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Who Hurts Where? Mapping the Burden of Overuse in Youth and Amateur Athletes Across High-Impact Sports

¿Quién sufre dónde? Mapeo de la Carga del Sobreuso en Atletas Jóvenes y Aficionados en Deportes de Alto Impacto

Dusan Strbac[1]; Dusica L. Maric[2]; Gordana Velikic[3,4]; Dusan M. Maric[4,5]; Nikola Vucinic[2]; Marija Maric[1]; Lidija Markovic[6]; David Cukanovic[1] & Dragana Radosevic[2]

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SUMMARY: Overuse symptoms, including fatigue, musculoskeletal pain, and stiffness, are common among athletes who are exposed to sustained training loads and inadequate recovery. These symptoms can progress into overtraining syndrome or chronic injury, particularly in younger or less conditioned individuals. Despite this, few studies have profiled overuse symptoms across multiple sports and training levels. The aim of this study was to assess the prevalence, anatomical distribution, and training-related correlates of overuse symptoms in amateur and professional male athletes engaged in football, basketball, and athletics. A cross-sectional study was conducted on 209 male athletes aged 15 to 37 years, who completed a standardized questionnaire assessing the presence and localization of overuse symptoms, as well as training routines. Descriptive and inferential statistical analyses, including chi-square tests, ANOVA, and Fisher's exact tests, were employed to assess differences in symptom prevalence across various sport types, age groups, and levels of athletic engagement. Fatigue was reported by 93.3 % of participants, and pain by 65.1 %. Pain prevalence was significantly higher among amateurs than among professionals (70.6 % vs. 54.8 %, $p = 0.033$) and showed a trend of increasing prevalence among younger athletes. Sport-specific symptom localization was observed, with lower limb symptoms predominating in football (hamstrings, quadriceps, and groin), ankle and shoulder symptoms in basketball, and lower back and knee symptoms in athletics. Higher weekly training hours and longer warm-up/stretching durations were associated with increased symptom reports, although the association was not statistically significant. Overuse symptoms are widespread among both amateur and professional athletes, with notable sport- and age-specific patterns. These findings support the need for early screening, individualized training load monitoring, and better coach-athlete education to prevent chronic musculoskeletal disorders and performance decline.

KEY WORDS: Overuse syndrome; Athlete health; Football; Basketball; Athletics.

INTRODUCTION

The physical demands of modern athletic training have intensified across all levels of sport, driven by trends toward early specialization, year-round competition, and high-performance expectations (Bell *et al*., 2019). These demands often exceed the adaptive capacity of young or underconditioned athletes, leading to a spectrum of physiological disturbances and musculoskeletal injuries that can impair long-term performance and health outcomes (Brenner & Council on Sports Medicine and Fitness, 2016; Giusti *et al*., 2020).

Contemporary training paradigms, particularly in high-impact sports, place unprecedented physiological stress on developing musculoskeletal systems, with youth athletes now training at volumes and intensities previously reserved for elite adult competitors (Myer *et al*., 2015; Jayanthi *et al*., 2019).

Among the most prevalent and insidious issues in this context are overuse-related symptoms, which arise from repetitive submaximal loading without sufficient recovery.

[1] Faculty of Medicine,University of Novi Sad, Serbia.
[2] Department of Anatomy, University of Novi Sad, Faculty of Medicine, Serbia.
[3] Hajim School of Engineering, University of Rochester, Rochester, NY, USA.
[4] Department for Research and Development, Clinic OrtoMD-P.A.R.K.S. Hospital, Novi Sad, Serbia.
[5] Faculty of Stomatology Pancevo, University Business Academy, Pancevo, Serbia.
[6] Physical and Health Education Unit, Faculty of Sport and Physical Education, University of Novi Sad, Serbia.

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Common manifestations include pain, fatigue, muscle stiffness, and joint discomfort, which, if left unaddressed, may develop into overtraining syndrome or chronic injury (Kreher & Schwartz, 2012; Aicale *et al*., 2018). Overtraining syndrome represents a maladaptive physiological state characterized by prolonged fatigue, mood disturbances, and systemic dysfunction involving the neuromuscular, immune, and endocrine systems (Rizzone *et al*. 2017; Aicale *et al*., 2018). The distinction between functional overreaching (a temporary state that can enhance performance with adequate recovery) and non-functional overreaching or overtraining syndrome (a pathological state requiring extended recovery periods) remains clinically challenging but critically important for athlete health management (Pfirmann *et al*., 2018; Fallon, 2020).

Multiple factors, including training volume and intensity, age, neuromuscular maturity, biomechanics, and recovery practices, influence the development of overuse symptoms. Additional risk factors include inadequate nutrition, poor sleep quality, psychological stress, and environmental conditions (Jayanthi *et al*., 2018). Sports involving high-impact or rapid directional changes, such as football, basketball, and athletics, impose substantial loads on the lower limbs and are associated with a higher incidence of soft tissue injuries and tendinopathies (Schwellnus *et al*., 2016; Eckard *et al*., 2017; Harper *et al*., 2019; Donovan *et al*., 2020; Goes *et al*., 2020; Räisänen *et al*., 2021; Zeleznik *et al*., 2023). The epidemiological burden of overuse injuries in these sports has increased significantly over the past two decades, with some studies reporting that overuse injuries now account for 30-50 % of all sports-related injuries in youth populations (Waldén *et al*., 2005; Drakos *et al*., 2010).

Despite this, few studies have systematically examined the distribution and frequency of overuse symptoms across different sports disciplines, age groups, and training profiles, particularly in mixed amateur and professional populations. Previous research has predominantly focused on single sports or elite populations, creating a significant knowledge gap regarding overuse symptom patterns in the broader athletic community (Van der Worp *et al*., 2015). Moreover, symptom tracking and injury prevention strategies often remain underdeveloped in amateur settings, where medical oversight may be limited. The lack of standardized screening tools and inconsistent definitions of overuse symptoms across studies further complicate our understanding of this phenomenon.

A better understanding of symptom prevalence and localization, especially when stratified by sport and competition level, may inform targeted interventions, improve athlete longevity, and reduce the risk of chronic injury or dropout from sport. Such knowledge is particularly crucial given the growing concern about early sport specialization and its associated risks, including increased susceptibility to overuse injuries and psychological burnout.

Accordingly, this study aimed to assess the prevalence, anatomical distribution, and training-related correlates of overuse symptoms in male amateur and professional athletes participating in football, basketball, and track and field athletics. By identifying sport-specific patterns, we aim to contribute to evidence-based prevention strategies and individualized management of training loads. Specifically, we hypothesized that: (1) overuse symptoms would be more prevalent in amateur compared to professional athletes due to differences in training sophistication and medical support; (2) symptom localization would demonstrate sport-specific patterns reflecting the biomechanical demands of each discipline; and (3) higher training volumes would be associated with increased symptom prevalence across all sports.

MATERIAL AND METHOD

Study Design and Participants: This cross-sectional study was conducted at multiple sports facilities in Novi Sad, Serbia, between March 1, 2024, and March 1, 2025. A total of 209 male athletes, including both amateur and professional participants, aged between 15 and 37 years, participated in the study. The sample included participants from three sports disciplines: football (n = 107, 51.2 %), basketball (n = 79, 37.8 %), and track and field (n = 23, 11.0 %).

Inclusion criteria were: (1) male athletes actively participating in organized training and competition; (2) minimum of 2 years of experience in their primary sport; (3) current training frequency of at least three sessions per week; and (4) ability to understand and complete the questionnaire in Serbian. Exclusion criteria included: (1) current acute injury requiring medical treatment; (2) history of major surgery in the past 6 months; (3) chronic medical conditions affecting exercise capacity; and (4) concurrent participation in multiple sports at competitive levels.

Professional athletes are defined as those who receive monetary compensation for their participation in athletics and compete at national or international levels. Amateur athletes were defined as those participating in organized sport without financial compensation, competing at regional or local levels. The results are presented in Tables I and II, at the end of this section.

Table I. Demographic and training characteristics of athletes by sport discipline.

Variable	Basketball	Athletics	Soccer	Total	p-value
N (%)	79 (37.8)	23 (11.0)	107 (51.2)	209 (100.0)	
Competition Level					
Professional, n (%)	30 (41.1)	11 (15.1)	32 (43.8)	73 (100.0)	p=0.203, X^2 = 3.193
Amateur, n (%)	49 (36.0)	12 (8.8)	75 (55.1)	136 (100.0)	
Age group in years, n (%)					
15-19	51 (38.9)	8 (6.1)	72 (55.0)	131 (100.0)	p=0.013, X^2 = 8.743
20-37	28 (35.9)	15 (19.2)	35 (44.9)	78 (100.0)	
Age of Sport Initiation, mean (SD)	8.67 (2.60)	10.61 (4.12)	6.37 (1.81)	7.71 (2.86)	p<0.001, F =37.677
Years of Participation, mean (SD)	11.09 (4.98)	9.13 (7.88)	13.11 (4.94)	11.91 (5.49)	p=0.001, F = 6.737
Training Days/Week, srednja vrednost (SD)	6.18 (0.94)	5.00 (1.09)	5.77 (0.81)	5.84 (0.96)	p<0.001, F = 16.13
Training Sessions/Day, srednja vrednost (SD)	1.80 (0.63)	1.30 (0.70)	1.81 (0.39)	1.75 (0.55)	p=0.001, F = 9.201
Training Hours/Week,	13.84 (4.80)	10.48 (4.68)	13.70 (4.05)	13.40 (4.51)	p=0.004, F = 5.667
Warm-Up Duration in minutes, n (%)					
5-10	37 (69.8)	3 (5.7)	13 (24.5)	53 (100.0)	p<0.001, X^2= 2.325
11-15	21 (24.1)	10 (11.5)	56 (64.4)	87 (100.0)	
16-20	21 (30.4)	10 (14.5)	38 (55.1)	69 (100.0)	
Stretching Duration After Training in minutes, n (%)					
5-10	54 (34.6)	15 (9.6)	87 (55.8)	156 (100.0)	p=0.073, X^2= 5.242
11-20	25 (47.2)	8 (15.1)	20 (37.7)	53 (100.0)	
Presence of Spinal Deformities, n (%)					
Yes	18 (40.9)	8 (18.2)	18 (40.9)	44 (100.0)	p=0.142, X^2= 3.903
No	61 (37.0)	15 (9.1)	89 (53.9)	165 (100.0)	
Fatigue During Training, n (%)					
None	6 (42.9)	1 (7.1)	7 (50.0)	14 (100.0)	p=0.008, X^2= 3.411
Very Rare	10 (24.4)	2 (4.9)	29 (70.7)	41 (100.0)	
Rare	34 (34.0)	11 (11.0)	55 (55.0)	100 (100.0)	
Frequent	29 (53.7)	9 (16.7)	16 (29.6)	54 (100.0)	
Pain, n(%)					
None	31 (42.5)	6 (8.2)	36 (49.3)	73 (100.0)	p=0.456, X^2= 2.616
Very Rare	29 (36.7)	8 (10.1)	42 (53.2)	79 (100.0)	
Rare	15 (34.9)	5 (11.6)	23 (53.5)	43 (100.0)	
Frequent	4 (28.6)	4 (28.6)	6 (42.9)	14 (100.0)	

Table II. Association of pain and fatigue symptoms with athlete characteristics.

	Pain	No Pain	Total	p-value	Fatigue	No Fatigue	Total	p
N (%)	136 (65.1)	73 (34.9)	209 (100.0)		195 (93.3)	14 (6.7)	209 (100.0)	
Competition Level, n (%)								
Professional	40 (54.8)	33 (45.2)	73 (100.0)	p=0.033,	69 (94.5)	4 (5.5)	73 (100.0)	p=0.775
Amateur	96 (70.6)	40 (29.4)	136 (100.0)	X^2 = 4.542	126 (92.6)	10 (7.4)	136 (100.0)	
Age Group, n (%)								
15-19	90 (68.7)	41 (31.3)	131 (100.0)	p=0.202	124 (94.7)	7 (5.3)	131 (100.0)	p=0.310
20-37	32 (41.0)	46 (59.0)	78 (100.0)		71 (91.0)	7 (9.0)	78 (100.0)	
Spinal Deformities, n (%)								
Yes	34 (77.3)	10 (22.7)	44 (100.0)	p=0.083	42 (95.5)	2 (4.5)	44 (100.0)	p=0.739
No	102 (61.8)	63 (38.2)	165 (100.0)		153 (92.7)	12 (7.3)	165 (100.0)	
Training Hours/ Week, n (%)								
1-14	72 (61.5)	45 (38.5)	117 (100.0)	p=0.288	109 (93.2)	8 (6.8)	117 (100.0)	p=1.000
15+	64 (69.6)	28 (30.4)	92 (100.0)		86 (93.5)	6 (6.5)	92 (100.0)	
Warm-Up Duration, n (%)								
5-15	87 (62.1)	53 (37.9)	140 (100.0)	p=0.267	131 (93.6)	9 (6.4)	140 (100.0)	p=0.778
16-20	49 (71.0)	20 (29.0)	69 (100.0)		64 (92.8)	5 (7.2)	69 (100.0)	
Stretching Duration After Training in minutes, n (%)								
5-10	100 (64.1)	56 (35.9)	156 (100.0)	p= 0.736	147 (94.2)	9 (5.8)	156 (100.0)	p=0.352
11-20	36 (67.9)	17 (32.1)	53 (100.0)		48 (90.6)	5 (9.4)	53 (100.0)	

Ethical Approval and Consent: All participants completed the questionnaire voluntarily after being informed about the purpose and scope of the research. Ethical approval was obtained from the Ethics Committee of the Faculty of Medicine at the University of Novi Sad (Protocol Number: 01-39/292/1). For participants under 18 years of age, parental consent was obtained in addition to participant assent. Participation was anonymous, and informed consent was obtained through written consent forms before data collection.

Data Collection. Data were collected using a structured, self-administered questionnaire delivered electronically via a secure online platform. The questionnaire had eight items designed to assess the presence, intensity, and impact of overuse-related symptoms during training or rest. The questionnaire was developed based on established overuse symptom assessment tools from previous research (Clarsen *et al*., 2013, 2020). Content validity was established through review by three sports medicine specialists and two exercise physiologists. The questionnaire included the following domains:

1. Demographic and training characteristics (age, sport, competition level, training history)
2. Training load parameters (weekly training frequency, daily session duration, total weekly hours)
3. Recovery practices (warm-up duration, stretching practices)
4. Symptom presence and frequency (pain, fatigue, stiffness)
5. Anatomical localization of symptoms (using body diagram)
6. Symptom impact on training and performance
7. Medical history (spinal deformities, previous injuries)

Questions specifically assessed pain, fatigue, anatomical localization of discomfort, and training routines (e.g., duration, warm-up, and stretching practices). Pain and fatigue were assessed using 4-point Likert scales: "never" (0), "very rarely" (1), "rarely" (2), and "frequently" (3). Anatomical localization was assessed using a standardized body diagram with 15 predefined regions.

Data Collection Procedure: Participants were recruited through convenience sampling from sports clubs and training facilities. Data collection sessions were conducted in group settings with trained research assistants present to answer questions and ensure completeness of responses. Each participant completed the questionnaire individually, with an average completion time of 15 to 20 minutes. All data were collected anonymously using participant identification codes.

Statistical Analysis. Data were analyzed using IBM SPSS Statistics, Version 22.0. Descriptive statistics were employed to summarize the data, including means and standard deviations for continuous variables and frequencies and percentages for categorical variables. Differences between groups were assessed using:

- The Chi-square (x^2) test for non-parametric categorical variables
- Analysis of Variance (ANOVA) for parametric continuous variables meeting assumptions of normality and homogeneity of variance
- In cases where expected frequencies were low, Fisher's Exact Test was used as an alternative to x^2

A p-value of <0.05 was considered statistically significant for all tests after correction for multiple comparisons. Results are presented in tables and figures as appropriate. All statistical assumptions were verified before conducting parametric tests, and appropriate non-parametric alternatives were used when assumptions were violated. Missing data (<5 % for any variable) were handled using listwise deletion. Sensitivity analyses were conducted to assess the impact of missing data on key findings.

RESULTS

A total of 209 male athletes (Fig. 1) participated in the study, comprising 107 football players (51.2 %), 79 basketball players (37.8 %), and 23 track and field athletes (11.0 %).

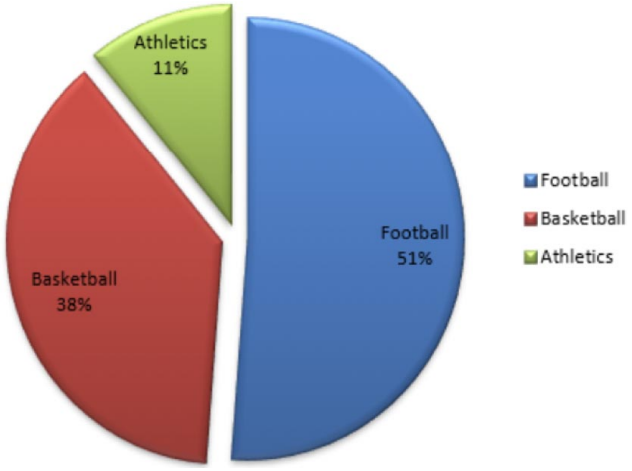

Fig. 1. Distribution of athletes by discipline.

Athlete Classification and Demographics. Among all participants, 73 (34.9 %) were professional athletes and 136 (65.1 %) were amateurs (Fig. 2). The highest proportion of professionals was found in football (43.8 %), while the lowest was in athletics (15.1 %); however, this difference was not statistically significant ($X^2 = 3.193$, $p = 0.203$).

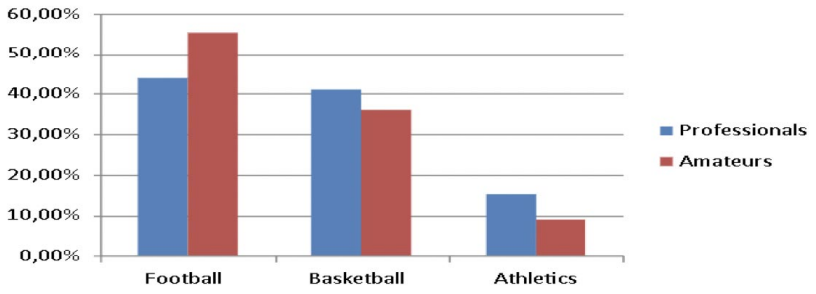

Fig. 2. Distribution of athletes according to the rank.

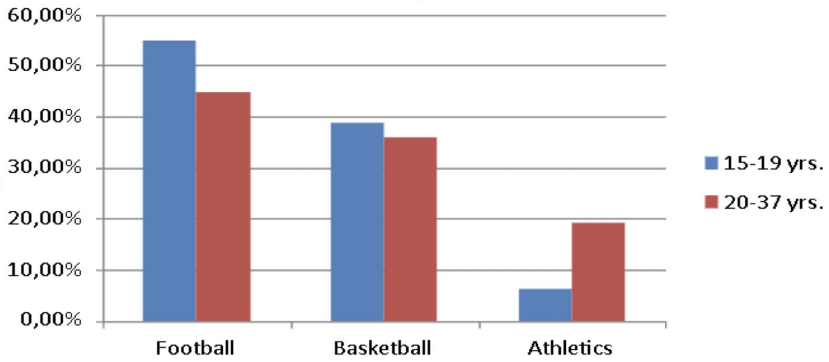

Fig. 3. Distribution of athletes by age

The mean age of participants was 19.91 ± 4.69 years, with a range from 15 to 37 years. Athletes were stratified into two age groups: 15-19 years (62.7 %) and 20-37 years (37.3 %) (Fig. 3). A statistically significant difference in age distribution was observed between sports ($X^2 = 8.743$, $p = 0.013$). Specifically, football and basketball had higher proportions of younger athletes compared to athletics.

Sports Background and Training Load. The average age at which participants began their sport was 7.71 ± 2.86 years, with football players starting the earliest (6.37 ± 1.81 years), followed by basketball (8.67 ± 2.60 years) and athletics (10.61 ± 4.12 years). This difference was statistically significant ($F(2,206) = 37.677$, $p < 0.001$). Post-hoc analysis revealed significant differences between all pairwise comparisons (all $p < 0.05$).

The mean duration of sporting experience was 11.91 ± 5.49 years, with football players reporting the longest involvement (13.11 ± 4.94 years) and track and field athletes the shortest (9.13 ± 7.88 years, $F(2,206) = 6.737$, $p = 0.001$). Post-hoc analysis showed football players had significantly longer experience than athletes ($p = 0.001$), while basketball players (11.09 ± 4.98 years) did not differ significantly from either group.

On average, participants trained 5.84 ± 0.96 days per week, with basketball players training the most frequently (6.18 ± 0.94 days), and track and field athletes the least (5.00 ± 1.09 days, $F(2,206) = 16.13$, $p < 0.001$). Basketball players trained significantly more days than both football (5.77 ± 0.81 days) and athletics (all $p < 0.001$), while football and athletics also differed significantly ($p < 0.05$).

Basketball and football players also engaged in significantly more daily training sessions (1.80 ± 0.63 and 1.81 ± 0.39, respectively) compared to track and field athletes (1.30 ± 0.70, $F(2,206) = 9.201$, $p = 0.001$). Weekly training duration was highest among basketball (13.84 ± 4.80 hours) and football players (13.70 ± 4.05 hours), compared to track and field athletes (10.48 ± 4.68 hours, $F(2,206) = 5.667$, $p = 0.004$).

Warm-Up and Stretching Practices. Significant differences were observed in warm-up durations across sports ($X^2 = 32.325$, $p < 0.001$). Basketball players most frequently reported warm-up periods of 5-10 minutes (69.8 %), while track and field athletes reported longer warm-ups of 16-20 minutes (43.5 %). Football players exhibited intermediate patterns, with 11-15 minute warm-ups being the most common (52.3 %).

Post-training stretching duration patterns showed that football players most often reported 5-10 minute stretches (55.8 %), while track and field athletes favored longer stretching periods (11-20 minutes: 65.2 %). However, these differences across sports were not statistically significant ($X^2 = 5.242$, $p = 0.073$).

Spinal Deformities. Spinal deformities were reported by 44 athletes (21.0 %), with the highest prevalence found among football and basketball players (both 16.8 % of the total sample). In contrast, track and field athletes had the lowest prevalence (4.1 % of the total sample). However, when analyzed by sport-specific proportions, the differences were not statistically significant ($X^2 = 3.903$, $p = 0.142$).

Prevalence of Pain. Pain was reported by 136 athletes (65.1 %), with occurrences described as "very rarely" in 37.8 %, "rarely" in 20.6 %, and "frequently" in 6.7 %. Pain was more commonly reported among amateurs than professionals (70.6 % *vs.* 54.8 %, $X^2 = 4.542$, $p = 0.033$) (Fig. 4).

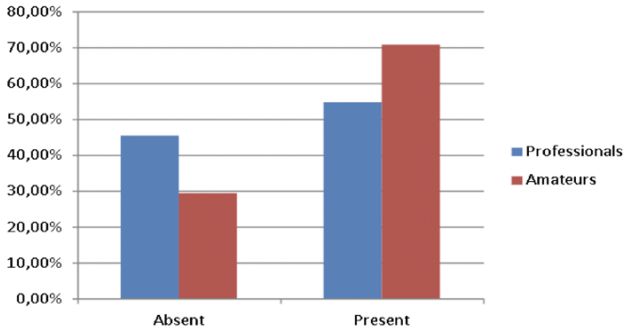

Fig. 4. Pain distribution according to the rank.

Though not statistically significant, younger athletes (15-19 years) reported pain more frequently than older athletes (68.7 % *vs.* 41.0 %, $X^2 = 1.630$, p = 0.202). Athletes with spinal deformities also reported pain more frequently than those without (77.3 % *vs.* 61.8 %, $X^2 = 3.002$, p = 0.083), though the difference was not significant.

Pain prevalence was higher among those training more than 15 hours per week (69.6 % *vs.* 61.5 %, $X^2 = 1.128$, p = 0.288), those who warmed up for more than 15 minutes (71.0 % *vs.* 62.1 %, $X^2 = 1.234$, p = 0.267), and those who stretched for more than 10 minutes post-training (67.9 % *vs.* 64.1 %, $X^2 = 0.114$, p = 0.736), though none of these were statistically significant (Fig. 5).

Prevalence of Fatigue. Fatigue was reported by 195 athletes (93.3 %), occurring "very rarely" in 19.6 %, "rarely" in 47.8 %, and "frequently" in 25.8 %.

Fatigue was slightly more common among professionals than amateurs (94.5 % *vs.* 92.6 %, p = 0.775), younger than older athletes (94.7 % *vs.* 91.0 %, $X^2 = 1.031$, p = 0.310), and those with spinal deformities (95.5 % *vs.* 92.7 %, p = 0.739). However, none of these differences were statistically significant.

No significant differences were observed in fatigue prevalence based on weekly training hours (>15 h: 93.5 % *vs.* ≤15 h: 93.2 %, p = 1.000), warm-up duration (5-15 min: 93.6 % *vs.* 16-20 min: 92.8 %, p = 0.778), or stretching duration (>10 min: 90.6 % *vs.* 5-10 min: 94.2 %, p = 0.352) (Fig. 6).

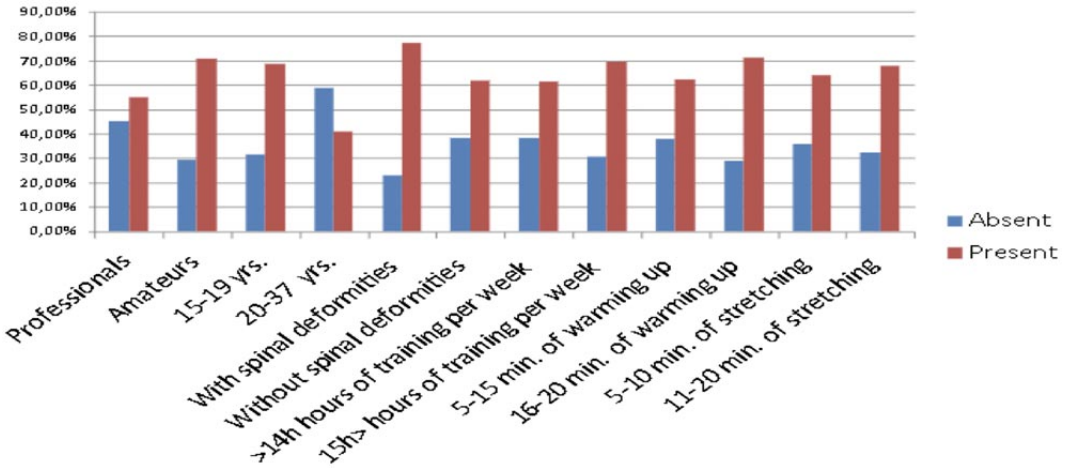

Fig. 5. Pain prevalence. Blue columns - pain absent, red columns - pain present.

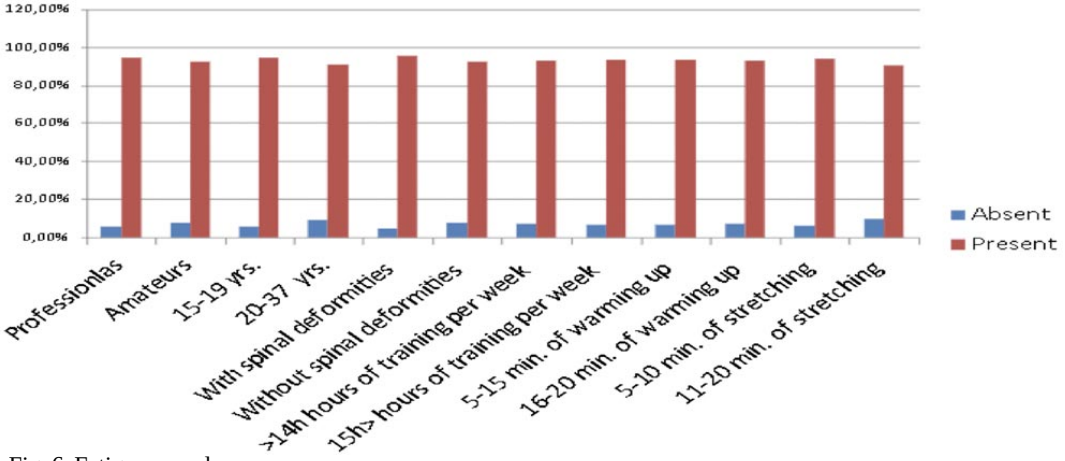

Fig. 6. Fatigue prevalence.

Anatomical Localization of Overuse Symptoms. As shown in Figure 7, overuse symptoms were most frequently localized to the lower limbs, with the highest rates among football players (80.61 %), primarily in the hamstrings (19.38 %), quadriceps (17.83 %), and groin (9.30 %). Among basketball players, symptoms most often affected the ankle (17.43 %) and, notably, the shoulder (7.34 %). In athletics, the most commonly affected regions were the lower back (22.73 %) and knees (15.91 %). Calf and upper back symptoms were reported at similar rates across all three sports.

Sport-Specific Symptom Patterns. When analyzing symptom distribution by sport, distinct patterns emerged. Football players demonstrated a clear lower limb focus, with 80.6 % of all reported symptoms localized to legs and pelvis. Basketball players exhibited a more diverse symptom distribution, with 68.8 % of symptoms in the lower limbs, but notable involvement in the upper limbs, specifically the shoulder (7.34 %). Track and field athletes exhibited a unique pattern with significant axial involvement (lower back: 22.73 %) in addition to lower limb symptoms.

No statistically significant differences in overall symptom prevalence were observed between sports for either pain ($X^2 = 1.557$, $p = 0.459$) or fatigue ($X^2 = 9.943$, $p = 0.008$). However, fatigue distribution patterns varied significantly across sports, with basketball players reporting more frequent symptoms of fatigue. It is important to note that while overall fatigue prevalence did not differ significantly across groups (Section 3.6), the distribution of fatigue frequency across sports was statistically significant ($X^2 = 9.943$, $p = 0.008$), indicating sport-specific differences in the expression of fatigue symptoms.

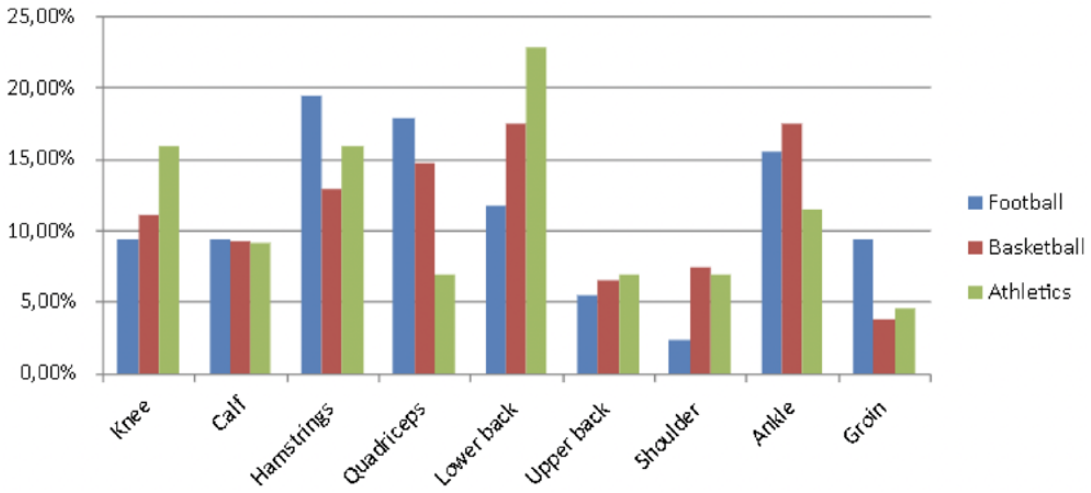

Fig. 7. The localization of overuse symptoms.

DISCUSSION

Overuse-related symptoms, such as pain and fatigue, are prevalent among athletes, particularly those subjected to high training loads without sufficient recovery. In this study, nearly two-thirds of participants reported experiencing pain (65.1 %), and an overwhelming majority reported fatigue (93.3 %). These findings reflect the increasing concern that the cumulative effects of repetitive microtrauma and inadequate recovery contribute significantly to performance decline and potential dropout from sport, particularly among youth and amateur populations.

The concept of overtraining syndrome (OTS) is central to understanding these symptoms. According to Kreher & Schwartz (2012), OTS is characterized by prolonged performance decrements, mood disturbances, and systemic physiological changes affecting the neuromuscular, endocrine, and immune systems. Our findings are consistent with this model, particularly among younger athletes (15-19 years old), who exhibited higher rates of pain and fatigue compared to older athletes. This vulnerability may stem from underdeveloped neuromuscular control and structural immaturity (Zeleznik *et al*., 2023), as well as the psychological stress associated with early sport specialization, a factor identified in earlier research as a risk for both physical injury and emotional burnout (Brenner & Council on Sports Medicine and Fitness, 2016; Bell *et al*., 2019; Giusti *et al*., 2020).

Interestingly, our results showed a significantly higher prevalence of pain among amateur athletes compared to professionals (70.6 % *vs*. 54.8 %, $p = 0.033$), reinforcing findings by Pfirrmann *et al*. (2016), who noted that amateur athletes attempting to transition into professional sport are often underprepared for the intensity and frequency of training. The mismatch between physical preparedness and training demands may exacerbate overuse injuries, especially in populations lacking structured conditioning programs.

Training volume was positively associated with symptom burden. Athletes training more than 15 hours per week were more likely to report pain (69.6 %), which aligns with Myer *et al*. (2015), who demonstrated that training beyond two hours per day increases injury risk by two- to threefold. However, the association did not reach statistical significance in our study, possibly due to sample size limitations or overlapping variances in rest and recovery practices.

Fatigue was notably high in both amateur and professional groups, with professional athletes reporting slightly higher rates (94.5 %), although the difference was not significant. This aligns with findings by the International Olympic Committee (Schwellnus *et al*., 2016), which highlight the cumulative physiological toll of elite-level sport, including disrupted sleep cycles, extensive travel, and inadequate recovery, as key contributors to chronic fatigue and immune suppression. Although the overall prevalence of fatigue was similarly high across groups, sport-specific analysis revealed significant distributional differences ($X^2 = 9.943$, $p = 0.008$), suggesting that fatigue manifests differently depending on biomechanical demands and recovery strategies inherent to each discipline.

The warm-up duration is known to influence injury risk, with prior research recommending 20 minutes of neuromuscular activation to reduce the incidence (Räisänen *et al*., 2021). Notably, in our cohort, athletes who warmed up for more than 15 minutes reported a slightly higher prevalence of pain (71.0 %) than those with shorter warm-ups (62.1 %). While not statistically significant, this may reflect reverse causality, where symptomatic athletes engage in longer warm-ups to compensate for underlying discomfort or prior injury.

Similarly, prolonged post-training stretching (more than 10 minutes) was associated with slightly higher reports of pain. One possible explanation is that fatigued muscles subjected to static or eccentric stretching may sustain further microtrauma, exacerbating delayed-onset muscle soreness (McGrath *et al*., 2014).

Anatomical localization of overuse symptoms revealed sport-specific vulnerability patterns. Football players most frequently reported discomfort in the posterior and anterior thigh and groin, consistent with UEFA data showing a high incidence of lower limb injuries in football (Waldén *et al*., 2005). Basketball players reported complaints of ankle and shoulder issues, consistent with studies from the NBA (Drakos *et al*., 2010). In track and field athletes, the lower back and knees were the most commonly affected areas, which partially aligns with data on running-related injuries (Van der Worp, 2015; Rojas-Valverde *et al*., 2019). These distinctions highlight the importance of sport-specific injury surveillance and prevention strategies.

In addition to physiological stress, the psychological component of overtraining should not be overlooked. Emotional exhaustion, decreased motivation, and depressive symptoms are increasingly recognized as indicators of training maladaptation, particularly in young athletes. These factors likely contribute to symptom persistence and may signal a need for psychological screening as part of load monitoring protocols.

Despite the established role of warm-ups and stretching in injury prevention, our findings suggest that recovery quality, including nutrition, sleep hygiene, and structured rest periods, may play an equally or more significant role in preventing injury. These were not assessed in the present study but should be included in future analyses to provide a more comprehensive picture of athlete health.

Limitations: This study has several limitations. First, data collection relied on self-reported measures, which are subject to recall and reporting biases, particularly regarding training volume and symptom severity. Second, the cross-sectional design limits the ability to make causal inferences. Third, the number of track and field athletes was relatively small, which may restrict the generalizability of findings within this group. Additionally, the study focused exclusively on male athletes; sex-specific analyses are warranted in future research.

Future Directions. Future studies should adopt longitudinal designs to monitor symptom development over time and identify causal relationships between training behaviors and overuse syndromes. The integration of objective measures, such as GPS-based load tracking, biochemical markers of inflammation or fatigue, and biomechanical screening, would enhance diagnostic precision. Expanding the participant pool to include female athletes, different age categories, and a broader array of sports would further enrich understanding and inform targeted interventions.

CONCLUSION

This study highlights the high prevalence of overuse-related symptoms, particularly pain and fatigue, among amateur and professional athletes engaged in football, basketball, and athletics. Pain was reported by 65.1 % of participants and was significantly more common among amateur athletes and those under the age of 20, suggesting that lower levels of physical preparedness and less structured training environments may increase susceptibility to musculoskeletal stress.

Although statistical significance was not reached in all comparisons, trends suggest that athletes who train more than 15 hours per week, perform extended warm-ups, or engage in prolonged post-training stretching are at an elevated risk of pain, potentially due to cumulative strain, suboptimal recovery, or underlying dysfunction. Fatigue was nearly ubiquitous across the cohort, affecting 93.3 % of participants, with a slightly higher prevalence among professionals. This underscores the systemic burden of high-volume training and competitive demands, even in well-conditioned athletes. Anatomical patterns of symptom localization varied by sport: football players most frequently reported symptoms in the hamstrings, quadriceps, and groin; basketball players reported symptoms in the ankle and shoulder; and track and field athletes reported symptoms in the lower back and knees. These findings underscore the need for age- and sport-sensitive prevention strategies and highlight the importance of early detection, individualized load management, and recovery optimization. Educational efforts targeting both athletes and coaches are critical to shifting the prevailing culture from "more is better" to a model of sustainable performance. Without such interventions, overuse symptoms may progress into chronic injuries with long-term consequences for athlete health and career longevity. The development and implementation of standardized screening tools for overuse symptoms may facilitate early intervention and reduce chronic burden.

STRBAC, D.; MARIC, D. L.; VELIKIC, G.; MARIC, D. M.; VUCINIC, N.; MARIC, M.; MARKOVIC, L.; CUKANOVIC, D. & RADOSEVIC, D. ¿Quién sufre dónde? Mapeo de la carga del sobreuso en atletas jóvenes y aficionados en deportes de alto impacto. *Int. J. Morphol., 43(6)*:1954-1963, 2025.

RESUMEN: Los síntomas de sobreuso, como la fatiga, el dolor musculoesquelético y la rigidez, son comunes entre los atletas expuestos a cargas de entrenamiento sostenidas y una recuperación inadecuada. Estos síntomas pueden progresar a síndrome de sobre entrenamiento o lesión crónica, especialmente en individuos más jóvenes o con menor condición física. A pesar de esto, pocos estudios han perfilado los síntomas de sobreuso en múltiples deportes y niveles de entrenamiento. El objetivo de este estudio fue evaluar la prevalencia, la distribución anatómica y los correlatos relacionados con el entrenamiento de los síntomas de sobreuso en atletas masculinos aficionados y profesionales que participan en fútbol, baloncesto y atletismo. Se realizó un estudio transversal en 209 atletas masculinos de 15 a 37 años, que completaron un cuestionario estandarizado que evaluaba la presencia y localización de los síntomas de sobreuso, así como las rutinas de entrenamiento. Se emplearon análisis estadísticos descriptivos e inferenciales, incluyendo pruebas de chi-cuadrado, ANOVA y pruebas exactas de Fisher, para evaluar las diferencias en la prevalencia de los síntomas en varios tipos de deporte, grupos de edad y niveles de participación atlética. La fatiga fue reportada por el 93,3 % de los participantes y el dolor por el 65,1 %. La prevalencia del dolor fue significativamente mayor entre los aficionados que entre los profesionales (70,6 % frente a 54,8 %, p = 0,033) y mostró una tendencia al aumento de la prevalencia entre los atletas más jóvenes. Se observó una localización específica de los síntomas según el deporte, con predominio de los síntomas en los miembros inferiores en el fútbol americano (Mm. de la región posterior del muslo, M.cuádriceps femoral e ingle), en el baloncesto, en el tobillo y el hombro, y en el atletismo, en la zona lumbar y la rodilla. Un mayor número de horas de entrenamiento semanales y una mayor duración del calentamiento/estiramiento se asociaron con un aumento de los informes de síntomas, aunque esta asociación no fue estadísticamente significativa. Los síntomas por sobreuso son comunes tanto entre los atletas aficionados como entre los profesionales, con patrones notables específicos según el deporte y la edad. Estos hallazgos respaldan la necesidad de una detección temprana, una monitorización individualizada de la carga de entrenamiento y una mejor formación de entrenadores y atletas para prevenir los trastornos musculoesqueléticos crónicos y el deterioro del rendimiento.

PALABRAS CLAVE: Síndrome de sobreuso; Salud del atleta; Fútbol americano; Baloncesto; Atletismo.

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Corresponding author:
Dusica L. Maric, MD, PhD, Full Professor
Department of Anatomy
University of Novi Sad
Faculty of Medicine
Novi Sad
SERBIA

E-mail: dusica.maric@ mf.uns.ac
maricduska@gmail.com