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An Assessment of Turkish Forest Fire Workers' Thoughts on Occupational Health and Safety

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Abstract

Forest fire workers (FFWs) operate in very difficult working conditions; they transport heavy equipment on rough and steep terrain and are exposed to high levels of noise, heat, stress, and smoke. Working in different fire sensitivity degree regions (FSDRs), FFWs experience occupational health and safety (OHS) problems as they are involved in dangerous and risky tasks. In Türkiye, which is a high-risk country in terms of forest fires, there is no comprehensive and well-documented data regarding what FFWs think about OHS, taking into account all FSDRs. In this study, the views of FFWs in Türkiye regarding OHS training, first aid training, the personal protective equipment (PPE) used by FFWs, the quality of the equipment and ergonomic suitability levels were investigated. The Body Mass Index (BMI) parameters of FFWs were also calculated. In addition, occupational accidents experienced by FFWs and the relationship between these occupational accidents and taking on additional duties were examined with the Spearman ranking correlation coefficient. 962 FFWs participated in the survey, which consisted of four sections and 20 questions. Whether the data obtained differs between the four FSDRs was examined with the Chi-Square test, Kruskal-Wallis H *test, and the Mann-Whitney* U *test. There was a statistical difference between FFWs operating in the FSDRs in terms of OHS and first aid training. The quality of the majority of PPE and equipment used statistically differed between FFWs operating in the FSDRs. There was a statistical difference between FFWs operating in the FSDRs in terms of work accidents. Occupational accidents of FFWs and the relationship between these and taking on additional duties were examined and a positive correlation was found between the occupational accidents of FFWs and the additional duties assigned to them. The average height of the FFWs was 175.03 cm. and the average weight was 81.01 kg. 1.46% of the FFWs were underweight, 37.42% were of normal weight, 44.39% were overweight, and 16.73% were obese. Although the health checks of the workers were carried out regularly, the BMI values were not at normal rates. Even though FFWs in Türkiye participate in OHS training at a high level, they cannot adequately reflect this training in their experiences. Regarding first aid, the level of participation or education was not sufficient. The General Directorate of Forestry (GDF) should increase the effectiveness of OHS training received by FFWs and their inspections on this issue.*

Keywords: forest fire workers, fire fighting, occupational accidents, personal protective equipment, body mass index, first aid training

1. Introduction

Forestry activities are carried out in the open air, under difficult working conditions, and the influence of many different risk factors. Forestry works are among the most physically demanding works compared to other activities. In many countries, the forestry is one of the sectors with the highest injury risk (Landekić et al. 2021, Landekić et al. 2023). Low productivity, low wages, high accident rates, and employment of local and migrant workers are among the characteristic features of forestry, which is viewed as one of the most dangerous industrial sectors in the world (ILO 1988, ILO 2011, Harrington 2021). Forest fires, which cause significant loss of life and property

in forestry activities, are among the disasters that negatively affect the balance of the natural ecosystem (Okan and Acar 2017).

Combating forest fires consists in reducing the risk of fires, extinguishing fires, and minimising the damage caused by fires (Güney et al. 2016). There has been an increase in technological possibilities in the fight against forest fires, and apart from manpower and hand tools, aircraft, construction equipment, sprinklers, etc., and vehicles are used more intensively. However, there has been an increase in the number of hazards and risks that may be encountered in terms of OHS with the increased use of technological opportunities in the fight against forest fires (Sayın et al. 2014). As the number and impact of forest fires increase, more FFWs are exposed to the health effects of fighting forest fires (Koopmans et al. 2020).

According to the International Labour Organization (ILO), all personnel should receive OHS and first aid trainings in combating forest fires. The basic trainings that are particularly emphasised are:

⇒ fire fighting techniques

⇒ safe use of firefighting equipment

⇒ measures to be taken to escape from the fire area in an emergency

⇒ accident risks and prevention in the fire area

⇒ first aid techniques applicable to accidents commonly encountered in fires (ILO 1988).

OHS training helps employees to develop their skills to reduce hazards and risks in the work environment, to recognise risks and hazards, and to learn how to safely use work equipment, handle fire safety, and provide emergency plans. First aid training helps employees know what to do in unexpected situations such as workplace accidents or emergencies (ILO 2016).

Pelletier et al. (2022) stated that the increase in global wildland fire activity has accelerated the urgency to understand the health risks associated with wildland fire suppression. According to the OHS workplace hazard classes, forest fires are classified as dangerous (OJ 2012). The most important reasons why forest fires are dangerous and carry a high risk of accidents are as follows (Hauke et al. 2011, Donarski 2022, Leduc et al. 2022):

⇒ working while exposed to flame and heat

⇒ working with the risk of contact/burning in a resinous, ash and ember environment

⇒ working in a high-temperature sunny environment

⇒ working with water and retarder/foam

⇒ breathing in a smoky environment with particulates/gas outlets

⇒ working in an environment with falling objects, such as trees and branches

⇒ working in a mobile (squatting, standing up, running) and non-ergonomic environment

⇒ long working hours

⇒ working in an environment with strong winds and low relative humidity

⇒ working in steep and open terrain

⇒ a risk of water loss (sweating) from the body and an increase in body temperature

⇒ falling, tripping and slipping on slippery, sharp, rough ground

⇒ working in a mechanically noisy environment.

For these reasons, PPE and training activities are important, both for the protection of personnel from dangers and risks and to provide experience.

Fighting forest fires is an extremely laborious process carried out in hot environments. PPE must be used to protect employees from thermal exposure. However, additional use of PPE may increase the physiological strains of FFWs and, consequently, limit their performance (Carballo-Leyenda et al. 2017, Okan and Acar 2017). PPE consists of special backpacks, fireproof clothing, helmets, fire shelters, gloves, leather boots and other basic safety items (NWCG 2022). For this reason, it has been revealed in various research studies that each PPE should meet a minimum quality standard, be comfortable, provide appropriate protection for the user, be checked periodically and not be adversely affected by environmental conditions (ILO 1988, Engur 2001, SAVER 2014, FSNAL 2020, Donarski 2022). It is thought that improvements in PPE can contribute to the implementation of operational interventions that can increase the effectiveness of firefighting (Fullagar et al. 2021). In Türkiye, FFWs are provided with trousers, fire boots, masks, gloves, shirts, caps, T-shirts and belts to wear while on the job. The clothing of FFWs is provided by the GDF once or twice annually at certain times of the year, and they do not have the chance to purchase the clothing they need at other times (Akay and Yenilmez 2007, Okan and Acar 2017, Bacı and Çalışkan 2022).

It is necessary to consider the effects of occupational exposure to forest fires on the health of FFWs and to implement policies to reduce risk (Koopmans et al. 2020). In this context, it is recommended to eliminate the shortage of skilled workers who take part in the fight against forest fires in Türkiye, to employ

FFWs who are employed all year rather than seasonally, to recruit a suitable number of FFWs as permanent staff and to switch to a shift system in order to eliminate worker shortage (FAT 2021, Karacabey 2021). In addition, it is necessary to foresee the potential negative physical and mental effects of the additional duties given to FFWs outside the forest fire season. It has been stated that the assignment of additional tasks to workers, which do not concern the actual situation but concern different staff, arises due to the complexity of the work distribution and job descriptions and faulty job design (Safak 2022).

The opinions and thoughts of FFWs regarding OHS, working conditions and PPE are important in terms of understanding the measures to be taken. The most important research priorities related to FFWs in Canada were expressed as the effects of smoke inhalation on respiratory health, fatigue and sleep, mental health, stress and long-term risk of disease (Pelletier et al. 2022). Semmens et al. (2016) investigated the employment, health and demographic information of 499 wildland firefighters through a questionnaire to investigate the health impact of fighting forest fires. Garcia et al. (2022) described the chronic pain of Spanish FFWs due to difficult working conditions. Fullagar et al. (2021) evaluated the current perceptions of Australian FFWs of heat stress, fatigue and recovery practices during active duty. McQuerry and Easter (2022) conducted a study in the USA to determine the cleaning practices of FFWs' PPE and the laundering resources that workers access while working in the field. Carballo-Leyenda et al. (2017) analysed the effect of four different kinds of PPE on the physiological stress of FFWs under moderate conditions.

In Türkiye, the satisfaction of FFWs with their work clothes was studied by Okan and Acar (2017). Gümüş and Türk (2011) examined the working conditions of FFWs and identified the main OHS problems. Gülci et al. (2016) investigated the ailments seen in FFWs working in fire watchtowers. Bacı and Çalışkan (2022) investigated the mental and physical health of FFWs by revealing the situation in recent years regarding OHS of FFWs and evaluating the psychosocial status of workers. Akay et. al. (2008) examined the working conditions of helicopter flight and ground crew working as a first response and air support team and identified the main health and safety problems. Akay and Yenilmez (2007) examined the working conditions of FFWs working in the Alanya, where there are first-degree fire-sensitive forests, and identified the main health and safety problems.

It is understood that in these studies on OHS dealing with FFWs in Türkiye, not all areas of sensitivity were included in the scope, and only a limited number of FFWs were interviewed in a certain region. In this study, however, a high level of worker participation from all FSDRs was ensured. In this context, the aims of the study were:

⇒ to find the extent of FFWs' participation in OHS training and first aid training

⇒ to calculate the BMI values of FFWs

⇒ to understand the quality and ergonomic suitability of PPE used by FFWs

⇒ to list the occupational accidents that FFWs are exposed to and the additional duties assigned

⇒ to determine the relationship between the occupational accidents that FFWs are exposed to, and the additional duties given.

2. Materials and Methods

2.1 Study Design and Data Collection

Türkiye's forests are divided into five FSDRs according to the average number of fires and the average burned forest area in the last twenty years (GDF 1995). Thirty-seven percent of the forests are in the first FSDR; 25% are in the second FSDR; 28% are in the third FSDR; 6% are in the fourth FSDR; and 5% are in the fifth FSDR (GDF 2022, Safak et al. 2023). Accordingly, the most forest fires and forest areas are located in the first region. The fewest forest fires occur in the fifth and fourth regions, and the amount of forest area in these regions is less than in the other regions. Therefore, in the study, the fourth and fifth FSDRs were combined and evaluated together, and analyses were made in terms of four FSDRs.

Within the scope of the study, five hypotheses were formulated:

⇒ $H_0$1: There is no difference between the FFWs operating in the FSDRs in terms of the first aid training and OHS training they receive

⇒ $H_0$2: There is no difference between the FFWs operating in the FSDRs in terms of BMI values

⇒ $H_0$3: There is no difference between FSDRs in terms of the quality and ergonomic suitability of PPE

⇒ $H_0$4: There is no difference between the FFWs operating in the FSDRs in terms of work accidents they experience

⇒ $H_0$5: There is no statistical relationship between the occupational accidents of FFWs and the additional duties assigned to these workers.

For the purpose of sampling all FFWs, a random cluster sample was used. A survey was used as the data collection tool in the study. The main material of the study was obtained from the survey conducted with personnel working in forest fire fighting activities in Türkiye. The survey filled out by the FFWs consisted of 20 questions, which were divided into four groups, and included:

⇒ In the first part, there was demographic data such as height, weight, age, education, marital status and years of experience

⇒ In the second part, there were questions about training activities within the scope of OHS

⇒ The third part covered work accidents

⇒ In the fourth part, there were questions about assigning additional duties.

The universe of this study consists of 9296 FFWs involved in firefighting activities. The number of FFWs to be interviewed in the study was calculated using the following formula (Eq. 1), (Orhunbilge 2000, Daşdemir 2021).

$$n \geq \frac{N \times p \times g \times Z^2}{\left[\left(N-1\right) \times d^2 + p \times q \times Z^2\right]} \quad (1)$$

Where:

n sample size

N size of the population (N=9296)

p existence possibility of the measured feature in the population (p=0.5)

q absence possibility of the measured feature in the population (q=0.5)

Z confidence coefficient (1.96 at 95% confidence level)

d accepted sampling error (0.05).

The n value was calculated as 369. However, the planned number of 369 FFWs was exceeded and 962 were interviewed in the study. The valid number of surveys is 962, and these surveys were conducted with FFWs working in 21 Regional Directorates of Forestry (RDFs) and 74 Forestry Enterprise Directorates (FEDs). The study was approved by the Social and Human Sciences Research Ethics Committee of the Istanbul University-Cerrahpaşa, Türkiye.

The FFWs answered the OHS questions in accordance with a nine-point scale. On this nine-point scale 1 signified very strongly disagree, 3 signified very little agreement, 5 signified moderately agree, 7 signified strongly agree and 9 signified very strongly agree. Points 2, 4, 6, and 8 were intermediate values of second alternative compared with the first.

2.2 Data Analysis

Descriptive statistics, such as frequencies, means, standard deviations and percentages, were used to describe the general statistical characteristics of our dataset.

Body Mass Index (BMI) is a parameter that shows whether an adult person's weight is normal for his/her height. BMI is calculated by dividing the body weight by the square of the height (kg/m²) and these values are discussed in six groups (Bogin and Varela-Silva 2012, Nuttall 2015). The BMI is calculated based on the height and weight values of the FFWs obtained from the survey data.

Since the data did not show normal distribution, the differences between all the FSDRs were compared with the Chi-Square test and the Kruskal-Wallis H test. Also, the difference between the two FSDRs was investigated by the Mann-Whitney U test (Kalaycı 2016). Moreover, the relationship between FFWs having an occupational accident and taking additional duties was tested with Spearman's rank correlation coefficient. Statistical analyses were performed using the statistical software SPSS 22 (IBM 2013).

The reliability of the data obtained according to the nine-point scale was tested with the internal consistency coefficient (α) developed by Cronbach (Cronbach 1951). For the reliability of the data, the internal consistency coefficient is required to be at least 0.60. In this context, Cronbach's α value was found to be 0.954 for 25 items (E3–E7; P1–P13; O1–O7) obtained according to the nine-point scale, and the data are appropriate.

3. Results

3.1 Participants' Demographics and BMI

Descriptive statistics of the FFWs are presented in Table 1. It shows that 67% of the participants were fire suppression workers and 33% were drivers or operators. In addition, 47% of the drivers and operators were fire truck drivers and 39% were initial responder vehicle drivers. The youngest was 18, the most experienced was 72 and the average age was 36.74 years. When the education level was examined, 59% of them had at least high school education. Besides, 67% of the FFWs were married and at least 80% of them were seasonal (temporary) workers.

The average height of the FFWs was 175.03 cm. The shortest was 155 cm, and the tallest was 198 cm (Table 2). The average weight was 81.01 kg. The lightest was 45 kg and the heaviest was 135 kg. According

Table 1 Descriptive statistics of participants

Characteristics	FSDRs				Total
	1st	2nd	3rd	4th	
Frequency, *N* (%)	539 (56.03)	172 (17.88)	124 (12.89)	127 (13.20)	962 (100.0)
Age (years), *M* (SD)	38.23 (10.62)	35.85 (10.57)	35.18 (10.13)	33.17 (10.58)	36.74 (10.69)
Min. age	18	18	19	19	18
Max. age	63	59	72	58	72
Education, *N* (%)	–	–	–	–	–
Primary school	157 (29.13)	32 (18.61)	12 (9.68)	10 (7.87)	211 (21.93)
Secondary school	127 (23.56)	24 (13.95)	17 (13.71)	15 (11.81)	183 (19.03)
High school	207 (38.41)	103 (59.88)	77 (62.1)	82 (64.57)	469 (48.75)
Associate degree	37 (6.86)	12 (6.98)	17 (13.71)	17 (13.39)	83 (8.63)
Bachelor's degree	11 (2.04)	1 (0.58)	1 (0.8)	3 (2.36)	16 (1.66)
Marital status, *N* (%)	–	–	–	–	–
Married	385 (71.43)	116 (67.44)	75 (60.48)	68 (53.54)	644 (66.94)
Single	154 (28.57)	56 (32.56)	49 (39.52)	59 (46.46)	318 (33.06)
Type of staff, *N* (%)	–	–	–	–	–
Permanent public labourer	111 (20.59)	33 (19.18)	9 (7.26)	13 (10.24)	166 (17.25)
Seasonal labourer	414 (76.81)	127 (73.84)	114 (91.93)	114 (89.76)	769 (79.94)
Indentured labourer	14 (2.6)	12 (6.98)	1 (0.81)	–	27 (2.81)
Role on crew, *N* (%)	–	–	–	–	–
Fire suppression worker	332 (51.0)	121 (18.6)	91 (14.0)	107 (16.4)	651 (66.67)
Driver or operator	207 (66.6)	51 (16.4)	33 (10.6)	20 (6.4)	311 (33.33)
Driver or operator Initial responder vehicle driver	83	21	12	4	120 (38.59)
Fire truck driver	92	24	13	16	145 (46.62)
Operators**	17	4	5	–	26 (8.36)
Water tank driver	15	2	3	–	20 (6.43)
Experience (years), *M* (*SD*)	12.00 (9.72)	9.02 (7.19)	7.98 (6.61)	7.46 (7.09)	10.35 (8.83)

* *N* – frequency; *M* – mean; *SD* – standard deviation; ** Dozer, Ladler, Excavator, Grader, Truck, Trailer

to Table 2, 1.46% of the FFWs were underweight (15≤BMI≤19.9), 37.42% were of normal weight (20≤BMI≤24.9), 44.39% were overweight (25≤BMI≤29.9), 13.83% were under class I obesity (30≤BMI≤34.9), 2.81% were under class II obesity (35≤BMI≤39.9), and 0.10% were under class III obesity (BMI≥40).

The Kruskal-Wallis *H* test was used to determine whether there was a difference between the FFWs in the fire sensitivity groups in terms of height, weight and BMI. Accordingly, there was no significant difference in terms of height (p>0.05), but there was a significant difference (p≤0.05) between the groups in terms of weight and BMI. In the pairwise comparison test between groups with the Mann-Whitney *U* Test, there was a significant difference between those in the first FSDR and those in the third and fourth regions in terms of both weight and BMI (Table 3).

3.2 OHS Training of Participants

FFWs are trained by an OHS specialist and a workplace physician. As seen in Table 4, 67% of FFWs received first aid training, and 80% received OHS training. After these trainings, FFWs feel safe and cautious (7.66). In the same context, FFWs' PPE knowledge is 7.63, heat-resistant clothing use is 7.78, gas mask use is 7.49 and first aid knowledge is 6.60.

Table 2 Participants' BMI

	FSDRs								Total	
	1st		2nd		3rd		4th			
	M (SD)		*M (SD)*		*M (SD)*		*M (SD)*		*M (SD)*	
Height, cm	174.73 (6.69)		175.01 (6.66)		175.41 (6.33)		175.93 (6.59)		175.03 (6.63)	
Mass, kg	82.24 (13.09)		79.97 (12.45)		79.17 (10.92)		78.97 (11.06)		81.01 (12.52)	
BMI, kg/m^2	*N* (%)	Age	*N* (%)	Age	*N* (%)	Age	*N* (%)	Age	*N* (%)	Age
Underweight	6 (1.11)	26.8	5 (2.91)	23.6	1 (0.81)	20.0	2 (1.57)	36.0	14 (1.46)	26.5
Normal weight	188 (34.88)	33.6	66 (38.37)	29.9	51 (41.13)	31.5	55 (43.31)	28.5	360 (37.42)	31.9
Overweight	232 (43.04)	39.4	78 (45.35)	40.1	59 (47.58)	36.9	58 (45.67)	36.5	427 (44.39)	38.8
Class I obesity	91 (16.88)	43.7	19 (11.05)	41.8	11 (8.87)	43.3	12 (9.45)	38.0	133 (13.82)	42.9
Class II obesity	21 (3.9)	45.6	4 (2.32)	38.0	2 (1.61)	42.0	–	–	27 (2.81)	44.2
Class III obesity	1 (0.19)	50.0	–	–	–	–	–	–	1 (0.10)	50.0

Cronbach's α value was found to be 0.807 for items E3–E7, and the data are reliable.

The Pearson's Chi-Square (E1 and E2) and the Kruskal–Wallis *H* test were used to examine whether there was a statistically significant difference between the FFWs in the FSDRs regarding the training subjects and their reflections on this training, and a difference ($p \leq 0.05$) was found between the groups in all subjects (Table 5). Paired comparison tests between groups were performed with the Mann–Whitney *U* Test. Within the scope of first aid training (E1) and information on the use of PPE (E4), there was a significant difference between the third FSDR and the second FSDR, the second and fourth FSDR, as well as between the second FSDR and the first and fourth FSDRs.

Regarding OHS training (E2) and first aid knowledge level (E7), a difference was determined between the first FSDR and the second and third FSDRs, and also between the fourth FSDR and the second and third zones. In terms of feeling more secure and cautious after the trainings (E3), there was only a difference between the first and second FSDRs. However, there was a significant difference between the first FSDR and the second and third FSDRs regarding the knowledge level of the use of heat-resistant clothing (E5) and wearing of gas masks (E6).

Table 3 Participants' differences in test results for BMI

	Kruskal–Wallis Test		Mann–Whitney U Test (p)					
	X^2	*p*	1 to 2	1 to 3	1 to 4	2 to 3	2 to 4	3 to 4
Height	4.67	0.20	–	–	–	–	–	–
Mass	9.72	0.02*	0.06	0.03*	0.02*	0.73	0.57	0.86
BMI	17.12	0.00*	0.08	0.01*	0.00*	0.31	0.09	0.55

* There are differences between groups ($p \leq 0.05$)

3.3 The Quality and Ergonomic Suitability of PPE and Use by Participants

Opinions on the quality and ergonomic suitability of PPE used by FFWs are presented in Table 6. This shows that FFWs valued the heat-resistant boots at a score of 6.88, and all the others scored above 7, and they evaluated the PPE as good quality. Cronbach's α value was found to be 0.958 for items P1–P13, and the data are reliable.

Kruskal–Wallis *H* test was used to examine whether there was a statistically significant difference between the opinions of FFWs in FSDRs in terms of the quality and ergonomic suitability of the PPE and equipment used by FFWs (Table 7). There was no significant difference ($p > 0.05$) between the groups in terms of the helmet (P1), helmet lamp (P2) and replacement gas mask filter (P8). Paired comparison tests between groups were performed with the Mann–Whitney *U* Test. There was a difference between the first FSDR and the second, third and fourth FSDRs regarding heat-resistant knitted hood (P3) quality. A difference was determined between the first FSDR and the second and third FSDRs in terms of the quality of the heat–resistant clothing (P4), heat–resistant gloves (P5), fire blanket (P11) and flasks (P13).

Table 4 Status of OHS training received and reflection by FFWs

	FSDRs				Total
	1st	2nd	3rd	4th	
E1. First aid training, *N* (%)					
Yes	387 (71.80)	107 (62.21)	62 (50.00)	84 (66.14)	640 (66.53)
No	152 (28.20)	65 (37.79)	62 (50.00)	43 (33.86)	322 (33.47)
E2. OHS training, *N* (%)					
Yes	460 (85.34)	123 (71.51)	84 (67.74)	105 (82.68)	772 (80.25)
No	79 (14.66)	49 (28.49)	40 (32.26)	22 (17.32)	190 (19.75)
E3. Feeling more confident and cautious after the trainings, *M* (*SD*)	7.64 (1.81)	7.70 (2.09)	7.53 (1.83)	7.77 (1.98)	7.66 (1.88)
E4. Use of PPE, *M* (*SD*)	7.88 (1.63)	7.41 (2.03)	6.99 (1.90)	7.48 (2.29)	7.63 (1.86)
E5. Use of heat resistant clothing	8.08 (1.50)	7.56 (2.08)	7.17 (2.21)	7.40 (2.40)	7.78 (1.88)
E6. Gas mask wear	7.85 (1.65)	7.05 (2.33)	7.00 (2.27)	7.00 (2.41)	7.49 (2.02)
E7. Level of first aid knowledge	6.93 (2.15)	5.83 (2.76)	6.19 (2.41)	6.67 (2.51)	6.60 (2.39)

As regards the dust particle mask (P6) quality, there was a significant difference between the first FSDR and the second and third FSDRs, as well as between the third and fourth zones. A difference was found between the third FSDR and the first and fourth FSDRs in terms of full/half face mask (P7), first aid kit (P10) and field pack (P12) quality. Regarding the quality of heat-resistant boots (P9), a difference was determined between the first FSDR and the second and third FSDRs, and also between the fourth FSDR and the second and third FSDRs. Cronbach's α value was found to be 0.895 for items O1–O7, and the data are reliable.

FFWs attributed the use of PPE 7.79 (O1) during the response to forest fires. The quantity of PPEs was scored as (O2) 7.55, the quality of PPEs (O3) 7.03; and PPE's replacement before the expiration date (O4) 7.20 (Table 8). FFWs rated the status of having the authorisation to use all materials or PPEs during forest fire fighting (O5) as 7.92. FFWs scored 7.72 for utilising the health check (O6) and 7.95 for regularly checking the materials in their field packs (O7).

The Kruskal–Wallis *H* test was used to examine whether there was a difference between the FSDRs and the FFWs' views on PPE and health check service utilisation control (Table 9). There was no significant

Table 5 Chi-Square and Kruskal–Wallis Test for status of receiving OHS training and the reflection to FFWs

	Chi-Square/Kruskal Wallis			Mann–Whitney *U* Test (*p*)					
	Name of Test	X^2	*p*	1 to 2	1 to 3	1 to 4	2 to 3	2 to 4	3 to 4
E1	Chi-Square	23.39	0.00*	0.03*	0.00*	0.22	0.02*	0.60	0.01*
E2	Chi-Square	29.82	0.00*	0.00*	0.00*	0.43	0.37	0.04*	0.01*
E3	Kruskal	10.17	0.02*	0.00*	0.95	0.11	0.09	0.44	0.32
E4	Kruskal	31.44	0.00*	0.01*	0.00*	0.68	0.01*	0.22	0.00*
E5	Kruskal	22.59	0.00*	0.01*	0.00*	0.16	0.07	0.63	0.05*
E6	Kruskal	25.07	0.00*	0.00*	0.00*	0.01*	0.50	0.99	0.56
E7	Kruskal	25.24	0.00*	0.00*	0.00*	0.56	0.60	0.01*	0.04*

* There are differences between groups ($p \leq 0.05$)

Table 6 Opinions on adequacy of Clothing and PPE

Material	FSDRs, *M* (*SD*)				Total
	1st	2nd	3rd	4th	
P1. Safety helmet	7.62 (2.15)	7.60 (2.42)	7.81 (1.91)	7.91 (2.05)	7.68 (2.16)
P2. Helmet lamp	7.42 (2.43)	7.30 (2.47)	7.54 (2.15)	7.69 (2.30)	7.45 (2.39)
P3. Heat-resistant knitted hood	7.57 (2.29)	6.60 (3.01)	6.76 (2.59)	6.46 (3.18)	7.14 (2.64)
P4. Heat-resistant clothing	7.61 (2.21)	6.80 (3.06)	6.94 (2.50)	7.01 (2.81)	7.30 (2.52)
P5. Heat-resistant gloves	7.55 (2.24)	6.70 (2.92)	6.99 (2.55)	7.12 (2.74)	7.27 (2.50)
P6. Dust particle mask	7.47 (2.32)	6.99 (2.65)	6.95 (2.41)	7.37 (2.60)	7.30 (2.44)
P7. Full/half face mask	7.62 (2.21)	7.37 (2.46)	6.96 (2.46)	7.32 (2.62)	7.45 (2.35)
P8. Replacement gas mask filter	7.27 (2.48)	6.91 (2.65)	6.97 (2.53)	7.02 (2.87)	7.13 (2.57)
P9. Heat-resistant boots	7.23 (2.46)	6.27 (3.25)	6.10 (2.72)	6.97 (2.89)	6.88 (2.74)
P10. First aid kit	7.52 (2.19)	6.95 (2.69)	6.95 (2.35)	7.26 (2.60)	7.31 (2.37)
P11. Fire blanket	7.63 (2.19)	7.01 (2.77)	6.99 (2.47)	7.14 (2.76)	7.37 (2.43)
P12. Field pack	7.52 (2.34)	7.14 (2.64)	7.10 (2.32)	7.69 (2.24)	7.42 (2.38)
P13. Flask	7.24 (2.68)	6.63 (3.09)	6.72 (2.66)	6.77 (3.03)	7.00 (2.81)

difference (p>0.05) in the opinion on renewing PPEs before the expiration date (O4).

Paired comparison tests between groups were performed with the Mann–Whitney *U* Test. There was a significant difference between the fourth FSDR and the first, second, and third FSDRs, as well as between the first and the second FSDR, in terms of the use of PPE (O1) during the response to forest fires. A difference was found between the third FSDR and the first and fourth FSDRs, as well as between the first FSDR and the second FSDR, in terms of the amount of PPE (O2). A significant difference was found between the first FSDR and the second and third FSDRs in terms of the quality (O3) of PPEs. There was a difference

Table 7 Kruskal-Wallis Test for Clothing and PPE

	Kruskal–Wallis Test		Mann–Whitney *U* Test (p)					
	X^2	p	1 to 2	1 to 3	1 to 4	2 to 3	2 to 4	3 to 4
P1	4.83	0.18	–	–	–	–	–	–
P2	4.03	0.26	–	–	–	–	–	–
P3	22.98	0.00*	0.00*	0.00*	0.01*	0.61	0.99	0.67
P4	13.37	0.00*	0.03*	0.00*	0.24	0.39	0.43	0.18
P5	11.63	0.01*	0.00*	0.01*	0.53	0.81	0.14	0.23
P6	10.39	0.02*	0.05*	0.01*	0.52	0.61	0.06	0.02*
P7	11.40	0.01*	0.22	0.00*	0.96	0.08	0.37	0.03*
P8	4.25	0.24	–	–	–	–	–	–
P9	27.44	0.00*	0.01*	0.00*	0.87	0.14	0.04*	0.00*
P10	11.59	0.01*	0.06	0.00*	0.90	0.35	0.23	0.03*
P11	12.10	0.01*	0.03*	0.00*	0.33	0.44	0.46	0.15
P12	9.73	0.02*	0.22	0.01*	0.26	0.32	0.07	0.01*
P13	9.51	0.02*	0.05*	0.01*	0.31	0.53	0.55	0.28

* There are differences between groups ($p \leq 0.05$)

Table 8 Thoughts on PPE

Thoughts	FSDRs, *M* (*SD*)				Total
	1st	2nd	3rd	4th	
O1. Use of PPE during the fight against forest fires	7.95 (1.54)	7.41 (2.18)	7.52 (2.09)	7.90 (2.14)	7.79 (1.84)
O2. Availability of adequate amount of PPE	7.78 (1.77)	7.27 (2.26)	7.04 (2.15)	7.45 (2.15)	7.55 (1.98)
O3. Quality of PPE	7.28 (2.14)	6.63 (2.68)	6.60 (2.47)	6.94 (2.66)	7.03 (2.37)
O4. Replacement of PPE before expiration date	7.42 (2.18)	6.86 (2.65)	6.90 (2.44)	7.01 (2.58)	7.20 (2.37)
O5. Authorisation to use all materials or PPE in fighting forest fires	8.13 (1.47)	7.94 (1.82)	7.26 (2.39)	7.66 (2.21)	7.92 (1.81)
O6. Health Check Service Utilisation	7.98 (1.69)	7.77 (2.03)	7.55 (2.28)	6.72 (2.92)	7.72 (2.07)
O7. Regularly checking the materials in the field pack	8.20 (1.41)	8.01 (2.01)	7.49 (2.27)	7.28 (2.64)	7.95 (1.88)

between the third FSDR and the first and second FSDRs in terms of the authorisation to use all materials or PPEs (O5) during forest fire fighting. There was a difference between the fourth FSDR and the first and second FSDRs in terms of passing the health check. A difference was found between the first FSDR and the third and fourth FSDRs, as well as between the second FSDR and the third FSDR, in terms of checking the items in the field pack regularly (O7).

3.4 Exposure to Occupational Accidents and Dangers to Participants

Fourty-four percent (426) of FFWs were exposed to occupational accidents, hazards and risks while performing their duties. The Pearson's Chi-Square Test was used to examine whether there was a difference between FFWs in terms of occupational accidents, danger and risk exposure, and a significant difference ($p \leq 0.05$) was found among the groups (Table 10). Paired comparison tests among groups were performed with the Mann–Whitney *U* Test. Accordingly, there is a difference between the first FSDR and the third and fourth FSDRs, and also between the second FSDR and the fourth FSDR in terms of occupational accident, hazard and risk exposure.

The risk types stated by 426 FFWs who were exposed to occupational accidents, hazards, or risks are shown in Table 11. In answering this question, FFWs marked more than one option. Details include:

⇒ being caught in a forest fire (47.42%)

⇒ bruises, crushes and sprains on the body due to falling while walking (46.95%)

⇒ skin lifting, blistering or cracking (30.52%)

⇒ exposure to heavy smoke (29.81%)

⇒ minor cuts or bodily injury during the use of hand tools or machinery (28.87%), which are listed as the most important occupational accidents, hazards and risks regarding forest fires.

Table 9 Tests for difference of opinions on clothing and PPE

	Kruskal–Wallis Test		Mann–Whitney *U* Test (*p*)					
	X^2	*p*	1 to 2	1 to 3	1 to 4	2 to 3	2 to 4	3 to 4
O1	14.28	0.00*	0.02*	0.12	0.03*	0.72	0.00*	0.01*
O2	15.77	0.00*	0.03*	0.00*	0.51	0.17	0.31	0.04*
O3	10.71	0.01*	0.02*	0.01*	0.83	0.81	0.15	0.10
O4	7.11	0.07	–	–	–	–	–	–
O5	9.49	0.02*	0.74	0.00*	0.51	0.02*	0.77	0.09
O6	12.10	0.01*	0.53	0.26	0.00*	0.64	0.02*	0.07
O7	11.05	0.01*	0.81	0.01*	0.02*	0.00*	0.06	0.92

* There are differences between groups ($p \leq 0.05$)

Table 10 State of exposure to occupational accident

	FSDRs				Total	
	1st	2nd	3rd	4th		
Yes, *N* (%)	268 (49.72)	76 (44.19)	44 (35.48)	38 (29.92)	426 (44.28)	
No, *N* (%)	271 (50.28)	96 (55.81)	80 (64.52)	89 (70.08)	536 (55.72)	
Chi-Square Test, X^2 (p)	20.97 (0.00*)	–	–	–	–	
Mann–Whitney *U* Test	1 to 2	1 to 3	1 to 4	2 to 3	2 to 4	3 to 4
p-value	0.22	0.00*	0.00*	0.12	0.01*	0.33

* There are differences between groups ($p \leq 0.05$)

Table 11 Exposing to occupational accidents, hazards and risk types

Occupational accidents	FSDRs, *N*				Total, *N* (%)
	1st	2nd	3rd	4th	
1. Traffic accidents	41	17	6	7	71 (16.67)
2. Minor cuts or bodily injuries while using a hand tool or machine	60	38	12	13	123 (28.87)
3. Finger, arm or leg breakage during hand tool or machine use	4	0	1	0	5 (1.17)
4. Exposure to heavy smoke	79	31	12	5	127 (29.81)
5. Danger of ignition or falling into embers during a forest fire	38	11	3	4	56 (13.15)
6. Staying in a forest fire	134	44	13	11	202 (47.42)
7. Bruising, crushing, sprains in the body due to falling while walking	119	38	20	23	200 (46.95)
8. Being under trees or logs	6	0	2	0	8 (1.88)
9. Falling from high	19	5	4	2	30 (7.04)
10. Skin lifting, skin blistering or skin cracking	82	29	6	13	130 (30.52)
11. Exposure to the impact of water or chemicals thrown by aircraft	82	18	7	4	111 (26.06)
12. Exposure to impact by materials, such as dust or stone ejected due to air circulation originating from aircraft	26	6	1	1	34 (7.98)
13. Dozer or other machinery accident	4	2	2	1	9 (2.11)
14. Exposure to oil/hot water in the kitchen	13	5	0	3	21 (4.93)
15. Electric shock	8	3	1	0	12 (2.82)

Table 12 Participation status of first aid and OHS training of those exposed to occupational accidents

		FSDRs, *N* (%)				Total
		1st	2nd	3rd	4th	
First aid training	Yes	190 (70.90)	49 (64.47)	28 (63.64)	31 (81.58)	298 (69.95)
	No	78 (29.10)	27 (35.53)	16 (36.36)	7 (18.42)	128 (30.05)
OHS training	Yes	239 (89.18)	51 (67.11)	34 (77.27)	35 (92.11)	359 (84.27)
	No	29 (10.82)	25 (32.89)	10 (22.73)	3 (7.89)	67 (15.73)

Table 13 Additional task status

	FSDRs				Total	
	1st	2nd	3rd	4th		
Additional task status	–	–	–	–	–	
Yes, *N* (%)	113 (20.96)	50 (29.07)	40 (32.26)	35 (27.56)	238 (24.74)	
No, *N* (%)	426 (79.04)	122 (70.93)	84 (67.74)	92 (72.44)	724 (75.26)	
Chi-Square Test, X^2 (p)	10.16 (0.02*)	–	–	–	–	
Mann–Whitney *U* Test	1 to 2	1 to 3	1 to 4	2 to 3	2 to 4	3 to 4
p-value	0.03*	0.01*	0.10	0.59	0.80	0.47

* There are differences between groups ($p \leq 0.05$)

The participation status of first aid and OHS training of those exposed to occupational accidents according to their FSDRs were examined in Table 12. Accordingly, 70% of those exposed to work accidents participated in first aid training, while 30% did not. Similarly, 84% of those exposed to work accidents participated in OHS training, while 16% did not.

3.5 Additional Tasks Given to FFWs

Table 13 shows the status of giving additional tasks to FFWs. The results show that 24.74% of FFWs are given duties in addition to their normal duties. Out of the fire season, these are mostly raw material (wood) production works (stamping, cutting, sizing), and afforestation works. In addition, it was stated that additional jobs were given to FFWs, such as chauffeur, gardener, construction works (painting, tilling, etc.), heating, cleaning, tea making, switchboard attendant and waiter, depending on their profession and abilities.

The Pearson's Chi-Square Test was used to determine whether there was a difference between FFWs in terms of additional assignments, and a significant difference ($p \leq 0.05$) was found between the groups (Table 13). Paired comparison tests between groups were performed with the Mann–Whitney *U* Test. It can be seen that there was a difference in exposure to additional duties between the first FSDR and the second and third FSDRs.

The relationship between those who had an occupational accident and those who received additional tasks was examined by Spearman's ranking correlation coefficient (Table 14). In general, a correlation of 0.01 significance level (p=0.000) was found between those who had an occupational accident and those who received additional tasks. According to this, among the FFWs in the first and fourth FSDRs, a correlation was found at a significance level of 0.01 (p 1 =0.003; p 4 =0.000) between those who had an occupational accident and those who received additional duties. The same relationship was not detected in the second and third FSDRs.

4. Discussion

4.1 OHS and First Aid Training, and BMI of FFWs

OHS and first aid trainings should be repeated and renewed regularly. Renewing these trainings ensures that employees are up-to-date and always aware of safety and health issues in the workplace. Also, training their workers can help foster a safety culture (ILO 2016). Participation in the first aid training organised by an occupational physician is at the level of 67%. The participation in the OHS training organised by the OHS specialist is 80%. While almost all of the FFWs should attend these two trainings, the participation in

Table 14 Relationship between taking an additional assignment and having an occupational accident

Spearman Test	1st FSDR	2nd FSDR	3rd FSDR	4th FSDR	General
Correlation Coefficient	0.126	0.075	–0.007	0.367	0.114
p	0.003**	0.328	0.939	0.000**	0.000**
N	539	172	124	127	962

** Correlation is significant at the 0.01 level (2-tailed)

the second and third FSDRs was lower than in the other two FSDRs. After these trainings, FFWs feel very safe and cautious. FFWs rated the level of knowledge about PPE, the use of heat-resistant clothing and gas masks as high. However, first aid knowledge was moderate. In this context, occupational physicians should attach more importance to first aid training.

In NWCG (2022), it is stated that forest fire fighting activities are difficult and dangerous jobs that require physical conditioning, mostly in underdeveloped and rural areas. The height of FFWs in Türkiye is between 155 cm and 198 cm, and their weight is between 45 kg and 135 kg. According to the BMI presented in Nuttall (2015), only 37% of fire workers are of normal weight in Türkiye. 1% of the personnel are underweight and 17% are obese. Although there is no statistically significant (0.05) difference in terms of height, there is a difference between those in the 1st FSDR and those in the third and fourth FSDR in terms of weight and BMI. It is thought-provoking that those in the 1st FSDR, which is most sensitive to forest fires, are heavier than the personnel in other regions. For this reason, it is important for FFWs to undergo physical condition tests, as stated in Leduc et al. (2022) and NWCG (2022), to enable them to perform their activities reated to fighting difficult and dangerous forest fires more easily. In NWCG (2022), it is stated that, as a condition of employment in the United States, the personnel must walk 3 miles with a 45 pound pack in 45 minutes. In Canada, personnel are required to complete the Physical Performance Change Standard within 14 minutes and 30 seconds (Leduc et al. 2022). In this context, training personnel to make physical activities such as hiking, jogging, and push-ups a part of their lifestyle gains importance.

4.2 Quality and Ergonomic Suitability of PPEs Used by FFWs

PPE, which is indispensable for OHS, is required to prevent workplace accidents (Bacı and Çalışkan 2022). It has been stated that PPE should be selected according to the hazards identified in the risk assessment process of the activity to be performed (SAVER 2014, FSANL 2020). The use of this equipment as described will provide appropriate protection to the user. The quality and ergonomic suitability of the heat-resistant boots used by fire workers were evaluated as medium. The quality and ergonomics of the heat-resistant boots used in the first and fourth FSDRs were found to be of statistically higher quality than in the second and third zones.

Among the protective equipment, only helmets provide full protection and are the most important safety equipment (Engur 2001, Akay and Yenilmez 2007). The minimum performance requirements and test methods for the helmet used in fighting forest fires are specified in the ISO-16073-5:2019 document (ISO 2019). Accordingly, the helmet should be light and should not apply excessive heat stress to the wearer. In this study, there was no statistical difference (p>0.05) between the FSDRs as the quality and ergonomic suitability of the helmet, helmet lamp and replacement gas mask filter were very sufficient. However, it is stated that the masks given to each FFW cannot prevent the inhalation of carbon monoxide gas, being only surgical masks that provide protection against dust and are easily flammable (Akay and Yenilmez 2007, Gümüş and Türk 2011, Bacı and Caliskan 2022).

The quality and ergonomic fit of the heat-resistant knitted hood were evaluated as adequate in the first FSDR and scored moderately in the other three FSDRs. The quality and ergonomic suitability of the heat-resistant suit and the heat-resistant gloves were considered very adequate in the first and fourth FSDRs, while they were rated as medium quality in the other two FSDRs. However, it is stated that the gloves given to each FFW do not provide protection against flames (Akay and Yenilmez 2007, Bacı and Çalışkan 2022).

One of the most important pieces of equipment that workers should have during firefighting is a protective blanket, and these blankets can protect workers if they are caught in a fire (Akay and Yenilmez 2007). In this study, the proficiency status of the fire blanket was evaluated with an average score of above 7, except for the third FSDR. There was a difference between the first FSDR and the second and third FSDRs in terms of their rating of the quality of the fire blanket and flask and the level of ergonomic fit. The quality and ergonomic fit level of the dust mask were rated better by the first and fourth FSDRs than by the other two FSDRs. The quality and ergonomic suitability of full/half masks, first aid kits and field packs were rated lower by the third FSDR than by the other FSDRs.

In Donarski (2022), it is stated that the ambient air temperature can vary by 1200°C depending on the size of the fire and temperature. For this reason, PPE is designed to minimise the risk of injury in case of short-term exposure to increased levels of radiant heat flow in the fight against forest fires. FFWs stated that they use PPE regularly during their response to forest fires. In terms of the use of PPE, the fourth FSDR differed from the other regions. The amount of PPE was at a high level, but for the third FSDR it was lower than in other regions.

The quality of PPE was found to be strongly sufficient and the quality of the equipment used in the

first fire sensitivity zone was qualified as higher than that in the other FSDRs. PPE is renewed before the expiration date and there is no statistical difference ($p \leq 0.05$) between FSDRs. They have the authority to use all materials or PPE at a very high level during the fight against forest fires. This authorisation is somewhat weaker for the third FSDR. FFWs control the materials in their field packs to a great extent, with more control in the first and second FSDRs. FFWs stated that they underwent extensive health checks. Health checks in the fourth FSDR were less rigorous than in other FSDRs.

In some studies, it is stated that firefighting personnel do not use their PPE properly and that inspections are not carried out adequately (Akay and Yenilmez 2007, Gümüş and Türk 2011, FAT 2021). In the Working Document of the Innovative Approaches in Combating Forest Fires (GDF 2019), it is stated that there is a serious technical infrastructure in occupational safety, and that all personnel involved in the fight against forest fires are equipped with world-class PPE. Although the use of PPE and other equipment among FFWs in Türkiye was found to be higher compared to previous studies (Akay and Yenilmez 2007, Gümüş and Türk 2011), the high rate of occupational accidents, danger, and risk exposure is a situation that should be questioned. The high rate explains that forest fire fighting activities are in the dangerous class within the scope of OHS. As a matter of fact, as the number of forest fires and the amount of burned areas increase, the rate of occupational accidents, danger, and risk exposure also increases. This ratio is the highest in the first FSDR and lowest in the fourth FSDR.

4.3 Having a Work Accident and Taking on Additional Tasks

It is stated that with the increase in forest fires, health risks become more frequent in activities aimed at extinguishing forest fires. The most common disorders are asthma, and chronic lung, heart, and psychological diseases (Reinhardt et al. 2000, Gordon and Larivière 2014, Groot et al. 2019, Donarski 2022, D'Evelyn et al. 2022, Pelletier et al. 2022). In Donarski (2022), risks that FFWs are exposed to in the work environment in terms of hands, feet, head, eyes, hearing and respiration are discussed. In NWCG 2022, types of work accidents in fires are explained. In NWCG (2022), allergic diseases caused by poisonous and thorny plant species in the human body, and snake, animal and insect bites are work accidents that are considered differently from this study. The most important risks presented among the results of this study are similar to the occupational accidents stated in NWCG (2022). Accordingly, the five most important work accidents, hazards, and risks identified in this study are:

- ⇒ staying in a forest fire (47%)
- ⇒ bruising, crushing, spraining (47%) in the body due to falling while walking
- ⇒ skin lifting, blistering or skin cracking (31%)
- ⇒ exposure to heavy smoke (30%)
- ⇒ minor cuts or bodily injury while using a hand tool or machine (29%).

In this study, it was determined that 44% of FFWs were exposed to occupational accidents, dangers and risks while performing their duties. In a study conducted by Bacı and Çalışkan (2022), it was stated that 47.6% of the workers working in Izmir RDF have had a work accident at least once in their lives. In other studies, similar hazards and risks, especially those being affected by smoke, have been revealed (Akay and Yenilmez 2007, Gümüş and Türk 2011, Bacı and Çalışkan 2022). In terms of FSDR, the first FSDR stands out in terms of occupational accidents, danger, and risk exposure.

FFWs not only work as temporary or seasonal FFWs during the forest fire season, but also perform additional forestry-related jobs outside the fire season (Bacı and Çalışkan 2022). It has been revealed in this study that 25% of FFWs are given additional tasks that might cause physical and mental fatigue, in addition to their duties. This situation poses a significant risk in terms of OHS rules. In Safak (2022), it is stated that assigning additional tasks to FFWs occurs as a result of the complexity of job distribution and job descriptions and faulty job design. Additional duties can have a direct impact on the performance of FFWs and may also pose significant risks to OHS rules. In addition, occupational accidents may occur as the additional tasks given are related to forestry practices. This additional task load may lead to low motivation for FFWs and frustration with the organisational structure in the future. For this reason, arrangements should be made for the permanent employment of FFWs (FAT 2021) with no additional tasks outside their job description.

In forest fires, it is impossible to completely eliminate the risks that personnel are exposed to (Hauke et al. 2011). However, it is important to develop a good management system, make a comprehensive risk assessment, be prepared for hazards and risks, organise training activities, use appropriate PPE, perform mental and physical health checks, create the infrastructure to keep employees fit and provide better protection to

FFWs. In this way, occupational accidents can be prevented.

4.4 Limitations of the Study

Although this study is the first to examine the views of FFWs on OHS in all FSDRs with a wide participation, it has some limitations. In the study, the surveys were made in the form of self-reporting. There may be bias as FFWs are employed by the public. In addition, this survey data is limited to a snapshot of current attitudes and behaviours at a given moment and can be affected by many factors (for example, seasons of extreme forest fires, institutional structure in the working regions, organisational culture). Although our results help to understand the views of FFWs on OHS, since Türkiye has a political environment where employment requirements may change, such data should be made periodically and the results monitored in order to create institutional memory.

5. Conclusions

It has been revealed in this study that the FFWs participating in forest fire fighting activities in Türkiye have a high level of participation in OHS training, but these trainings have not enough effect on their experiences. It has been determined that the level of participation or training in first aid is not sufficient. Although the health checks of the workers are carried out regularly, it has been understood that their BMI values are not at normal rates. It can be seen that occupational physicians do not play an active role in either training or directing employees and managers.

Occupational accidents, exposure to danger and risk are found to be high in forest fire fighting activities. The number and quality of PPE is generally considered very sufficient. However, the number and quality differ between regions. As a result, all of the determined hypotheses were rejected, except for some sub-items. It has been observed that there is a statistical difference among FSDRs in terms of OHS and the first aid training received by FFWs, as wel as a statistical difference among FSDRs in the vast majority of PPE and other equipment used. There is a difference between BMI in the first FSDR and in the third and fourth regions. It has been determined that there is a statistical difference among FSDRs in terms of occupational accidents. In addition, a significant relationship was found between the additional duties assigned to FFWs and exposure to occupational accidents and hazards. The GDF should take into account the results and recommendations of this study in the preparation of forest fire action plans and in determining OHS and risks in order to combat forest fires more effectively. Future research should address knowledge gaps in our study of the effects of forest fires on OHS. The focus should be on developing pertinent mitigation strategies that take into account the needs of FFWs, as well as potential hazards and risks, and working conditions.

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