Trauma Monthly 2026; 31(4): 1965-1975

10.30491/tm.2026.591900.1961

Trauma Monthly

Research Article

Investigating the Relationship Between Safety Behavior, Musculoskeletal Disorders, and Quality of Life of Prehospital Emergency Operational Personnel

Seyed Mahmood Hosseini Al-Madavari[1], Abbas Ali Dehghani Tafti[1], Arefeh Dehghani [2], Adel Eftekhari[3*]

[1] Department of Health in Disaster and Emergencies, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
[2]Department of Biostatistics, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
[3] Department of Nursing, Meybod School of Medical Sciences, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

***Corresponding Author**: Adel Eftekhari, Department of Nursing, Meybod School of Medical Sciences, Shahid Sadoughi University of Medical Sciences, Yazd, Iran, Email: Adel.eftekhari.66@gmail.com, ORCID: 0000-0001-7961-2699

Received 2026-02-05 ; **Accepted** 2026-07-25; **Online Published** 2026-08-29

Abstract

Introduction: Due to the physically demanding and high-stress nature of emergency medical services, Emergency Medical Services (EMS) personnel are at increased risk of musculoskeletal disorders (MSDs) and reduced quality of life. Safety behavior may be associated with lower occupational health risks in this population. This study investigated the relationship between safety behavior, MSDs, and quality of life among EMS personnel.

Method: This cross-sectional study was conducted in 2025 among 232 EMS personnel in Yazd Province, selected through stratified random sampling. We collected data using the Safety Behavior Questionnaire developed by Mehdinia et al., the Nordic Musculoskeletal Questionnaire, and the World Health Organization Quality of Life Questionnaire (WHOQOL-BREF). We analyzed the data using SPSS version 27 with descriptive and inferential statistical tests, including the Mann-Whitney U test, Kruskal-Wallis test, Spearman correlation coefficient, and multiple linear regression analysis.

Result: The mean scores for safety behavior, MSDs, and quality of life were 3.19 +/- 0.25, 4.60 +/- 1.54, and 46.28 +/- 19.08, respectively. Safety participation showed significant positive correlations with mental health ($r = 0.154$, $p = 0.019$) and social relationships ($r = 0.150$, $p = 0.010$). Safety behavior was also significantly associated with MSDs ($p < 0.05$). Regression analysis showed that MSDs were significantly associated with safety behavior ($B = -0.022$, $p = 0.030$), whereas quality of life did not significantly predict safety behavior ($p = 0.48$). In addition, age ($p = 0.014$), educational level ($p = 0.038$), body mass index ($p = 0.032$), and weekly working hours ($p = 0.014$) were significantly related to safety behavior, whereas work shift was not ($p = 0.825$).

Conclusion : The findings indicate that MSDs are a common occupational health concern among EMS personnel in Yazd Province. Safety behavior showed a statistically significant association with MSDs, although the observed relationships were weak. Therefore, safety-related behaviors, along with other occupational factors, should be considered when evaluating EMS personnel's occupational health status.

Keywords: Safety behavior, musculoskeletal disorders, quality of life, emergency medical services.

Introduction

Pre-hospital Emergency Medical Services (EMS) are a fundamental component of healthcare systems, delivering urgent medical care as quickly as possible to preserve life and prevent further complications. EMS personnel serve on the front lines of emergencies and crises, routinely working under conditions marked by intense physical demands, psychological strain, and occupational hazards[1,2]. Their responsibilities require rapid response, critical decision-making, and physically strenuous activities, including manual patient handling in unpredictable environments, often during prolonged and consecutive work shifts. Collectively, these factors

Copyright © 2026 The Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

impose considerable physical and psychological burdens that may adversely affect long-term occupational health[3,4].

Among the most significant occupational health challenges faced by EMS personnel are musculoskeletal disorders (MSDs), which are recognized as major contributors to morbidity, physical disability, healthcare utilization, and absenteeism in developing countries[5]. These disorders commonly result from repetitive and heavy patient-handling tasks performed under ergonomically unfavorable conditions, as well as exposure to workplace violence and traumatic incidents[6]. Previous studies have demonstrated that the prevalence of MSDs among EMS workers is substantially higher than that observed in many other high-risk occupations. Tahernejad et al. reported that the incidence of MSDs among EMS personnel was up to three times higher than that of comparable occupational groups[7]. In addition, recent systematic reviews and meta-analyses indicate that more than 56% of EMS professionals experience chronic musculoskeletal pain or discomfort[7,8].

The consequences of MSDs extend beyond temporary work restrictions or functional limitations. These conditions can negatively affect physical and psychological well-being, diminish quality of life (QoL), and create broader social and economic burdens[,10]. Therefore, assessing EMS personnel QoL through a comprehensive framework that includes physical, psychological, social, and environmental dimensions is essential[11].

Quality of life is a multidimensional concept encompassing not only physical health but also psychological and social well-being[12]. In occupational health research, the World Health Organization Quality of Life Questionnaire (WHOQOL-BREF) is widely used to evaluate individuals' perceptions of well-being across physical, psychological, social, and environmental domains[13,14]. QoL is not merely an indicator of health status; it also reflects occupational functioning and service quality. Previous studies have shown that poor QoL among EMS personnel is associated with increased fatigue, reduced job motivation, impaired performance, and higher turnover rates[13,15]. Given the critical role of EMS personnel as first responders, declining well-being may adversely affect public health outcomes and patient safety. In particular, reduced psychological and social well-being may be associated with higher levels of stress and anxiety, which in turn may increase the likelihood of professional errors and compromise the quality of emergency care[12]. Furthermore, poor QoL among EMS personnel may impose considerable socioeconomic costs on healthcare systems through increased healthcare utilization and reduced workforce productivity[14,16]. Consequently, promoting staff well-being should be an individual and organizational priority.

Beyond ergonomic and environmental factors, psycho-behavioral factors play an important role in determining occupational health outcomes among EMS personnel[17]. One of the most important of these factors is safety behavior, which reflects the extent to which individuals actively engage in behaviors intended to reduce occupational risks and promote workplace safety. Safety behavior includes adherence to ergonomic principles during patient handling, proper use of personal protective equipment, compliance with safety guidelines, and participation in organizational safety practices[14,17]. Evidence suggests that adherence to such behaviors, particularly during high-pressure emergencies or periods of fatigue, may be associated with a lower risk of occupational injuries and professional errors[,17]. Given the demanding and unpredictable nature of EMS work, understanding the factors that influence occupational health is essential for designing effective preventive interventions.

Although previous studies have examined musculoskeletal disorders, quality of life, and occupational risks among EMS personnel, they have often investigated these factors separately. Limited evidence exists on the relationship between safety behavior, MSDs, and quality of life within a single analytical framework in pre-hospital emergency settings. Therefore, this study aimed to investigate the relationship between safety behavior, musculoskeletal disorders, and quality of life among EMS personnel in Yazd Province.

Methods

This cross-sectional correlational study was conducted in 2025 among EMS personnel employed at urban and road emergency stations in Yazd Province, Iran. The study population included all eligible EMS personnel working in these stations. The study first stratified stations into two categories: urban and road stations. Participants were then selected using stratified random sampling proportional to each stratum's size to ensure appropriate representation of the target population. Eligible participants were randomly selected from staff rosters using a random number generator.

The sample size was calculated based on the study conducted by Nasiry Zarrin Ghabaee et al. [1]. Assuming a minimum correlation coefficient of 0.30 between quality of life and MSDs, with a 95% confidence level, 90% statistical power, and a 5% anticipated attrition rate from a population of 300 EMS personnel, the required sample size was estimated to be 232 participants. We invited 250 personnel to participate, of whom 232 completed the questionnaires, yielding a response rate of 92.8%. Eighteen participants (7.2%) were excluded because their questionnaires were incomplete or they were unwilling to continue participating.

The inclusion criteria were active employment in EMS operations and at least one year of work experience. Exclusion criteria included musculoskeletal symptoms unrelated to occupational activities, severe chronic or underlying diseases (e.g., advanced osteoarthritis), concurrent employment in other occupations, and unwillingness to continue participation.

We collected data using four instruments: a demographic information questionnaire, the Nordic Musculoskeletal Questionnaire (NMQ), the Safety Behavior Questionnaire developed by Mahdinia et al., and the WHOQOL-BREF. Demographic variables included age, marital status, work experience, educational level, employment status, station type (urban or rural), work shift pattern, body mass index (BMI), and weekly working hours.

The NMQ, developed by Kuorinka et al. in 1987[1], is a 27-item instrument that assesses musculoskeletal symptoms in nine body regions: neck, shoulders, elbows, upper back, lower back, wrists/hands, thighs/hips, knees, and ankles/feet. Participants reported whether they had experienced pain or discomfort in these regions during the previous 12 months and the previous 7 days. The questionnaire also assessed whether these symptoms had restricted daily or occupational activities or required medical attention. Responses were scored dichotomously ("yes" = 1, "no" = 0). A total score ranging from 0 to 9 was calculated based on the number of affected body regions, with higher scores indicating greater MSD prevalence and severity. Mokhtari-Nia et al. reported a Cronbach's alpha coefficient of 0.91 for the Persian version of the questionnaire[20] .

The Safety Behavior Questionnaire developed by Mahdinia et al. consists of 23 items divided into two subscales: safety participation (11 items) and safety compliance (12 items). Respondents rate items on a 5-point Likert scale from 1 ("never") to 5 ("always"). The instrument's internal consistency was satisfactory, with Cronbach's alpha coefficients of 0.90 for the overall scale, 0.86 for safety compliance, and 0.87 for safety participation[21]. For data analysis, we calculated a composite mean score by averaging the two subscales, and we also calculated individual subscale scores for specific analyses. Mean scores for each domain were calculated by dividing the total score of the domain by the number of items, resulting in scores ranging from 1 to 5[23,24] .

Quality of life was assessed using the WHOQOL-BREF, a standardized 26-item questionnaire evaluating four domains: physical health, psychological health, social relationships, and environmental health, in addition to two general items assessing overall quality of life and general health status[25] . Nejat et al. confirmed the validity of the Persian version of this instrument. They reported acceptable test-retest reliability coefficients for the physical health (0.77), psychological health (0.77), social relationships (0.77), and environmental health (0.84) domains[26] . In the present study, Cronbach's alpha was 0.91. We calculated domain scores according to the WHOQOL-BREF scoring guidelines. The researcher converted raw domain scores to a standardized scale ranging from 0 to 100.

To recruit participants, the researcher visited eligible EMS workplaces with an official letter of introduction. The researcher obtained written informed consent from all participants. Questionnaires were completed through self-administration.

The researcher analyzed data using SPSS version 27. We used descriptive statistics, including means, standard deviations, frequencies, and percentages, to summarize demographic characteristics, MSDs, safety behavior, and quality of life. We assessed data normality using the Kolmogorov–Smirnov test. Because the data

were not normally distributed, we used non-parametric statistical tests—including the Mann–Whitney U test and the Kruskal–Wallis test—to evaluate group differences. Post-hoc pairwise comparisons were performed using the Bonferroni correction where applicable. We used Spearman's correlation coefficient to assess the strength of associations between continuous variables. We used multiple linear regression to examine the predictive associations between independent variables and the outcome. A p-value of less than 0.05 was considered statistically significant.

Results

This study included 232 EMS personnel working in the prehospital emergency system in Yazd Province. All participants were male. The mean age was 36.8 ± 7.6 years, and the mean work experience was 13.8 ± 5.7 years. Regarding educational level, 100 participants (43.1%) had a bachelor's degree or higher, 98 (42.2%) had an associate degree, and 34 (14.7%) had a high school diploma. In terms of workplace assignment, 134 participants (57.8%) were employed at urban emergency bases and 98 (42.2%) at road emergency bases. Rotating shifts were reported by 192 participants (82.8%), and 127 (54.7%) worked more than 40 hours per week. The mean body mass index (BMI) was 25.9 ± 4.4 kg/m².

Table 1 shows mean scores for overall safety behavior, musculoskeletal disorders (MSDs), and quality of life of 3.19 ± 0.25, 4.60 ± 1.54, and 46.28 ± 19.08, respectively. Safety behavior scores differed significantly by age (p = 0.014), educational level (p = 0.038), and weekly working hours (p = 0.014). No significant differences in safety behavior were observed according to marital status, work experience, employment status, type of prehospital emergency base, work shift, or BMI (all p > 0.05).

For MSDs, we found significant associations with age (p = 0.039), work experience (p = 0.036), and weekly working hours (p = 0.006). MSDs were not significantly associated with marital status, educational level, employment status, type of prehospital emergency base, work shift, or BMI (all p > 0.05). For quality of life, we found a significant association only with BMI (p = 0.004), with no significant associations for the other demographic variables.

As shown in Table 2, the most frequently reported musculoskeletal symptoms in the past 12 months involved the knees (163 participants, 70.2%), lower back (160, 68.9%), and upper back (158, 68.1%). A similar pattern was observed for symptoms during the previous 7 days, with the highest prevalence again reported in the knees (162, 69.8%), followed by the lower back (153, 65.2%) and upper back (135, 58.2%). Pain-related disability was most commonly reported in the lower back (135, 58.2%), upper back (134, 57.7%), and knees (132, 56.8%).

As shown in Table 3, the total safety behavior score did not significantly correlate with mental health (r = 0.01, p = 0.71). However, when the two dimensions were examined separately, a distinct pattern emerged: Safety Participation was positively and significantly correlated with mental health (r = 0.154, p = 0.019), whereas Safety Compliance showed a negative and significant correlation (r = -0.13, p = 0.035). This suggests that the overall safety behavior score obscures the different relationships between its components and psychological well-being.

In addition, safety participation demonstrated significant positive correlations with social relationships (r = 0.15, p = 0.01).

Before conducting the regression analysis, we examined the assumptions of linear regression. The residuals were normally distributed (p = 0.20), no evidence of multicollinearity was observed (VIF < 5), and no autocorrelation of residuals was detected (Durbin-Watson = 1.77).

The regression model examining associations between quality of life and musculoskeletal disorders and overall safety behavior showed that musculoskeletal disorders were significantly associated with safety behavior (B = -0.022, Beta = -0.13, p = 0.03). In contrast, quality of life was not significantly associated with safety behavior (B = 0.001, Beta = 0.046, p = 0.48). Among the variables entered into the model, musculoskeletal disorders showed the largest standardized coefficient. However, the model's overall explanatory power was low (R = 0.14, R^2 = 0.02, adjusted R^2 = 0.012), indicating that these variables explained only a small proportion of the variance in safety behavior.

Table 1. Demographic characteristics of pre-hospital emergency personnel and their associations with mean musculoskeletal disorder scores (during the past 12 months), quality of life, and safety behavior.

Demographic characteristics	Mean ± SD	n (%)	Musculoskeletal disorders	Quality of life	Safety behavior
Age (years)			Median(IQR)	Median(IQR)	Median(IQR)
< 35	36.8 ± 7.6	93 (40.0%)	5(2.5)	50(25)	3.16(0.32)
36–45		112 (48.27%)	5(2)	50(28.1)	3.18(0.28)
> 45		27 (11.63%)	5(2)	50(25)	3.17(0.31)
p-value			0.039*	0.874	0.014*
Marital status			Median(IQR)	Median(IQR)	Median(IQR)
Single	-	64 (27.6%)	5(2)	50(25)	3.14(0.23)
Married		168 (72.4%)	5(3)	50(37.5)	3.18(0.33)
p-value			0.504	0.168	0.616
Work experience (years)			Median(IQR)	Median(IQR)	Median(IQR)
< 5	13.8 ± 5.7	15 (6.46%)	5(2)	50(25)	3.06(0.17)
6–15		143 (61.63%)	4.5(3)	50(25)	3.18(0.31)
> 15		74 (31.89%)	5(2)	50(25)	3.17(0.28)
p-value			0.036*	0.385	0.160
Educational level			Median(IQR)	Median(IQR)	Median(IQR)
Diploma	-	34 (14.7%)	4.6(1)	37.5(25)	3.4(0.55)
Associate degree		98 (42.2%)	5(2)	50(37.5)	3.3(0.45)
Bachelor's degree and higher		100 (43.1%)	5(3)	50(25)	3.33(0.36)
p-value			0.430	0.066	0.038*
Employment status			Median(IQR)	Median(IQR)	Median(IQR)
Permanent		128 (55.2%)	4.7(2)	50(25)	3.18(0.18)
Fixed-term		60 (25.9%)	5(1.75)	37.5(21)	3.14(0.28)
Contractual		25 (10.8%)	3(4)	50(25)	3.14(0.18)
Mandatory service		19 (8.2%)	5(2)	37.5(37)	3.13(0.18)
p-value			0.539	0.231	0.712
Type of prehospital emergency base			Median(IQR)	Median(IQR)	Median(IQR)
Roadside base		98 (42.2%)	5(2.25)	50(25)	3.18(0.3)
Urban base		134 (57.8%)	4.7(5)	50(37.5)	3.17(0.32)
p-value			0.595	0.315	0.825
Work shift	-		Median(IQR)	Median(IQR)	Median(IQR)
Morning		14 (6.0%)	5(4.25)	50(28.1)	3.12(0.32)
Night		26 (11.2%)	5(3)	50(12.5)	3.23(0.29)
Rotating		192 (82.8%)	5(2)	50(25)	3.17(0.3)
p-value			0.9	0.476	0.825
BMI			Median(IQR)	Median(IQR)	Median(IQR)
< 18.5	25.9 ± 4.4	6 (2.6%)	4.5(2.7)	43.7(53)	3.22(0.29)
18.5–24.9		98 (42.2%)	4(2.5)	50(25)	3.14(0.34)
25–29.9		91 (39.2%)	5(2)	50(25)	3.18(0.25)
≥ 30		37 (15.9%)	5(3)	37.5(25)	3.18(0.3)
p-value			0.290	0.004*	0.5
Weekly working hours			Median(IQR)	Median(IQR)	Median(IQR)
26–30	38.3 ± 1.57	14 (6.0%)	3.5(3.2)	43.7(28)	3.19(0.35)
31–35		29 (12.5%)	5(2)	37.5(25)	3.13(0.22)
36–40		62 (26.7%)	5(2.2)	37.5(18)	3.17(0.23)
> 40		127 (54.7%)	5(2)	50(25)	3.18(0.33)
p-value			0.006*	0.572	0.014*

The statistical tests used were the Mann–Whitney U and Kruskal–Wallis tests; $p < 0.05$.

Table 2. Frequency distribution of pain prevalence and pain-related disability across different body regions among operational pre-hospital emergency personnel during the previous 12 months and the previous 7 days.

Body region	Pain or discomfort in the past 12 months, n (%)	Pain or discomfort in the past 7 days, n (%)	Pain related disability, n (%)
Neck	130 (56.0%)	129 (55.6%)	108 (46.6%)
Elbow	134 (57.8%)	133 (57.0%)	112 (48.3%)
Wrist	109 (47.0%)	101 (43.5%)	105 (45.3%)
Upper back	158 (68.1%)	135 (58.2%)	134 (57.7%)
Low back (waist)	160 (68.9%)	153 (65.2%)	135 (58.2%)
Hip and thigh	135 (58.2%)	133 (57.0%)	106 (45.7%)
Knee	163 (70.2%)	162 (69.8%)	132 (56.8%)
Leg and ankle	108 (46.6%)	107 (46.1%)	126 (54.3%)
Shoulder	116 (50.0%)	115 (49.6%)	110 (47.4%)

Table 3. Correlations among dimensions of Safety behavior and its dimensions, quality of life, and musculoskeletal disorders.

Safety behavior and its dimensions	Outcome variables	Correlation coefficient *	*P*-value
Safety compliance dimension	Overall quality of life	−0.03	0.65
	Physical health	0.064	0.30
	Mental health	-0.13	0.035*
	Environmental health	0.068	0.30
	Social relationships	0.004	0.95
	Musculoskeletal disorders	-0.03	0.59
Safety participation dimension	Overall quality of life	0.080	0.224
	Physical health	0.06	0.32
	Mental health	0.154	0.019*
	Environmental health	0.02	0.70
	Social relationships	0.15	0.01*
	Musculoskeletal disorders	-0.07	0.27
Overall Safety behavior	Overall quality of life	0.05	042
	Physical health	0.123	0.06
	Mental health	0.01	0.71
	Environmental health	0.08	0.22
	Social relationships	0.12	0.06
	Musculoskeletal disorders	-0.08	0.22
Spearman correlation coefficient; p < 0.05			

Table 4. Multiple linear regression analysis of the associations of quality of life and musculoskeletal disorders with safety behavior

	Unstandardized Coefficients		**Standardized coefficient (Beta)**	**95.0% Confidence Interval for B**		**P value**	***R***	***R Square***	***Adjusted R Square***	***Collinearity Statistics***	
Variables	Unstandardized coefficient (β)	Standard error		Lower Bound	Upper Bound					*Tolerance*	*VIF*
Constant	3.26	0.068	-	3.135	3.401		0.14	0.02	0.012	-	-
Quality of life	0.001	0.001	0.046	-.044	-.001	0.48				0.999	1.001
Musculoskeletal disorders	-0.022	0.011	-0.13	-.001	.002	0.03*				0.999	1.001

Discussion

This study investigated the relationship between safety behavior, musculoskeletal disorders (MSDs), and quality of life among pre-hospital emergency medical services personnel. The findings suggest that safety behaviors may be associated with a lower prevalence of musculoskeletal disorders and better quality-of-life status in certain dimensions, particularly physical and mental health. However, because the study is cross-sectional, causal inferences cannot be made.

The results demonstrated a high prevalence of musculoskeletal disorders among pre-hospital emergency personnel, with all participants (100%) reporting symptoms in at least one of the nine assessed body regions. According to the Nordic Musculoskeletal Questionnaire, the most commonly affected areas during both the past 12 months and the past 7 days were the knee, lower back, and upper back. These findings are consistent with those reported by Tahernejad et al. (2024), who identified a similarly high prevalence of MSDs among pre-hospital emergency workers, particularly in the waist, knee, and back regions[7]. These patterns may reflect the physically demanding nature of emergency work, including patient lifting, sudden movements, and transportation activities; however, longitudinal research is needed to confirm this interpretation.

Unfavorable working conditions, such as sudden patient movements, manual handling, and repeated transfers, may explain the high prevalence of MSDs in these anatomical regions. Rezaei et al. (2021) reported that healthcare workers are particularly vulnerable to lower back injuries during patient handling because of improper posture and sudden exertion, and that repetitive lifting significantly increases injury risk 28. Similarly, Abedini et al. (2013) found that the highest prevalence of musculoskeletal complaints among hospital nursing staff was in the lower back (71.5%), followed by the legs and wrists [29]. Lin et al. (2020) also reported that lower back and shoulder pain were the most prevalent musculoskeletal complaints among nurses, which is broadly consistent with the findings of the present study [30].

Musculoskeletal disorders remain one of the most significant occupational health problems globally, in both developed and developing countries [3]. Previous evidence indicates that the prevalence of work-related MSDs exceeds 30% in the general workforce. In countries such as the United States, Finland, Sweden, and the United Kingdom, these conditions are a leading cause of absenteeism and occupational disability [31,32]. Given the continuous involvement of EMS personnel in patient handling and transport, a high prevalence of such disorders is expected. Nevertheless, several studies suggest that EMS personnel do not consistently adhere to preventive safety measures [33,34] . This highlights the need for improved training and stronger implementation of occupational safety protocols.

The findings also suggest that safety behavior is positively associated with physical and psychological domains of quality of life. This indicates that safety-oriented behaviors may play an important role in physical and mental well-being. However, these findings are correlational and should not be interpreted causally. Pérez-Valdecantos et al. (2022) similarly reported that adherence to workplace safety principles and stress management strategies among emergency workers was associated with improved professional quality of life [35]. In addition, Panahi Gholoub et al. (2024) demonstrated that safety-based educational interventions can improve both quality of working life and mental and physical health among EMS personnel [36].

These findings emphasize that safety behavior should not be viewed merely as procedural compliance, but also as a psychological factor that may enhance employees' sense of control, competence, and workplace security. This perceived control may reduce occupational stress and improve psychological well-being, thereby positively relating to quality of life beyond preventing physical injury.

The results further indicated a significant inverse relationship between safety behavior and musculoskeletal disorders. Higher safety behavior scores were associated with a lower prevalence of MSDs, while individuals with MSDs reported lower levels of safety behavior. Najafi Ghezeljeh (2022) reported similar findings, observing an inverse relationship between safety behavior and occupational injuries among EMS personnel and noting that increases

in unsafe behaviors significantly raised injury risk [37]. Crawford (2020) also reported a negative association between safety behavior and workplace injuries in a systematic review 38. Likewise, Hege et al. (2019) emphasized that adherence to safety protocols and the use of modern protective strategies can significantly reduce occupational injuries in high-risk environments [39].

Both dimensions of safety behavior—compliance and participation—were significantly associated with musculoskeletal disorders. Safety compliance, in particular, appears to be more closely related to injury prevention and occupational health outcomes. This underscores the importance of structured, intervention-based programs to improve safety adherence. While environmental and ergonomic conditions contribute to injury risk, safety behavior may function as an important moderating factor that can help mitigate these risks when properly strengthened. Therefore, behavioral interventions should be prioritized alongside environmental modifications.

Regarding demographic variables, we found no significant associations between safety behavior and marital status, employment status, or workplace location. Gavili et al. (2019)[40] and Shamsadini et al. (2016)[41] reported similar findings. However, some studies have reported conflicting results, suggesting that marital status may influence safety behavior in certain occupational settings [42,43]. These discrepancies may reflect differences in occupational context, training programs, and cultural factors.

The present study observed a significant inverse relationship between education level and safety behavior, consistent with findings reported by Gharibi et al. (2016)[44]. This inconsistency across studies may reflect differences in the content and practical relevance of safety training programs. In high-intensity emergency settings, operational experience may influence safety behavior more than formal education alone.

The results also showed that age, BMI, work experience, shift work, and weekly working hours were significantly associated with musculoskeletal disorders. Higher BMI, longer work experience, and greater working hours were more common among individuals with MSDs. Matre et al. (2021) also reported a significant relationship between shift work and musculoskeletal disorders, although some studies have reported contradictory findings[45]. Rafiee et al. (2025) similarly found a positive association between work experience and MSDs [46]. These differences may reflect variations in occupational structure, workload, and methodological approaches.

Overall, these findings suggest a multifactorial risk profile. Increased work experience may reflect cumulative occupational strain, while higher BMI may increase biomechanical load on the musculoskeletal system. These findings highlight the importance of targeted preventive strategies, including early screening for experienced workers and integrated interventions combining nutrition, physical activity, and safety training for individuals with higher BMI.

Additionally, age showed a positive association with musculoskeletal disorders, whereas education level demonstrated a negative association. These findings are consistent with previous studies [32,4] . The age-related increase in MSDs may reflect degenerative musculoskeletal changes, while higher education may be associated with greater health literacy and preventive behaviors.

In conclusion, the observed associations between safety behavior, musculoskeletal disorders, and quality of life underscore the potential value of behavior-based preventive strategies for EMS personnel. However, these findings should be interpreted with caution. The study is limited by its cross-sectional design, which precludes causal inferences, and the relatively low explanatory power of our regression model, suggesting that unmeasured variables likely contribute significantly to these outcomes. Furthermore, reliance on self-reported data and a predominantly male cohort limit the generalizability of our results. Future longitudinal research incorporating more comprehensive predictive models and diverse participant samples is warranted further to elucidate the complexities of occupational health in this setting.

Conclusion

Given the highly stressful nature and substantial physical and psychological demands of pre-hospital emergency work, along with the high prevalence of musculoskeletal disorders in this occupational group, the present study's findings indicate that while musculoskeletal disorders may show a detectable statistical association with safety behavior, they are not major determinants. Therefore, the observed association between safety behavior and musculoskeletal disorders suggests that safety-related behaviors, alongside other

occupational factors, should be considered when assessing these employees' health status.

In this context, incorporating occupational safety practices, working conditions, and personnel physical and mental health status into occupational health assessments may provide a more comprehensive understanding of the challenges faced by pre-hospital emergency staff. Considering these factors together can clarify occupational health risks in this group and support the development of more effective interventions to improve working conditions and overall well-being.

Acknowledgment

The authors sincerely thank all the participating prehospital emergency personnel for their valuable cooperation in this study. We also express our gratitude to the authorities and management of the Yazd Prehospital Emergency Medical Services for their essential support and facilitation throughout the research process.

Conflict of Interest Disclosures

The authors declare that they have no competing interests.

Funding Sources

This study was funded/supported by Shahid Sadoughi University of Medical. The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the article.

Authors' Contributions

S.M.H.A. & A.A.D.T conceptualization, methodology, project administration; A.D. methodology, data curation; A.E. supervision; A.E. methodology, study consultation; S.M.H.A. Conceptualization, project administration. All Authors have participated in writing, editing, and reading the manuscript, and they all approved the final version for submission.

Ethical Statement

This article is derived from a master's thesis in the field of "Health in Accidents and Emergencies" which was approved by the Research Council of Shahid Sadoughi School of Public Health, Yazd and has the ethics code IR.SSU.SPH.REC.1404.075. In this study, written consent was obtained from all participants and the research process was fully explained.

Declaration of Generative AI and AI-assisted technologies

During the preparation of this work the authors used Chatgpt in order to writing the manuscript. After using this service, the authors reviewed and edited the content as needed and takes full responsibility for the content of the published article.

References

1. Pouraghaei M, Shams VS, Moharamzadeh P, Abrishami L, Balafar M. The impact of prehospital emergency services on the outcome of trauma patients. 2020;9:139-42.
2. Hegenberg K, Althammer A, Gehring C, Prueckner S, Trentzsch H, editors. Pre-hospital emergency medical services utilization amid COVID-19 in 2020: descriptive study based on routinely collected dispatch data in Bavaria, Germany. Healthcare; 2023: MDPI.
3. Greaves I, Porter K. Oxford handbook of pre-hospital care: Oxford University Press; 2021.
4. Gill TK, Mittinty MM, March LM, Steinmetz JD, Culbreth GT, Cross M, et al. Global, regional, and national burden of other musculoskeletal disorders, 1990–2020, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021. The Lancet Rheumatology. 2023;5(11):e670-e82.
5. Aljerian N, Alshehri S, Masudi E, Albawardi AM, Alzahrani F, Alanazi R. The prevalence of musculoskeletal disorders among EMS personnel in Saudi Arabia, Riyadh. The Egyptian Journal of Hospital Medicine. 2018;73(1):5777-82.
6. Kamali N, Amini Z, Hatami SH, Khatib K, Mohammadi S. Musculoskeletal Disorders in Emergency Medical Services Staff: Predictors and Relationship With Occupational Stress. Health in Emergencies and Disasters Quarterly. 2025;10(4):301-14.
7. Tahernejad A, Makki F, Rezaei E, Marzban H, Tahernejad S, Sahebi A. Musculoskeletal disorders in emergency medical services personnel: a systematic review and meta-analysis. Public Health. 2024;237:107-15.
8. Nazzal MS, Oteir AO, Alrawashdeh A, Alwidyan MT, Obiedat Q, Almhdawi KA, et al. Prevalence of work-related musculoskeletal disorders and associated factors affecting emergency medical services professionals in Jordan: a cross-sectional study. BMJ open. 2024;14(4):e078601.
9. Bardhan R, Byrd T, editors. Psychosocial work stress and occupational stressors in emergency medical services. Healthcare. 2023; 11:976.
10. Galiana L, Kowalczuk K, Sansy N. Psychological distress, burnout, quality of life, and wellness among healthcare workers. Frontiers Media SA. 2022; 13:913941.
11. Fatahi Y, Norouzinia R, Aghabarary M. Professional quality of life and resilience in pre-hospital emergency technicians during COVID-19 in Iran: a cross-sectional study. Journal of

Medical Ethics and History of Medicine. 2022;15:15.
12. Galiana L, Kowalczuk K, Sansy N. Editorial: Psychological Distress, Burnout, Quality of Life, and Wellness Among Healthcare Workers. Front. Psychol. 13: 913941. doi: 10.3389/fpsyg. Psychological Distress, Burnout, Quality of Life, and Wellness among Healthcare Workers. 2022:4.
13. Nabi AR, Kaviyani S, Sadeghi GH. The relationship between job burnout and quality of work life in pre-hospital emergency staff: Descriptive-correlation study. 2024.
Melnyk H, Di Tosto G, Powell J, Panchal AR, McAlearney AS. Conflict in the EMS workforce: an analysis of an open-ended survey question reveals a complex assemblage of stress, burnout, and pandemic-related factors influencing well-being. International journal of environmental research and public health. 2023;20(10):5861.
14. Chor WPD, Ng WM, Cheng L, Situ W, Chong JW, Ng LYA, et al. Burnout amongst emergency healthcare workers during the COVID-19 pandemic: A multi-center study. The American journal of emergency medicine. 2020;46:700.
15. Wilkinson-Stokes M, Tew M, Yap CY, Crellin D, Gerdtz M. The economic impact of community paramedics within emergency medical services: a systematic review. Applied Health Economics and Health Policy. 2024;22(5):665-84.
16. Lee J, Resick CJ, Allen JA, Davis AL, Taylor JA. Interplay between safety climate and emotional exhaustion: effects on first responders' safety behavior and wellbeing over time. Journal of business and psychology. 2024;39(1):209-31.
17. Nasiry Zarrin Ghabaee D, Haresabadi M, Bagheri Nesami M, Esmaeili R, Talebpour Amiri F. Musculoskeletal disorders in nurses and their relationship with occupation-related stress. Journal of Mazandaran University of Medical Sciences. 2016;25(132):91-102.
18. Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sшrensen F, Andersson G, et al. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Applied ergonomics. 1987;18(3):233-7.
19. Mokhtarinia HR, Hosseini ZSJ, Shokouhyan SM, Gabel CP. Translation, cultural adaptation and assessment of psychometrics properties of the Extended Version of the Nordic Musculoskeletal Questionnaire (NMQ-E) in Persian language speaking people. BMC musculoskeletal disorders. 2024;25(1):89.
20. Mahdinia M, Arsang Jang S, Sadeghi A, Karimi A. Assessment of safety behavior and determination of its predictive individual and occupational variables. Occupational Medicine Quarterly Journal. 2017;9(3):22-31.
21. Mahdinia M, Arsang JS, Sadeghi A, Malakouti J, Karimi A. Development and validation of a questionnaire for safety behavior assessment. 2016.
22. Sadeghi SJ, Taheri A, Lotfi KF, Sharifi N. Predicting the Safety Behavior of Health Care Staffs Based on Perceived Stress, Work-life Conflict, and Emotional Intelligence with Mediating Role of Burnout. 2021.
23. Abri M, Vosoughi S, Abolghasemi J, Taslimi H, Ebrahimi H. The Study of Relationship between Socioeconomic Status and Safety Behaviors in Workers of Subway Construction Project in Qom, Iran. Journal of Occupational Hygiene Engineering. 2022;9(2):95-101.
24. Development of the World Health Organization WHOQOL-BREF quality of life assessment. The WHOQOL Group. Psychol Med. 1998;28(3):551-8. doi: 10.1017/s0033291798006667. PMID: 9626712.
25. Nejat S, Montazeri A, Holakouie Naieni K, Mohammad K, Majdzadeh S. The World Health Organization quality of Life (WHOQOL-BREF) questionnaire: Translation and validation study of the Iranian version. Journal of School of Public Health and Institute of Public Health Research. 2006; 4 (4) :1-12.
26. Yousefnezhad M, Shareinia H, Kheirkhah EL, Sajjadi M. Translation and psychometric evaluation of the Persian version of the nurses' quality of life scale: a validation study in Iran. BMC nursing. 2024;23(1):183.
27. Rezaei B, Mousavi E, Heshmati B, Asadi S. Low back pain and its related risk factors in health care providers at hospitals: A systematic review. Ann Med Surg (Lond). 2021;70:102903. doi: 10.1016/j.amsu.2021.102903. PMID: 34691437; PMCID: PMC8519806.
28. Abedini R, Choobineh A, Hasanzadeh J. Musculoskeletal load assessment in hospital nurses with patient transfer activity. International Journal of Occupational Hygiene. 2013;5(2):39-45.
29. Lin SC, Lin LL, Liu CJ, Fang CK, Lin MH. Exploring the factors affecting musculoskeletal disorders risk among hospital nurses. Plos one. 2020;15(4):e0231319.
30. Ming-Lun Lu, Brian D. Lowe, Ninica L. Howard, Alysha R. Meyers, Robert R. Fox, Ren G. Dong, Brent A. Baker ; Work-related Musculoskeletal Disorders, Modern Occupational Diseases Diagnosis, Epidemiology, Management and Prevention (2022) 1: 287. https://doi.org/10.2174/9789815049138122010018.
31. Greggi C, Visconti VV, Albanese M, Gasperini B, Chiavoghilefu A, Prezioso C, et al. Work-related musculoskeletal disorders: a systematic review and meta-analysis. Journal of Clinical Medicine. 2024;13(13):3964.
Bledsoe BE, Sweeney RJ, Berkeley RP, Cole KT, Forred WJ, Johnson LD. EMS provider compliance with infection control recommendations is suboptimal. Prehospital Emergency Care. 2014;18(2):290-4.
32. Moshtagh Eshgh Z, Peyman A, Amirkhani A, Taghinejad F. The relationship between occupational stresses with job burnout in pre-hospital emergency staff. Jorjani Biomedicine Journal. 2014;2(2):41-33.
33. Pйrez-Valdecantos D, Caballero-Garcнa A, Bello HJ, Noriega-Gonzбlez D, Palomar-Ciria N, Roche A, et al. Professional quality of life of healthcare workers in hospital emergency departments. Behavioral Sciences. 2022;12(6):188.
34. Panahi-Qoloub A, Zohari Anboohi S, Nasiri M, Vasli P. The impact of the education program based on dimensions of quality of work life among emergency medical services providers. BMC Health Services Research. 2024;24(1):260.
35. Najafi Ghezeljeh T, Balouchi M, Haghani S. Survey of attitudes about patient safety in pre-hospital emergency operating staff of Mashhad-Iran in 2019. Iran Journal of Nursing. 2022;35(137):0.-
36. Crawford JO, Berkovic D, Erwin J, Copsey SM, Davis A, Giagloglou E, et al. Musculoskeletal health in the workplace. Best practice & research clinical rheumatology. 2020;34(5):101558.
37. Hege A, Lemke MK, Apostolopoulos Y, Whitaker B, Sцnmez S. Work-life conflict among US long-haul truck drivers: Influences of work organization, perceived job stress, sleep, and organizational support. International journal of environmental research and public health. 2019;16(6):984.
38. Gavili H, Fathi M, Zarezadeh Y, Roshani D, Yaghubi M. Attitudes toward safety and its affecting factors in Sanandaj emergency medical services staffs, in 2017. 2019;24(1):134-145.
39. Shamsadini Lori A, Osta A, Atashbahar O, Ramazani S, PourAhmadi M, Ahmadi Kashkoli S. Patient safety culture from the viewpoint of nurses of teaching hospitals affiliated with Shahid Beheshti University of Medical Sciences. Journal

of Health Based Research. 2016;2(1):81-92.
40. Amini M, Alimohammadi I, Jahanihashemi H, Fallah D. The relationship between the prevalence of accidents and safety culture in two detergents and cleaners companies in 2013. Iran Occupational Health.2013;10(6):93-105.
41. Ghahramani A, Fazli B. An investigation of safety attitude in a number of manufacturing companies in Urmia. Journal of Health & Safety at Work. 2017;6.(4)
42. Gharibi V, Mortazavi SB, Jafari AJ, Malakouti J, Abadi MBH. The relationship between workers' attitude towards safety and occupational accidents experience. International Journal of Occupational Hygiene. 2016;8(3):145-50.
43. Matre D, Christensen JO, Mork PJ, Ferreira P, Sand T, Nilsen KB. Shift work, inflammation and musculoskeletal pain—The HUNT Study. Occupational Medicine. 2021;71(9):422-7.
44. Skamagki G, Carpenter C, King A, Wehlin C. How do employees with Chronic Musculoskeletal disorders experience the management of their Condition in the Workplace? A metasynthesis. Journal of occupational rehabilitation. 2023;33(4):702-12.
45. Rafiee M, Alboghobeish A, Saremi M, Esmaeili SV. Exploring the relationship between mental work load, work ability, and musculoskeletal disorders: A cross-sectional modeling study among health service workforces in Iran. PLoS One. 2025;20(5):e0322993.
46. Crawford J, Davis A. Work-related musculoskeletal disorders: why are they still so prevalent. Evidence from a literature review [Internet] European Agency for Safety and Health at Work–EU-OSHA. 2020.