professional help after the injury (46.0% male and 54.0% female).

Table 1. Participants characteristics

Variable	Variable	Injured athletes	Uninjured athletes	Total
CrossFit experience	12 - 24 months	111 (66.9%)	204 (70.3%)	315 (69.1%)
	6 - 12 months	16 (9.6%)	22 (7.6%)	38 (8.3%)
	< 6 months	4 (2.4%)	21 (7.2%)	25 (5.5%)
	> 24 months	35 (21.1%)	43 (14.8%)	78 (17.1%)
Trainig volume (weekly)	1 - 3 hours	43 (25.9%)	64 (22.1%)	107 (23.5%)
	3 - 5 hours	25 (15.1%)	75 (25.9%)	100 (21.9%)
	6 - 9 hours	74 (44.6%)	117 (40.3%)	191 (41.9%)
	> 9 hours	24 (14.5%)	34 (11.7%)	58 (12.7%)
Preferred training format	Alone	49 (29.5%)	90 (31.0%)	139 (30.5%)
	In a group	100 (60.2%)	175 (60.3%)	275 (60.3%)
	With a partner/friend	17 (10.2%)	25 (8.6%)	42 (9.2%)
CrossFit competitions	Yes	98 (59.0%)	130 (44.8%)	228 (50.0%)
	No	68 (41.0%)	160 (55.2%)	228 (50.0%)
Regular participation in other sports	Yes	103 (62.0%)	181 (62.4%)	284 (62.3%)
	No	63 (38.0%)	109 (37.6%)	172 (37.7%)
Previous experience with fitness training	Yes	128 (77.1%)	226 (77.9%)	354 (77.6%)
	No	38 (22.9%)	64 (22.1%)	102 (22.4%)
Prevention of health problems	Yes	47 (28.3%)	100 (34.5%)	147 (32.2%)
	No	119 (71.7%)	190 (65.5%)	309 (67.8%)
Strength and conditioning for another sport	Yes	28 (16.9%)	50 (17.2%)	78 (17.1%)
	No	138 (83.1%)	240 (82.8%)	378 (82.9%)
Escape from daily life	Yes	63 (38.0%)	97 (33.4%)	160 (35.1%)
	No	103 (62.0%)	193 (66.6%)	296 (64.9%)
Improving fitness	Yes	93 (56.0%)	178 (61.4%)	271 (59.4%)
	No	73 (44.0%)	112 (38.6%)	185 (40.6%)
Increasing muscular strength	Yes	77 (46.4%)	132 (45.5%)	209 (45.8%)
	No	89 (53.6%)	158 (54.5%)	247 (54.2%)
Community	Yes	71 (42.8%)	112 (38.6%)	183 (40.1%)
	No	95 (57.2%)	178 (61.4%)	273 (59.9%)
Participation in competitions	Yes	29 (17.5%)	25 (8.6%)	54 (11.8%)
	No	137 (82.5%)	265 (91.4%)	402 (88.2%)
Mental health	Yes	63 (38.0%)	119 (41.0%)	182 (39.9%)
	No	103 (62.0%)	171 (59.0%)	274 (60.1%)
Other	Yes	2 (1.2%)	2 (0.7%)	4 (0.9%)
	No	164 (98.8%)	288 (99.3%)	452 (99.1%)

Table 2. Frequency and distribution of injuries by exercise type.

Exercise	Count	%	% Male	% Female
Box Jump	36	10.9	55.6	44.4
Burpee	4	1.2	50	50
Ghd Sit-Up	4	1.2	50	50
Rope Climb	7	2.1	14.3	85.7
Handstand Push-Up	10	3	40	60
Handstand Walk	8	2.4	50	50
Muscle Up Variations	16	4.9	87.5	12.5
Pull Up Variations	30	9.1	36.7	63.3
Push-Up	7	2.1	28.6	71.4
Lunges	4	1.2	75	25
Devils Press	4	1.2	75	25
Deadlift	30	9.1	60	40
Clean	26	7.9	65.4	34.6
Shoulders To Overhead	11	3.3	45.5	54.5
Snatch	42	12.8	35.7	64.3
Toes To Bar	12	3.6	25	75
Squat (All Types)	37	11.2	45.9	54.1
Other	41	12.5	48.8	51.2

Table 3. Injury locations.

Location	Count	%	% Male	% Female
Head	6	3.6	33.3	66.7
Spine	51	30.7	39.2	60.8
Ribs	7	4.2	28.6	71.4
Pelvis	7	4.2	14.3	85.7
Shoulder	47	28.3	48.9	51.1
Arm	15	9	53.3	46.7
Elbow	9	5.4	66.7	33.3
Forearm	7	4.2	42.9	57.1
Wrist	23	13.9	47.8	52.2
Palm	24	14.5	29.2	70.8
Fingers	13	7.8	61.5	38.5
Hip	7	4.2	42.9	57.1
Thigh	10	6	50	50
Knee	17	10.2	47.1	52.9
Lower Leg	14	8.4	57.1	42.9
Ankle	9	5.4	44.4	55.6
Foot	3	1.8	33.3	66.7
Toes	2	1.2	50	50

These results highlight the substantial impact of injuries on continued CrossFit® participation and the need for prevention strategies. Complete details are summarized in Table 4.

Individuals who sustained an injury were, on average, younger (30.8 ± 7.1 years) than those who did not report an injury (33.1 ± 7.4 years; $t = -2.68$; $p = 0.008$) and reported a higher weekly training volume (5.9 ± 2.5 h/week vs. 5.3 ± 2.3 h/week; $t = 2.00$; $p = 0.046$). Differences in CrossFit® training experience were marginally significant ($\chi^2 = 7.63$; $p = 0.054$), with athletes who had more experience showing a lower incidence of injury, although this trend did not reach statistical significance.

The analysis of differences between groups in injury occurrence by CrossFit® experience ($\chi^2 = 7.63$; $p = 0.054$) and the number of training hours per week ($\chi^2 = 7.35$; $p = 0.062$) revealed no significant differences between groups. However, in both cases, a borderline trend toward a higher injury rate was observed among intermediate athletes and those with greater training volumes.

Overuse injuries were by far the most common, accounting for nearly half of all cases (49.2%, n = 175). Skin-related injuries were the second most prevalent (9.6%, n = 34), followed by muscle or tendon tears (8.4%, n = 30) and joint dislocations (7.9%, n = 28). Injuries involving other joint structures (e.g. sprains and strains) made up 7.3% of cases (n = 26). Fractures were the least common, comprising only 2.8% of all reported injuries (n = 10).

Logistic regression (Table 5) identified two significant predictors of injury occurrence: age (OR = 0.97; 95% CI: [0.94–0.99]; $p = 0.032$) and competition participation (OR = 0.61; 95% CI: [0.39–0.96]; $p = 0.039$). Increasing age was associated with a slightly lower likelihood of sustaining an injury. Similarly, respondents who did not participate in competitions had a significantly lower probability of injury compared to those who did. Other factors (sex, length of experience, and weekly training hours) were not significant predictors of injury occurrence in this model.

Discussion

This study investigated the prevalence, types, and risk factors of injuries among Czech CrossFit® practitioners. The findings indicate that injuries are a common occurrence in this population, with 36.4% of participants reporting at least one injury in the past six months. The most affected anatomical regions were the spine, shoulder, and palm, and the most frequently involved exercises were snatches, box jumps, deadlifts, cleans, and pull-up variations. Furthermore, age and competitive participation emerged as significant predictors of injury risk.

The injury rate observed in this study aligns with prior research indicating substantial injury rates among CrossFit® athletes, typically ranging between 19.4% and 73.5% prevalence, with incidence estimates from approximately 2.1 to 5.3 injuries per 1,000 training hours (Brandsema et al., 2022; Feito et al., 2018; Cheng et al., 2020; Lenz et al., 2024; Moran et al., 2017). Our findings also support evidence that overuse injuries represent the most prevalent injury type in CrossFit®, accounting for nearly 50% of cases, followed by skin lesions and muscle or tendon tears. This distribution is similar to those reported by other investigators (Alekseyev et al., 2020; Aune and Powers, 2017; da Costa et al., 2019), suggesting that high-repetition, high-intensity sessions may contribute to the accumulation of microtrauma over time.

Table 4. Impact of injuries on training routine.

Reported variables	Reported variables	Count	%	% Male	% Female
Injury sustained (last 6 months)	Yes	166	36.4	47.6	52.4
	No	290	63.6	46.6	53.4
Training interrupted due to injury	Yes	125	75.3	45.6	54.4
	No	41	24.7	53.7	46.3
Training routine modified after injury	Yes	124	74.7	50	50
	No	42	25.3	40.5	59.5
Duration of training break	1 day to 1 week	87	52.4	46	54
	1 week to 1 month	44	26.5	56.8	43.2
	1 - 3 months	22	13.3	36.4	63.6
	More than 3 months	13	7.8	46.2	53.8
Duration of training modifications	1 day to 1 week	48	28.9	43.8	56.2
	1 week to 1 month	46	27.7	41.3	58.7
	1 - 3 months	31	18.7	54.8	45.2
	More than 3 months	34	20.5	50	50
	I had to stop CrossFit entirely	7	4.2	71.4	28.6
Number of injuries	One only	96	57.8	46.9	53.1
	Two	49	29.5	49	51
	Three or more	21	12.7	47.6	52.4
Injury occurrence	During the session	114	68.7	49.1	50,9
	During independent exercise without time pressure	23	13.9	47.8	52.2
	At the end (during the last exercise)	17	10.2	41.2	58.8
	At the beginning	12	7.2	41.7	58.3
Professional help sought	Yes	100	60.2	46	54
	No	66	39.8	50	50
Type of professional help	Surgery	16	12.2	37.5	62.5
	Physiotherapy	83	63.4	47	53
	Prescription medication	17	13	47.1	52.9
	Injection	15	11.5	40	60
Injury prevention equipment	Chalk	368	27.9	46.7	53.3
	Kinesiology tape	172	13	49.4	50.6
	Hand grips	343	26	49.3	50.7
	Weightlifting belt	212	16.1	52.4	47.6
	Lifting straps / gloves	72	5.5	54.2	45.8
	Joint supports	123	9.3	63.4	36.6
	None of the above	28	2.1	46.4	53.6

Table 5. Logistic regression results.

Variables	Coef	OR	CI_lower	CI_upper	p_value
const	0.74	2.10	0.63	7.00	0.22
Age	- 0.03	0.97	0.94	1.00	0.03
Sex	- 0.14	0.87	0.58	1.31	0.51
CrossFit experience 6 - 12 months	0.08	1.08	0.48	2.44	0.85
CrossFit experience < 6 months	- 1.13	0.32	0.10	1.07	0.06
CrossFit experience > 24 months	- 0.35	0.70	0.42	1.19	0.19
Training volume 3 - 5 hours / week	0.43	1.54	0.87	2.72	0.14
Training volume 6 - 9 hours / week	0.21	1.23	0.61	2.47	0.56
Training volume > 9 hours / week	0.18	1.20	0.54	2.67	0.66
CrossFit competitions partitipation	- 0.49	0.61	0.38	0.97	0.04

Reference categories: sex = female; CrossFit® experience = 12–24 months; training volume = <3 h/week; competition participation = yes. Model p = 0.005; Nagelkerke R^2 = 0.0054.

The lack of significant sex differences in injury occurrence is consistent with some previous reports that male and female athletes share a similar risk profile in CrossFit® (Feito et al., 2018; Hopkins et al., 2019). However, the most injured body regions showed a higher proportion of female athletes reporting injuries, particularly for exercises like snatches and pull-up variations. This pattern might reflect different movement strategies or strength profiles between sexes (Bartolomei et al., 2021; Gourgoulis et al., 2002), warranting further biomechanical investigation. Additionally, sex-specific factors may play a role in these injury patterns. Greater joint mobility and flexibility in women, which can exceed that of men by several degrees, may influence movement control and joint stability during high-speed or loaded exercises (Arshad et al., 2019; Neto et al., 2023). Moreover, hormonal fluctuations across the menstrual cycle can impact neuromuscular function and tissue laxity, with some phases associated with increased ligamentous laxity and a potentially higher risk of injury (MacMillan et al., 2024).

Interestingly, athletes who sustained injuries were on average younger and trained more hours per week than their uninjured counterparts. Although differences in training experience failed to reach statistical significance, a marginal trend suggested a protective effect of greater CrossFit® experience. This is supported by prior research identifying novice athletes as particularly susceptible to injury due to incomplete skill development and insufficient adaptation of connective and muscular tissues to sport-specific loads (Mehrab et al., 2017; Moran et al., 2017). Furthermore, more experienced athletes typically have better-developed soft-tissue resilience and greater neuromuscular control, allowing them to tolerate progressive increases in training volume and intensity more safely (Brandsema et al., 2022). They may also possess more refined self-regulation skills, enabling them to optimize load management and recognize early signs of overreaching or discomfort before an acute or overuse injury develops (Caparros, 2024; Inoue et al., 2022). Our logistic regression analysis confirmed that age was a significant protective factor, in line with findings that younger athletes may be more prone to aggressive training behaviors, potentially elevating their injury risk due to more frequent or higher-intensity sessions (Aune and Powers, 2017). However, conclusions across studies remain inconclusive, as other investigations have not found age to be a significant predictor of injury occurrence (Alekseyev et al., 2020; Ferreira et al., 2025).

Most injuries did not require surgery but significantly disrupted training—over 75% of athletes had to interrupt or modify their routines, and around 60% sought professional care. While 57.6% returned to full training within a month, nearly a quarter needed more than three months to recover, indicating that some injuries were more severe or persistent. These findings highlight the relevance of injury prevention strategies, early management of complaints, and a greater emphasis on skill mastery and gradual progression of intensity—especially for intermediate-level athletes (Lau and Mukherjee, 2023; Thornton et al., 2021). Implementing appropriate warm-ups, scaling exercises according to skill level, and emphasizing movement quality may help reduce the risk of recurrent injuries, (Emery and Pasanen, 2019; Nicolay et al., 2022).

When examining exercises most commonly associated with injuries, the snatch and pull-up variations accounted for 12.8% and 9.1%, respectively. However, when grouping movements by their primary pattern, Olympic weightlifting exercises (e.g., cleans, shoulders-to-overhead, snatches) together comprised approximately 23% of all reported injuries. Similarly, grouping exercises that involve hanging (e.g., pull-up variations, muscle-ups, toes-to-bar) resulted in a total of 17.8%. These findings, while not directly identifying the injured region for each movement, support the assumption—also reported in prior research—that exercises involving high mechanical demands on the shoulder may contribute to its vulnerability and higher injury incidence (Brandsema et al., 2022).

Our findings align with trends observed across several European studies, which report similar injury prevalence rates ranging from approximately 22% to 48% (Ferreira et al., 2025; Lenz et al., 2024; Minghelli and Vicente, 2019; Szajkowski et al., 2023; Tafuri et al., 2019). The most affected areas include the shoulder and lumbar spine, with key risk factors identified as training frequency, competition participation, and experience. Despite methodological differences among studies, there is remarkable consistency in the type and location of injuries reported.

In exercises that involve lifting, such as deadlifts and squats, biomechanical loading of the lumbar spine plays a critical role in the etiology of low-back injuries. The deadlift, especially under substantial load, generates significant anterior shear and compressive forces across the lumbar spine and sacroiliac junction (Erdağı and Poyraz, 2020; Herbaut and Tuloup, 2025). Poor control of the lumbar spine and core during these compound lifts can lead to cumulative microtrauma to vertebral endplates, discs, and surrounding soft tissues. Repetitive high-intensity squatting, particularly at end ranges of hip flexion, also stresses posterior spinal structures and lumbopelvic stabilizers, increasing the risk of overuse syndromes (Hopkins et al., 2019; Stone et al., 2024; Straub and Powers, 2024).

Similarly, overhead movements and dynamic body weight exercises place the shoulder complex under substantial stress due to high degrees of humeral elevation, rapid deceleration forces, and significant torque at the glenohumeral and scapulothoracic joints (Williamson and Price, 2021). Olympic weightlifting variants (e.g., snatches, clean and jerks) and hanging exercises (e.g., muscle-ups, kipping pull-ups, toes-to-bar) require rapid shoulder stabilization under load, creating high tensile forces in the rotator cuff tendons and bicipital apparatus (Dinunzio et al., 2019; Rahim et al., 2017; Soriano et al., 2019). These demands are compounded by repeated end-range motions, especially if scapular control and thoracic mobility are insufficient, which can predispose athletes to impingement syndromes, labral tears, or tendinopathies.

Several limitations must be acknowledged. This was a self-reported, cross-sectional survey, and as such, the data may be subject to recall bias or under-reporting of minor injuries that did not require professional attention (Everhart et al., 2020; Stracciolini et al., 2020). Furthermore, some questions allowed for open-ended responses, and respondents may not have accurately recognized or classified an injury or health issue if it was not assessed by a healthcare professional. This could have introduced additional variability into the data, potentially affecting the precision of the findings.

Future research should aim to incorporate longitudinal designs and objective injury assessments to better capture the onset and progression of injuries over time. Additionally, more detailed biomechanical and training load analyses could help identify sport-specific risk factors and inform targeted prevention strategies for CrossFit® athletes.

Conclusion

This study found that injuries are relatively common among Czech CrossFit® athletes, most often affecting the spine, shoulder, and palm. Olympic lifts and hanging movements were frequently implicated, likely due to their high biomechanical demands. While injury rates were similar across sexes, women reported more shoulder injuries. Younger age and higher training volume increased injury risk, whereas greater experience appeared protective. Although most injuries were minor, a notable proportion required extended recovery. These findings underscore the importance of proper warm-ups, load management, and technique. Future longitudinal studies with objective data are needed to guide more effective injury prevention strategies in CrossFit®.

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Key points

- 36.4 % of CrossFit athletes reported at least one injury in the past 6 months, with no significant difference between men and women.
- Spine, shoulder, and palm were the most injured anatomical regions.
- Injured athletes were younger and had a higher weekly training volume compared to uninjured athletes.

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