Impact of Active Duty Duration on Firefighters: An Analysis of Respiratory Functions and Physical Performance

İtfaiyecilerin Meslekte Geçirdikleri Aktif Dönem Uzunluğunun Solunum Fonksiyonları ve Merdiven Tırmanma Performansına Etkisinin İncelenmesi

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ABSTRACT

This study investigates the impact of active working periods on respiratory functions and physical performance in firefighters, considering the challenging conditions they face. Fifty-five firefighters, aged 18 to 64 years, with a minimum of two years of active service, were categorized into two groups: Group A (less than 10 years of service) and Group B (10 years or more). Assessment parameters included pulmonary functions, maximal inspiratory and expiratory pressures (MIP, MEP), 6-minute walk test distance (6MWD), Stair Climbing Test time (SCT), and Cornell Musculoskeletal Disorders Questionnaire (CMDQ). Group B displayed a higher average age, intervention in more fires, and increased exposure to toxic substances ($p > .005$). However, no significant differences were observed in pulmonary functions, respiratory muscle strength, and CMDQ scores between the groups. Group A exhibited a statistically significant increase in 6MWD, while Group B showed significantly greater SCT values. A weak and negative correlation ($r = .010$) was noted between work duration and forced vital capacity, and a moderate and positive correlation ($r = .519$) between work duration and SCT. The findings suggest a potential decline in respiratory functions and physical performance among firefighters with increased work duration. Emphasizing public awareness of occupational health risks and implementing preventive measures are crucial for safeguarding their well-being. Further research and targeted interventions are essential to support firefighters in maintaining optimal health and performance in their demanding profession.

Keywords: Firefighter, Respiratory functions, Occupational exposure.

ÖZ

Bu çalışma, itfaiyecilerin karşılaştıkları zorlu koşullar dikkate alınarak aktif çalışma sürelerinin solunum fonksiyonları ve fiziksel performans üzerindeki etkisini araştırmaktadır. Yaşları 18 ile 64 arasında değişen ve en az iki yıl aktif hizmet deneyimi olan elli beş itfaiyeci iki gruba ayrıldı: Grup A (10 yıldan az hizmet veren) ve Grup B (10 yıl veya daha fazla hizmet veren). Değerlendirme parametreleri arasında solunum fonksiyonları, maksimum inspiratuar ve ekspiratuar basınçlar (MIP, MEP), 6 dakikalık yürüme testi mesafesi (6DYT), Merdiven Tırmanma Testi süresi (SCT) ve Cornell Kas-İskelet Bozuklukları Anketi (CMDQ) yer aldı. Grup B'de daha yüksek ortalama yaş, daha fazla yangına müdahale ve toksik maddelere daha fazla maruz kalma görüldü ($p > 0,005$). Ancak gruplar arasında solunum fonksiyonları, solunum kas gücü ve CMDQ skorları açısından anlamlı farklılık gözlenmedi. Grup A'da 6DYT'de istatistiksel olarak anlamlı bir artış görülürken, Grup B'de 6DYT değerleri anlamlı derecede yüksek bulundu. Çalışma süresi ile zorlu yaşamsal kapasite arasında zayıf ve negatif bir korelasyon ($r = 0,010$), çalışma süresi ile 6DYT arasında ise orta ve pozitif bir korelasyon ($r = 0,519$) tespit edildi. Bulgular, itfaiyecilerde çalışma süresinin artmasıyla birlikte solunum fonksiyonlarında ve fiziksel performansta potansiyel bir düşüş olabileceğini düşündürmektedir. Kamuoyunun iş sağlığı riskleri konusundaki farkındalığının vurgulanması ve önleyici tedbirlerin uygulanması, onların refahının korunması açısından çok önemlidir. İtfaiyecilerin zorlu mesleklerinde optimum sağlık ve performansı korumalarını desteklemek için daha fazla araştırma ve hedefe yönelik müdahaleler gereklidir.

Anahtar Kelimeler: İtfaiye, Solunum fonksiyonları, Mesleki maruziyet

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INTRODUCTION

Firefighters play a crucial role as front liner esponders, regularly confronting challenging and perilous situations encompassing firefighting, traffic accidents, and search and rescue operations[1]. The inherent risks associated with the sescenarios, including cardiovascular challenges and thermal stresses, contribute to increased fatigue and shortened working durations[2]. Elevated thermal exposure exacerbates conditions like hyperthermia and dehydration, further limiting the operational time of firefighters and intensifying fatigue levels[3]. Additionally, the firefighting profession is linked to a decline in respiratory functions among its practitioners.

Numerous studies have emphasized the impact of smoke exposure on there spiratory health of firefighters, indicating a decrease in forced expiratory volume in one second (FEV_1) among individuals exposed to more severe smoke conditions[4]. Prolonged exposure to toxic agents in firefighting environments has also been linked to a higher incidence of respiratory symptoms and bronchiolar ventilation problems. In a separate study, the impact of toxic substances present at fire scenes on there spiratory functions of firefighters was investigated. A study group comprising both animal models and firefighters with a minimum of 10 years of experience was formed. The study group exhibited a high prevalence of pathological symptoms, and the incidence of these symptoms was found to be correlated with the duration of occupational exposure to toxic agents. Animal studies from the same research indicated evidence of extensive lung fibrosis, supporting the clinical findings in firefighters[5]. A 2020 study in the United States examined spirometry values to observe changes in the respiratory function of firefighters over a 5-year period. The reductions in FEV_1, Forced Vital Capacity (FVC), and FEV_1/FVC were found to be two to four times greater than the expected decline at 5 years[6]. In a Swiss study, the respiratory health of Professional firefighters was compared to a healthy population control group. The study revealed that firefighters reported respiratory symptoms such as headache, eye burning, nasal discharge, cough, and shortness of breath more frequently during work. Additionally, atopy was observed more frequently in firefighters[7]. Therefore, the number of years spent in the profession and the rate of exposure to fire smoke may have an effect on respiratory functions.

While existing literature predominantly focuses on the impact of smoke exposure on firefighters' respiratory functions concerning occupational exposure, fewer studies explore the effects of this exposure on exercise capacity and physical performance. The stair climbing test is an affordable, portable and safe method. Embedded within the nationally established Candidate Physical Ability Test, this test simulates firefighting scenarios and serves as a primary screening tool for firefighter candidates[8]. During firefighting operations, firefighters wear heavy protective equipment to regulate their body temperature and shield themselves from external heat sources. As a result, activities like climbing stairs consume considerable energy due to the additional load from the protective gear[9]. In this context, firefighting requires a high level of physical muscle strength and endurance. The ability to walk, sit, stand, and climbstairs significantly impacts an individual's daily participation and overall quality of life[10]. The test has been shown to produce valid and reliable results for various age groups, including older adults[11]. In a recent study, the effects of the stair-climbing test on metabolism and cardiorespiratory system were examined. Accordingly, it was found that the stair-climbing test imposed higher metabolic demands compared to the treadmill and 6-minute walking test[12]. These findings

support the use of the stair climbing test as a valuable measure of endurance capacity.

The aim of our study is to examine the effect of the active period of firefighters in the units on the respiratory functions and physical performance, and to raise social awareness about possible occupational diseases and precautions to be taken.

METHODS

Data collection

This observational cross-sectional study was approved by the Ethics Committee on 10 October 2022 (approval number: 22/471). The study was conducted in accordance with the Declaration of Helsinki and is registered at ClinicalTrials.gov (NCT05657626).

Research Group

Volunteers working in the Europian Side Fire Department of İstanbul Municipality, aged between 18 and 64 years, were included in the study if they did not have any psychological, cognitive, or emotional problems and did not suffer from chronic cardiac or pulmonary diseases that could prevent them from participating in the study. Only firefighters who had been actively working for at least two years were eligible for participation. Demographic information of the individuals included in the study was collected, and the "Informed Consent Form" was signed by each participant. Conversely, firefighters with less than 2 years of service in the institution, those with pre-existing chronic respiratory diseases before employment commencement, or individuals who did not provide written consent for participation were excluded from thes tudy.

The cases were categorized into two groups based on their years of work experience: those who had been working for less than 10 years (Group A) and those who had been working for 10 years or more (Group B).

The sample size for the study was determined based on data from a previous study conducted by Swain et al. (2010). Through these calculations, it was concluded that a total of 50 cases should be included in the sample, aiming for a 95% power level and a type 1 error rate of 0.05[13].

Data Collection Tools

The study protocol encompassed six assessments, each designed to comprehensively evaluate various aspects of firefighters' health and performance. The assessments included fire brigade enrollment and demographic assessment, measurement of respiratory muscle strength, pulmonary function tests, a 6-minute walk test, the Cornell Musculoskeletal Disorders Questionnaire for assessing musculoskeletal disorders, and the Stair Climbing test for evaluating stair climbing performance. Each assessment was conducted as a structured test.

In collecting sociodemographic data, a "Demographic Data Form" was utilized, covering essential information such as age, gender, height, weight, marital status, smoking and alcohol use, fire service start date, total time spent on duty, department type and rank, estimated number of fires responded to, estimated number of toxic exposures, specific work-related exposures, injuries or diseases, type and severity of injury, affected body part, event at the time of injury (fire location, transportation, training), factors causing injury (equipment failure, lack of training, firefighter fatigue), and occurrences of dyspnea and coughing spells during sleep.

Respiratory muscle strength was measured, and maximal inspiratory pressure and maximal expiratory pressure (MIP/MEP) were measured with a Pony Fx (Cosmed, Italy) respiratory function test device. For MIP measurement, participants were instructed to exhale slowly until reaching the residual volume level, and then

to perform a rapid inspiration. During this rapid inspiration, the shutter in the tubing was closed. Participants' inspiratory strength was measured using a pressure gauge against the closed shutter. Standard mouthpieces and nose clips were used during the test. To prevent the spread of unwanted harmful microorganisms, a bacterial filter was incorporated into the setup. Additionally, particular attention was given to ensure that there were no leaks from the lip edges. For MEP measurement, the participant was asked to reach the total lung volume level and then perform a forceful exhalation through the mouthpiece, simulating the act of inflating a balloon, for at least 1.5 seconds. In the meantime, the pressure created by rapid expiration was measured by sensors. Shutter opened after 1.5-2.0 seconds and the test was terminated. In cases where multiple tests were required, maximum 3-5 tests were performed and the participant rested for at least 1 minute between the each test. Care was taken to ensure that there was no more than 10 cmH_2O difference between the measurements. The highest rating achieved was recorded and compared with the expected value[14].

The pulmonary function test was performed with Pony Fx pulmonary function tester. To administer the test correctly, participants were initially instructed to assume the proper position. They were then asked to wear a nose clip, insert the mouthpiece, and keep their lips closed. At the beginning of the test, the participants were asked to perform a rapid and deep inspiration, ensuring they reached the total lung volume level. Afterward, a strong expiration was requested without holding the breath for more than 1 second. However, the participants were asked to continue the maximal expiratory maneuver until they completely exhaled all the air from their lungs. The test was stopped as soon as the test was repeated 8 times without obtaining a valid result or when the participant identified fatigue[15].

The 6-minute walk test, considered the gold standard for evaluating exercise capacity, was conducted in a 30-meter corridor. Physiological parameters such as heart rate, oxygen saturation (SpO_2), and blood pressure were measured using appropriate devices. Participants' levels of dyspnea and fatigue were assessed using the Modified Borg Scale, and measurements were recorded before and after the test[16].

“Cornell Musculoskeletal Disorders Questionnaire” was used to evaluate musculoskeletal disorders. This survey; It was developed to evaluate musculoskeletal disorders in the Cornell University workforce[17]. It has been adapted and validated for use in the Turkish population[18]. In the test, there are evaluations of 20 body parts on three scales of musculoskeletal disturbance frequency, severity, and interference with work capacity. For assessing frequency, participants were asked how often they experienced problems within the last week. The severity was categorized as mild, moderate, or very severe, while participants also indicated the extent of the related musculoskeletal issue (none, a little, or a lot). The test was available in separate forms for men and women. The risk score was obtained from the answers given and interpreted according to this table[18].

The stair climbing test was applied to evaluate stair-climbing performance. Before beginning the test, the procedure was explained to the participants. To warm up, participants were asked to go up and down the 26-step ladder (stair height: 20 cm) once without wearing weighted vests. Following the warm-up, each participant was fitted with a 20 kg weighted vest by two researchers responsible for the study, and the vest was securely fastened to the body using 2 Velcro straps. This added weight was intended to simulate the equipment used during missions. When the participants were commanded to start the test, they were told to go up and down the stairs 4 times (a total of 104 steps) without any pauses or

holding onto the railing or wall. It was stated that they should touch each step with one foot as fast as possible and at the end of the fourth lap, the timer will be stopped when they touch both feet in the lower area[11].

Statistical Analysis

Data analysis was performed using SPSS 25 package program. The percentage and frequency values for categorical variables; For quantitative variables, median, minimum and maximum values were presented. Comparisons between two independent categorical variables were performed using the chi-square test. In the comparison of categorical and quantitative variables; firstly, the conformity of the data to the normal distribution was determined using the Shapiro-Wilk test. To analyze the relationship between two quantitative variables, Pearson correlation was applied when the data followed a normal distribution. In comparisons between two independent quantitative measures, the Wilcoxon test was used. Type I error rate (α) was taken as .05 in the study.

Limitation

Our study has several limitations. The most significant limitation of the study is that it is a cross-sectional study and no long-term follow-up study. In addition, considering that physical functions may be affected with increasing age, the lack of control groups consisting of similar age groups is a limitation. It is also a shortcoming that the exercise habits of the participants were not questioned.

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RESULTS AND DISCUSSION

In our study, a cohort of 55 firefighters, with a mean age of 38.00 years (ranging from 16 to 52 years), was examined. Of the participants, 51 (92.7%) were male. Statistical analyses revealed significant differences among groups categorized by years of study in terms of age (<.001), gender (p=.028), estimated number of fire interventions (<.001), and number of toxic substance exposures (<.001) (refer to Table 1).

No statistically significant differences were observed between the groups in pulmonary function test scores, respiratory muscle strength, and musculoskeletal problems (p>.05). However, upon comparing the groups, it was noted that Group A exhibited higher exercise capacity (p = .008) and shorter stair climbing time (p = .001) (see Table 2).

Correlation analyses exploring the relationship between years of professional experience and various measurement parameters revealed that as the years of experience increased, FVC decreased (r=-.346), and stair climbing test time increased (r=.519). No significant correlations were observed with other parameters (see Table 3).

Table 1. Demographic characteristics and anamnesis information of the cases

Demographic features	Whole group N=55	Group A (n=26)	Group B (n=29)	p
Age, year	38.00(16-52)	27.50 (22-38)	40.00 (16-52)	<.001
BMI, (kg/m²)	26.70(21-33)	25.4 (21-32.8)	27.4 (22.9-33.7)	.071
Gender, n(%) **Male/ female**	51/4(93/7)	22/4 (85-15)	29/0 (100-0)	.028
Smoke, n(%) **Yes/ No**	31/24(56/44)	15/11 (58/42)	16/13 (55/45)	.851
Alcohol, n(%) **Yes/ No**	4/51(7/93)	3/23 (12/88)	1/28 (3/97)	.249
Professional Experience Year, year	12.00(2-28)	2 (2-7)	16 (11/28)	<.001
Estimated number of fires intervened,(n)	1700.00(15-17000)	500.00(80-4000)	3500.00(15-17000)	<.001
Estimated number of Toxic Substance Exposures, (n)	300.00(0-15000)	50 (2-1500)	1000 (0-15000)	<.001
Sleeping Dyspnea and Coughing Attacks, n(%) **Yes/No**	5/500(9/91)	1/25 (4/96)	4 / 25 (14/86)	.200
Sleep apnea, n(%) **Yes/No**	7/48(13/87)	1/25 (4/96)	6/23 (21/79)	.061

**Group A: Firefighters working for less than 10 years, *Group B: Firefighters working for 10 years or more.*BMI: Body mass index. *Data are given as median (minimum-maximum) or "%".*

Table 2. Clinical characteristics of the cases

	Group A (n=26)	Group B (n=29)	p
Lung Functions			
FEV_1, lt	3.975 (1.89-5.16)	.390 (1.73-5.39)	.109
FEV_1%	93.5 (46-122)	92.00 (40-123)	.973
FVC, lt	4.8750 (3.29-6.43)	4.5000 (3.36-6.62)	.050
FVC %	95.50 (71-120)	96 (72-123)	.853
FEV_1/FVC	78.50 (42-88)	79.00 (32-91)	.299
PEF	5.2400 (1.56-10.39)	5.9400 (2.57-10.89)	.238
PEF %	9.74 (6.99-10.99)	9.11 (8.48-9.89)	.113
Respiratory muscle strength			
MIP, cmH_2O	125 (72-190)	128 (75-175)	.879
MIP%	115.50 (67-179)	126 (75-168)	.655
MEP, cmH_2O	120 (48-235)	112 (72-159)	.625
MEP%	89.50 (34-164)	84 (53-116)	.742
Cornell Musculoskeletal Disorders Questionnaire			
Neck	0 (0-10.5)	0 (0-10)	.983
Shoulder	0 (0-7)	0 (0-7)	.928
Back	0 (0-60)	0 (0-40)	.387
Upper Arm	0 (0-20)	0 (0-6)	.135
Waist	0 (0-14)	3 (0-60)	.060
Forearm	0 (0-1.5)	0 (0-0)	.291
Wrist	0 (0-3)	0 (0-10)	.697
Hip	0 (0-3.5)	0 (0-10)	.067
Upper leg	0 (0-14)	0 (0-209)	.201
Knee	0 (0-15)	1.5 (0-30)	.109
Lower Leg	0 (0-7)	0 (0-30)	.504
Foot	0 (0-3.5)	0 (0-7)	.697
Exercise capacity			
6MWD,m	650 (508-800)	587 (425-1440)	.008
Stair clambing test time (sc)			
	27.67 (21.79-39.70)	31.35 (24.33-44.0)	.001

**Group A: Firefighters working for less than 10 years, *Group B: Firefighters working for 10 years or more.*FVC: mandatory vital capacity;*FEV_1: Forced expiratory volume in one second; *FEV_1/FVC: Tiffeneau-Pinelli index; *PEF: Peak Expiratory Flow Rate; *MIP: Maximum inspiratory pressure; *MEP: Maximum expiratory pressure, *6MWD: 6 Minutes walking test distance. *Data are given as median (minimum-maximum) or %.*

A prior study on firefighters emphasized the examination of risk factors such as age, height, body mass index (BMI), exposure time, physical activity, smoking, and pulmonary function parameters[19]. In alignment with this, our study delved into age, gender, smoking habits, body mass index, exercise routines, and overall health status. Our evaluations revealed consistent results in firefighters for the mentioned parameters. Notably, our study expanded on the previous research by including assessments of the estimated number of fire interventions, exposure to toxic substances, and the occurrence of breathing problems during sleep. As anticipated, the frequency of exposures increased with the duration of study, and a significant portion of the participants were identified as smokers. A noteworthy finding was the absence of a decline in respiratory functions despite both smoking and occupational smoke exposure. This anomaly may be attributed to the physical activity levels and sports habits prevalent among firefighters.

In a study conducted in South Korea, it was found that spirometric measurement values were significantly reduced in firefighters compared to non-firefighters[19]. In another study, spirometry values were examined to observe changes in respiratory function of firefighters in the United States over a 5-year period. Accordingly, the decreases in FEV_1, FVC and FEV_1/FVC were two to four times greater than the expected decline at 5 years[6]. In our study, we observed a decrease in FVC value as the duration of Professional experience increased according to the SFT result.

In a comparative study involving a healthy control group and non-smoking male firefighters observed significantly lower values of pulmonary function test parameters in firefighters compared to the healthy subjects[20]. Although our study did not include a control group, we conducted a comparison with normative values of spirometric measurements. Upon analyzing our data individually, it becomes evident that spirometer values exhibit variation, with percentage comparisons to expected values ranging from 40% to 96%. This variability can be attributed to the heterogeneous nature of our case group.

Table 3. Correlation Analysis Table of Occupational Oxperience Year and Other Work Result Measurements.

(n=55)		**FEV_1 lt**	**FEV_1 %**	**FVC lt**	**FVC %**	**FEV_1/ FVC**	**PEF lt**	**PEF %**	**MIP H_2O**	**MIP %**	**MEP H_2O**	**MEP %**	**6MWD (m)**
	R	-.203	.038	-.346(**)	-.141	.114	.147	.231	-.077	-.016	-.029	.001	-.223
	p	.137	.783	.01	.304	.407	.284	.576	.576	.910	.836	.992	.101
Professional Experience Year		Neck Cornell Score	Shoulder Cornell Score	Back Cornell Score	Upper Arm Cornell Score	Forearm Cornell Score	Wrist Cornell Score	Hip Cornell Score	Upper Leg Cornell Score	Knee Cornell Score	Lower Leg Cornell Score	Foot Cornell Score	Stair-Climbig Time (sc)
	*R**	-.042	-.164	-.150	-.091	-.156	.050	.193	-.121	.148	.167	.084	.519
	p	.763	.231	.275	.511	.255	.719	.158	.378	.281	.222	.54	<.001

**Group A: Firefighters working for less than 10 years, *Group B: Firefighters working for 10 years or more.*FVC: mandatory vital capacity;*FEV_1: Forced expiratory volume in one second; *FEV_1/FVC: Tiffeneau-Pinelli index; *PEF: Peak Expiratory Flow Rate; *MIP: Maximum inspiratory pressure;*MEP: Maximum expiratory pressure, *6MWD: 6 Minutes walking test distance, *r: correlation coefficie Based on our study findings, it was observed that an increase in the number of years spent by firefighters in the profession and their exposureto smoke and toxic substances correlates with a decline in their respiratory functions and physical performance.*

A study conducted in the United States of America during winter months focused on non-smoking forest firefighters who worked in fire seasons with a high probability of fires. The findings indicated that, despite observed decreases during the working shift for FVC and FEV_1values, pulmonary function test values on fire and non-fire days were similar[21]. In our study, we specifically evaluated the number of fire interventions, noting an increase in parallel with the years of Professional experience. Our assessments revealed a relationship between the current value of FVC and the years of Professional experience. This suggests that the cumulative exposure to

harmful particles over the years in the profession may impact lung functions. However, contrary to existing literature, we did not find a correlation between the peak expiratory flow current value and years of professional experience.

Exercise capacity plays a crucial role in the job performance of firefighters[22]. In one study, the effect of field tests was examined to evaluate the aerobic working capacity of firefighters. Accordingly, a strong correlation was found between laboratory and indirect (field) aerobic capacity tests and firefighting duties[23]. Results; shows that the 6MWT performed on the treadmill can be evaluated as well as laboratory exercise capacity tests as a field test in the interpretation of the work performance of firefighters. A recent study examined the relationship between firefighters' physical capacity and their work capacity. Accordingly, models excluding anthropometric data have been found to be valid in the assessment of physical work capacity for firefighting work duties[24]. The results Show that field tests like the 6MWT can assess firefighters' physical working capacity as well as laboratory tests. In our study, we also employed the 6MWT to measure exercise capacity. While we did not find a direct relationship between the years of professional experience and the 6-minute walking distance, we did observe that the walking test results were lower in firefighters with a working period of 10 years or more. This situation may be secondary to exposure in respiratory functions, as well as may be explained by increasing age or sports habits. However, exercise habits were not reported in our study.

Firefighters are at risk for the development of musculoskeletal disorders. In the US National Fire Protection Association report, strains and sprains were reported to account for over 40% of injuries sustained during fire ground operations in 2005[25]. The result of another study involving 320 firefighters that evaluated the relationship between job demand of firefighters and work-related musculoskeletal disorders shows that an increase in firefighter job demand can lead to high musculoskeletal dysfunctions[26]. In another study of 101 firefighters, the CMQ was administered for work-related musculoskeletal disorders due to the great physical demands of their duties. The data obtained indicated that the lumbar region had the highest prevalence of injury[27]. According to the results of the CMQ in our study, unlike the literature, we could not find a relationship between body regions and years of professional experience. This may be due to the fact that firefighters receive training at certain periods and keep their condition high by participating in a regular exercise program. It is essential to consider that our study is limited due to the fact that our study is a cross-sectional study. For this reason, large prospective studies are needed.

In our study, it was preferred to use the SCT, which is similar to the occupational physical strain of firefighters. In a study using this test, the relationship between high heart rate response to stair climbing performance and low level of functionality was pointed out. However, no significant correlation was found between physiological values such as heart rate and VO_{2max} (maximum oxygen uptake) measured during the test[8]. Another study examined the effects of age on cardiorespiratory fitness and physical activity levels in firefighters, revealing a decline in cardiorespiratory fitness with advancing age[28]. In a study evaluating the relationship between balance and stair-climbing activity, it was determined that firefighters with more years of professional experience and active duty performed better in stair-climbing activity due to their exposure to activities requiring balance[29]. As a result of another study, muscle strength, and structure were examined by ultrasound and computed tomography, and it was found that weak quadriceps muscle strength adversely affected lower extremity

performance. It has been stated that lower muscle strength doubles the risk of movement limitation during tasks such as climbing stairs, particularly in older individuals. From this point of view, the number of years of professional experience that increases with age affects stair climbing performance negatively[30]. In our study on firefighters, it was determined that the longer years of professional experience prolong the time of climbing stairs.

CONCLUSION AND RECOMMENDATIONS

As a result of our study, it was determined that respiratory functions and physical performance were negatively affected as the duration of professional experience increased. The significance of our study lies in being the first to address the challenges that may arise during firefighters' active careers and to examine the changes in their physical performance. In addition, the outputs obtained from this study are a preliminary study for future research on firefighter health.

Author Contributions

Conceptualization: [Betül Ayten KARAMAN, Buse BAŞ, Hatice Kübra KÜRK, Sena ARICAN]; Methodology: [Betül Ayten KARAMAN, Buse BAŞ, Hatice Kübra KÜRK, Sena ARICAN]; Formal analysis and investigation: [Betül Ayten KARAMAN, Hatice Kübra KÜRK, Sena ARICAN, Esra PEHLİVAN]; Writing - original draft preparation: [Betül Ayten KARAMAN, Buse BAŞ, Hatice Kübra KÜRK, Sena ARICAN Writing - review and editing: [Betül Ayten KARAMAN, Hatice Kübra KÜRK, Sena ARICAN, Fulya Senem KARAAHMETOĞLU, Esra PEHLİVAN]; Funding acquisition: [Betül Ayten KARAMAN, Buse BAŞ, Hatice Kübra KÜRK, Sena ARICAN]; Resources: [Betül Ayten KARAMAN, Buse BAŞ, Hatice Kübra KÜRK, Sena ARICAN]; Supervision: [Fulya Senem KARAAHMETOĞLU, Esra PEHLİVAN].

Availability of Data And Material

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of interests: The authors declare that they have no interests, financial or otherwise, that are directly or indirectly related to the work submitted for publication.

Ethical approval

Hamidiye Scientific Research Ethics Committee examined the questionnaires and related materials and determined that they are exempt with in the scope of the current diagnosis and treatment guidelines published by the Ministry of Health in 30/09/2022 (22/471).

Data Availability Statement

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

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