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Comparison of Multidimensional Fatigue Profiles Among Playing Positions in Elite Adolescent Soccer Players

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Abstract: The study compared the multidimensional fatigue profiles of adolescent soccer players across different playing positions (defenders, midfielders, and forwards) using the Multidimensional Fatigue Inventory (MFI-20). Fatigue in soccer is often attributed to the high physical and cognitive demands of the sport, which vary significantly by position. However, it is unclear if these positional load differences translate into distinct subjective fatigue dimensions in youth athletes. A cohort of adolescent female soccer players completed the MFI-20, which assesses five dimensions: General Fatigue (GF), Physical Fatigue (PF), Reduced Activity (RA), Reduced Motivation (RM), and Mental Fatigue (MF). One-way Analysis of Variance (ANOVA) was used to compare scores between positions. The results revealed no statistically significant differences between defenders, midfielders, and forwards for any fatigue dimension: GF ($p = 0.6967$), PF ($p = 0.5807$), RA ($p = 0.2551$), RM ($p = 0.8218$), and MF ($p = 0.4139$). Despite defenders exhibiting slightly higher mean scores in general fatigue and midfielders showing the highest physical fatigue, the lack of statistical significance suggests that subjective fatigue perception may be more influenced by individual recovery capacity or overall team load rather than specific positional roles in this population. Coaches should prioritize individualized monitoring strategies over position-specific assumptions when managing fatigue in adolescent soccer players.

Keywords: Youth Sports, Athlete Monitoring, Multidimensional Fatigue, Positional Demands, Recovery.

INTRODUCTION

Soccer is a physically demanding sport that alternates between low-to-moderate intensity activities and high-intensity actions such as sprinting, jumping, tackling, and rapid directional changes (FIFA World Cup match analysis literature; Bangsbo *et al.*, 2006; Stølen *et al.*, 2005). Time-velocity analyses show that elite athletes do repeated bursts of high-intensity running, speeding up, slowing down, and changing direction on top of a lot of aerobic demand (Mohr *et al.*, 2003; Bradley *et al.*, 2009). Young athletes need to be careful about how much they train because their bodies are still growing, their peak height velocity is still rising, their neuromuscular development is still growing, and they are under a lot of academic stress (Malina *et al.*, 2004; Lloyd & Oliver, 2012). If these athletes don't get enough rest during these important growth periods, they could be at risk for non-functional overreaching, overtraining syndrome, a higher risk of injury, performance stagnation, or diminishing returns (Meeusen *et al.*, 2013; Soligard *et al.*, 2016). Consequently, a primary objective of sports scientists and practitioners is to ascertain the factors that induce fatigue in youth soccer.

In soccer coaching, the positional requirements create different tactical and physical needs. Wide midfielders and fullbacks usually run longer distances and at higher speeds, but center defenders have to deal with a lot of mechanical stress because they are always speeding up, slowing down, and making contact with the ground (Bradley *et al.*, 2009; Di Salvo *et al.*, 2007).

High cumulative match workloads occur because central midfielders can often handle high aerobic loads while still helping with transitional play (Rampinini *et al.*, 2007). In theory, fatigue responses differ based on these external load patterns that are specific to each position. Positions with greater sprint exposure may demonstrate elevated neuromuscular and central fatigue due to repeated eccentric loading (Naelec *et al.*, 2012), while tactically intricate roles necessitating ongoing perceptual-cognitive engagement may reveal increased mental fatigue (Smith *et al.*, 2018). However, it remains uncertain whether these fluctuations in external load lead to substantial multidimensional subjective fatigue variations, particularly among adolescent populations.

A multifaceted approach capable of distinguishing between physiological and psychological components is essential for the evaluation of fatigue. The Multidimensional Fatigue Inventory (MFI-20) assessed five distinct domains: General Fatigue, Physical Fatigue, Reduced Activity, Reduced Motivation, and Mental Fatigue (Smets *et al.*, 1995).

The MFI-20 provides a comprehensive profile of fatigue by assessing metabolic, neuromuscular,

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behavioral, and cognitive dimensions, unlike single-item measures such as the Borg Rating of Perceived Exertion (Borg, 1982). The instrument has demonstrated robust construct validity and internal consistency (Cronbach's α typically > 0.80) in both clinical and non-clinical populations, including young adults (Smets *et al.*, 1995; Lin *et al.*, 2009). In youth sports, where fatigue can stem from both training and psychosocial factors, such multidimensional assessment is especially relevant.

While positional variations in match demands are well-documented, empirical data concerning positional disparities in subjective fatigue remains insufficient. Some research indicates substantial inter-position variability in high-speed running and overall distance (Bradley *et al.*, 2009); however, post-match recovery kinetics of lactate, creatine kinase, and heart rate do not consistently exhibit differences by position (Nédélec *et al.*, 2012). Furthermore, individual differences in strength, aerobic capacity, sleep quality, and recovery methods may lessen positional effects at the group level (Kellmann, 2010). Inter-individual variability among adolescents is influenced by their maturation status (Malina *et al.*, 2004). Consequently, it remains uncertain whether fatigue monitoring methodologies ought to be tailored or position-specific.

The primary purpose of this study was to compare the five dimensions of the MFI-20 across defenders, midfielders, and forwards in a cohort of elite adolescent soccer players. We hypothesized that midfielders would report significantly higher Physical Fatigue and General Fatigue scores compared to defenders and forwards. By examining multidimensional fatigue profiles, this study aims to inform monitoring position-specific fatigue be more appropriate.

MATERIALS & METHODS

Participants

A group of elite adolescent female soccer players (age= 17 ± 1.1 years, training age= 5 ± 1.6 years) participated in this cross-sectional study. Participants were recruited from a professional youth academy and were categorized into three primary playing positions: Defenders (n=40), Midfielders (n=32), and Forwards (n=29). Inclusion criteria required participants to be active in the academy's competitive season and free from acute injury at the time of assessment. All participants and their legal guardians provided informed consent prior to data collection.

Test Protocol

Fatigue status was assessed using the Multidimensional Fatigue Inventory (MFI-20). The MFI-20 is a 20-item self-report instrument that measures fatigue across five subscales:

- General Fatigue (GF): Overall perception of tiredness and lack of energy.
- Physical Fatigue (PF): The physical sensation of being tired.
- Reduced Activity (RA): The behavioral manifestation of fatigue (doing less).
- Reduced Motivation (RM): The psychological aspect related to the lack of desire to start or continue activities.
- Mental Fatigue (MF): Cognitive tiredness, including difficulty concentrating.

Each subscale consists of four items, with responses provided on a 5-point Likert scale ranging from 1 ("Yes, that is true") to 5 ("No, that is not true"). Total scores for each subscale range from 4 to 20, with higher scores indicating higher levels of fatigue.

Data were collected during a mid-season training week to ensure that the reported fatigue reflected typical seasonal demands. Surveys were administered face-to-face 30 minutes prior to a scheduled training session to minimize the acute influence of immediate physical exertion. Participants were instructed to reflect on their feelings over the preceding 24–48 hours.

Statistical Analysis

Descriptive statistics (Mean ± Standard Deviation) were calculated for each MFI-20 subscale by playing position. The normality of the data was assessed using the Shapiro-Wilk test. A one-way Analysis of Variance (ANOVA) was conducted for each of the five fatigue dimensions to determine if significant differences existed between Defenders, Midfielders, and Forwards. The alpha level for all tests was set at $p < 0.05$. Statistical analyses were performed using IBM SPSS (Version 26).

RESULTS

The summary statistics for each of the five MFI-20 dimensions across playing positions are presented in Table 1. Defenders reported the highest mean scores for General Fatigue (12.1 ± 2.74), while Midfielders reported the highest mean scores for Physical Fatigue (11.25 ± 3.3). Forwards generally reported the lowest fatigue scores across most dimensions, particularly in Mental Fatigue (8.79 ± 2.65).

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Table 1: MFI-20 Fatigue Subscale Scores by Playing Position (Mean ± SD)

Dimension	Midfielders	Defenders	Forwards	η^2	F-statistic	p-value
GF	11.59 ± 3.18	12.10 ± 2.74	11.59 ± 2.93	0.007	0.363	0.697
PF	11.25 ± 3.30	10.55 ± 3.12	10.59 ± 2.69	0.011	0.547	0.581
RA	11.12 ± 2.51	10.95 ± 2.63	10.10 ± 2.53	0.027	1.385	0.255
RM	10.56 ± 2.99	10.50 ± 2.44	10.17 ± 2.38	0.004	0.197	0.822
MF	9.69 ± 2.83	9.40 ± 2.53	8.79 ± 2.65	0.018	0.890	0.414

Note: General Fatigue (GF), Physical Fatigue (PF), Reduced Activity (RA), Reduced Motivation (RM), Mental Fatigue (MF)

The results of the one-way ANOVA indicated that there were no statistically significant differences between positions for any of the fatigue dimensions (Table 1). The visual representation of these scores (Figure 1) highlights the subtle differences in mean values across positions, which did not reach statistical significance.

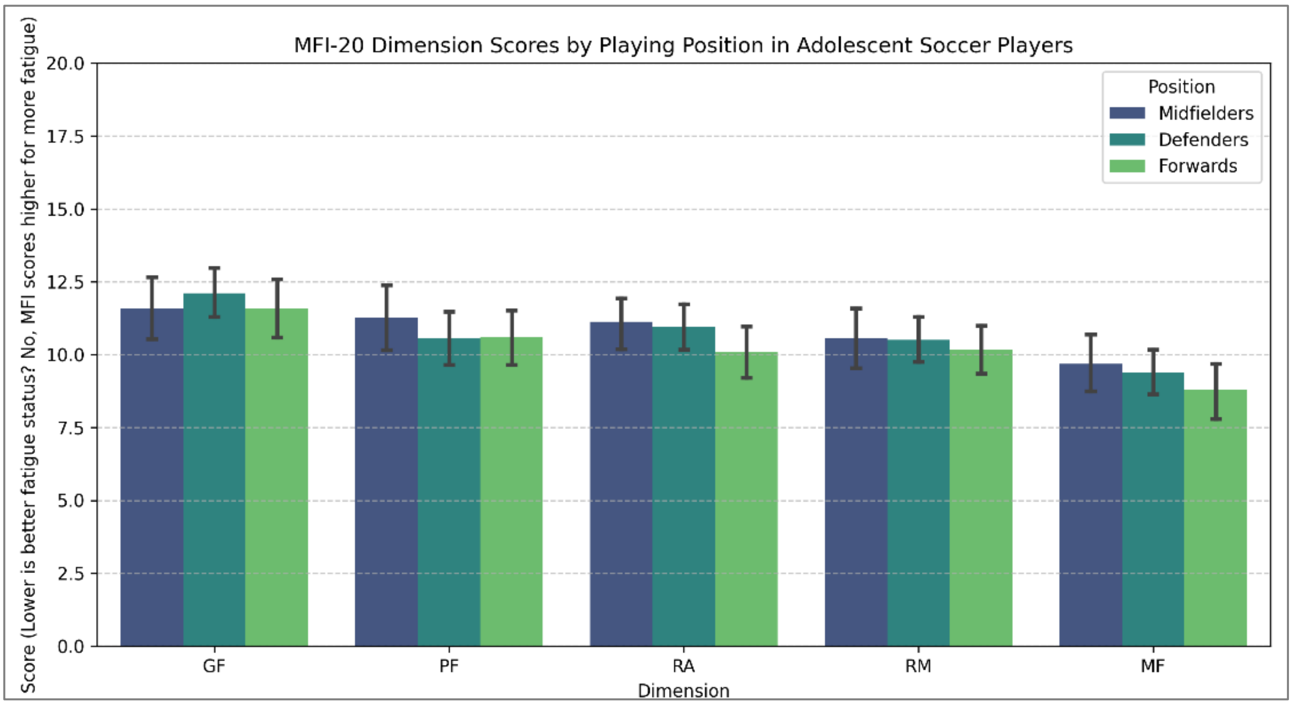

Figure 1: Comparison of MFI-20 subscale scores (General Fatigue (GF), Physical Fatigue (PF), Reduced Activity (RA), Reduced Motivation (RM), Mental Fatigue (MF)) between Defenders, Forwards, and Midfielders.

DISCUSSION

The primary finding of this investigation was that playing position did not significantly influence the multidimensional fatigue profile of elite adolescent soccer players across a typical competitive microcycle. Despite positional differences, where midfielders generally accumulate greater total and high-speed running distances, and forwards perform more repeated sprint actions—the subjective perception of fatigue, as measured by the Multidimensional Fatigue Inventory (MFI-20), remained statistically uniform in this cohort. This suggests that although external load profiles may vary, the internal psychophysiological response to these demands comes to a similar perceptual outcome within a structured elite youth training setting.

The relatively low mean scores across the five MFI-20 dimensions (approximately 9–12 out of 20) indicate that the cohort was generally well-recovered and not experiencing excessive functional overreaching. The highest scores were observed in General Fatigue, particularly among defenders (12.1), which may reflect psycho-educational stress common in adolescent populations rather than purely sport-specific physical strain. Therefore, interpreting fatigue data in youth athletes necessitates a biopsychosocial framework rather than a purely physiological lens.

Although statistical analyses revealed no significant positional differences, subtle changes in mean values warrant careful contextual interpretation.

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Previous time–velocity analyses, such as those reported by Pettersen *et al.* and Sepúlveda *et al.*, have documented greater total distance and sustained high-intensity activity among midfielders which was concurrent with the slightly higher physical fatigue (11.25) and reduced activity (11.12). Conversely, forwards demonstrated the lowest Mental Fatigue (8.79), which may reflect role-specific cognitive demands; attacking players often engage in intermittent, explosive decision-making sequences rather than sustained tactical organization responsibilities typical of defensive and midfield units.

Defenders, who displayed the highest General Fatigue scores, may be influenced by the high frequency of decelerations, aerial duels, and contact situations inherent to defensive play. Studies by Muñoz-Castellanos *et al.* and Sládečková *et al.* have highlighted the substantial mechanical and neuromuscular stress associated with repeated braking and directional changes during congested fixtures. However, the relatively large intra-positional standard deviations (2.38–3.30) observed in the present study indicate considerable inter-individual variability. This variability suggests that intrinsic characteristics—such as aerobic fitness, neuromuscular efficiency, biological maturation stage, sleep behavior, psychological resilience, and coping strategies—may exert a stronger influence on fatigue perception than positional role per se. This interpretation is supported by work from Nobari *et al.* and Anderegg *et al.*, who emphasized the predominance of individual load tolerance and contextual factors in determining fatigue and recovery dynamics in youth athletes.

In elite adolescent soccer, training is typically periodized at the team level, while match-play position-specific demands differ, and thus the cumulative differences in perceived fatigue. Moreover, the MFI-20 primarily reflects sub-acute or accumulated fatigue rather than acute post-match exhaustion. The psychobiological model of fatigue proposes that athletes adjust perceived exertion and motivational drive based on anticipated effort and prior experience.

The practical implications of these findings are substantial for coaches, sport scientists, and performance practitioners. Practitioners should avoid deterministic positional assumptions, rather prioritizing individual adaptation status. The observed variability underscores the importance of athlete-specific profiling. Integrating subjective fatigue scales with objective metrics may strengthen early detection of maladaptation and reduce the risk of overuse injuries or burnout, as emphasized in athlete health frameworks.

In summary, the absence of positional differences in multidimensional fatigue among elite adolescent soccer players suggests that fatigue perception in youth sport is influenced more by shared training structures and individual characteristics than by tactical role alone. These findings reinforce the necessity of an integrative framework to optimize long-term athlete development and performance sustainability.

Several limitations should be noted. This was a cross-sectional study conducted at a single time point; longitudinal tracking across a full season or through a congested match schedule might reveal positional differences that were not apparent during a standard training week. Additionally, the sample size within each positional subgroup may have limited the statistical power to detect small effect sizes. Future research should integrate MFI-20 scores with objective external load data (e.g., GPS, accelerometry, electromyography) and biological markers (e.g., blood lactate, heart rate variability) to provide a more comprehensive picture of the load-fatigue relationship in youth soccer.

CONCLUSION

In conclusion, positional roles do not appear to result in distinct multidimensional fatigue profiles in elite adolescent soccer players during a standard competitive week. While positional physical demands are heterogeneous, the subjective experience of general, physical, mental, and motivational fatigue is relatively uniform across the squad. These findings emphasize the importance of individualized fatigue monitoring and caution against using playing position as the sole basis for prescribing recovery or adjusting training workloads in youth populations.

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Conflict of Interest The authors declare that there are no conflicts of interest regarding the publication of this paper.

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