

Occupational Health Hazards among Firefighters at Benha City

Mohamed Gamal El Diasty¹, Ebtesam Mohamed Abd El- All² and Wafaa Ata Mohammed³

(1) B.Sc. of Nursing, Faculty of Nursing, Alexandria University, Egypt, (2) Professor of Community Health Nursing, Faculty of Nursing, Benha University, Egypt and (3) Lecturer of Community Health Nursing, Faculty of Nursing, Benha University, Egypt

Abstract

Background: Firefighting is physically and physiologically exhausting besides encompassing exposure to toxic fire emissions. **Aim of the study:** Was assessed the occupational health hazards among firefighters at Benha City. **Research design:** A descriptive study design was used to conduct this study. **Setting:** This study was conducted at Benha firefighting Station which located in Benha City. **Sample:** A systematic random sample was used in the study; it includes 222 firefighters. **Tool:** An interviewing questionnaire was used and consists of five parts to assess: A) Demographic characteristics of firefighters. B) Firefighter's work characteristics. C) Occupational health hazards that facing firefighters at their work place. D) Firefighter's knowledge regarding occupational hazards E) Firefighter's reported practices regarding usage of preventive measures. **Results:** 78% of firefighters worked more than 8 hours daily, 76% of firefighters were exposed to occupational hazards as burn, sleep deprivation, heat stress, inhalation of smoke and poisoning gases and 77% of firefighters had inadequate knowledge regarding to occupational health hazards. **Conclusion:** There was highly statistically significant relation between total firefighters' knowledge and their total practices (p- value < 0.001). **Recommendations:** Continuous training courses about occupational health hazards should be provided for Benha firefighters.

Key words: Firefighting, Firefighters, Occupational health hazards

Introduction

An occupational hazard is usually a situation that has enough potential to damage workers. There are two types of occupational hazards (health hazards and safety hazards), safety hazards as unsafe equipment, unprotected electrical sources and work at height without fall protection while, health hazards may include chemical hazards, physical hazards, biochemical hazards, biological hazards and psychological hazards. The potential risks to safety and health for those who work outside house is called occupational health hazards (Pandeya et al., 2020).

Safety hazards are those aspects of the work environment that have the potential of immediate and sometimes violent harm to an employee; for example, loss of hearing, eye sight or body parts, sprains, bruises, broken bones, burns and electric shock. Occupational accident may arise from three dimensions: The task to be done, for instance malfunctioning machines and lack of personnel protective equipment (Marico & Paulo, 2020).

Fire-fighters are regularly involved in fire-fighting activities across different scenarios (i.e., fires in rural areas, forests and urban environments) (e.g., structural fire events

including residential, industrial, oil wells and aviation infrastructures) and in wildland-urban interfaces. Firefighting comprises numerous risk activities combined with exposure to high temperatures and to a complex mixture of hazardous pollutants released from the burning of several materials including but not limited to sources of biomass such as wood, bushes, and agricultural wastes (e. g., forest fires), plastic- and textile-based materials, furnishings, electrical/electronic equipment and fuels (Altshuler et al., 2020).

Firefighters facing many occupational problems that is characterised by high-stress, high-risk and low control of the job-related tasks. Occupational hazards experienced by firefighters may be categorized for convenience as physical, thermal and ergonomic, chemical, and psychological. The level of exposure experienced by a fire-fighters in a given fire depends on what is burning, the combustion characteristics of the fire, the structure on fire, the presence of nonfuel chemicals, the measures taken to control the fire, the presence of victims requiring rescue and the position or line of duty held by the firefighter while fighting the fire (Paterson et al., 2021).

The occupational health nurse may be involved with prevention of injury or disease. The nurse may identify the need for modify working environments, systems of work or change working practices in order to reduce the risk of hazardous exposure. Occupational health nurses are skilled in considering factors, such as firefighter's behaviour and habits in relation to actual working practices. The nurse can also collaborate in the identification, conception and correction of work factors, choice of firefighter's protective equipment, prevention

of firefighting injuries and diseases (Moore et al., 2021).

Significance of the study

Occupational injuries result from a complex interplay of multiple risk factors. Exposure to physical, mechanical and chemical hazards and the performance of unsafe practices by fire-fighters are the leading causes of occupational injuries. Similarly, psychosocial factors, work arrangements, socio-demographic characteristic of fire-fighters, environmental and social conditions are other potential risk factors. An estimated number of 271 million people suffer from work related injuries and 2 million die as a consequence of these injuries. Fire-fighters have high prevalence for occupational health hazards and its consequence health problems (Nahar & Begum, 2019).

Aim of the study

This study aimed to assess the occupational health hazards among fire-fighters at Benha City.

Research questions

1. What is fire-fighter's knowledge regarding occupational hazards related to their work?
2. What are firefighters reported practices regarding usage of preventive measures related to their work?

Subjects and Method

Research design

Descriptive study design (a research method that describes the characteristics of the population or phenomenon that is being studied. This methodology focuses more on the

Occupational Health Hazards among Firefighters at Benha City

“what” of the research subject rather than the “why” of the research subject) was used to conduct this study.

Setting

The study was conducted at Benha Firefighting Station which located in Benha City.

Sampling

A systematic random sample was used in the study, the total number of firefighters at the previous mentioned setting are 890 firefighters. Firefighters were placed in a list with a serial number, and then the starting point was randomly selected, after that each member was selected every 4 members to be in the sample. The total number of the sample was 228 firefighters.

Tool of data collection

An interviewing questionnaire: It was developed by the investigator and supervisor staff, based on reviewing related literatures and written in Arabic language. It consisted of five parts:

Part I: It was concerned with assessment of demographic characteristics of firefighters. It composed of seven closed ended questions about age, marital status, educational level, residence, years of experience, income and smoking habits.

Part II: It was concerned with assessment of firefighter’s work characteristics: Firefighter’s work characteristics which included 3 closed ended questions (multiple choice type) covering the areas of working hours, years of experience, training courses and its numbers.

Part III: It was concerned with assessment of occupational health hazards that facing firefighters at their work place which include two parts:

A): Occupational health hazards that facing firefighters at their work which include 9 closed ended questions (multiple choice type) covering the areas of occupational hazards as heat stress, burn, noise, inhalation smoke and toxic gases, fracture, suffocation, slipping and falls, crushing with hard object and sleep deprivation.

B): Firefighter’s occupational health problems which included 6 closed ended questions (multiple choice type) covering the areas of occupational health problems as respiratory problems, gastrointestinal problems, eye problems, skin problems, ear problems and neurological problems.

Part IV: It was concerned with assessment of firefighter’s knowledge regarding occupational hazards which include three parts:

A): Firefighters knowledge regarding occupational health hazards which included 4 closed ended questions (multiple choice type) covering the areas of meaning of occupational health hazards, causes of occupational health hazards, types of occupational health hazards and protective methods of occupational health hazards.

B): Firefighters knowledge regarding heat stress which included 4 closed ended questions (multiple choice type) covering the areas of meaning of heat stress, symptoms of heat stress, causes of heat stress and protective methods of heat stress.

C): Firefighters knowledge regarding occupational health problems which included 6

closed ended questions (multiple choice type) covering the areas of occupational health problems as respiratory problems, gastrointestinal problems, eye problems, skin problems, ear problems and neurological problems.

Scoring system

Knowledge score for each answer was given as following:

Two points for Correct and complete answer, one point for Correct and incomplete answer, zero point for Don't know and the total score of knowledge was twenty-eight points.

The total knowledge score was considered good if the score of the total knowledge $>75\%$ ($>$ twenty-one points), it was scored average between 50% to 75% (twenty-one points - fourteen points) and it was scored poor $<50\%$ ($<$ fourteen points).

Part V: It was concerned with assessment of firefighter's reported practices regarding usage of preventive measures which include four parts:

A): Using personal protective equipment which included 8 closed ended questions (multiple choice type) as wearing a uniform (apron), a helmet, face shield, eye protection, gloves, safety shoes, respirator and earmuff.

B): Heat stress practices which included 8 closed ended questions (multiple choice type) as transfer the injured quickly to a well-ventilated place, placing the victim in a sitting position, remove tight clothes, keep the airway open, ensure the degree of awareness of the injured person, avoid drinking any liquid in the event that the person loses his consciousness, transfer the injured person to the hospital

immediately and observing the respiratory rate of the injured person.

C): Burn practices which included 8 closed ended questions (multiple choice type) as transporting the injured person from the place of fire to a place with good ventilation, gently remove any tight clothing from the affected area, putting the injured part under the running of cold water, clean the burn site with a salt solution and then with a suitable disinfectant, leave skin bubbles without attempting to remove them, don't cover the burn with a layer of toothpaste, cover the affected part with sterile Vaseline gauze and cover the burn victim with a clean sheet.

D): Falling practices which included 6 closed ended questions (multiple choice type) as take off any clothing over the area of the fracture, avoid moving the fractured organ, notice the color and swelling of the skin, as well as the absence of bleeding, using ice to reduce swelling and pain, avoid return the fractured part to its anatomical position, raise a persons' leg and lowers his head in a state of shock.

Scoring system

One point for Done, zero point for Not done and the total practices score was thirty points. The total practices score was considered satisfied if the score $\geq 50\%$ (\geq fifteen points) and considered unsatisfied if it was $< 50\%$ ($<$ fifteen points).

Content validity and reliability

Tools of the study were given to a group of 5 members of faculty staff nursing experts from the community health nursing specialists who reviewed the tools for clarity, relevance, comprehensiveness, applicability and easiness

Occupational Health Hazards among Firefighters at Benha City

for implementation and according to their opinion minor modifications were carried out. The reliability of the developed tools was estimated using Cronbach's α test to measure the internal consistency of the tools. It was found that the reliability of knowledge was 0.76, reliability of practices was 0.61 and the reliability of satisfaction was 0.60.

Pilot study

The pilot study was conducted on 10% (22 firefighters) of the total sample to test the tools clarity, simplicity and applicability and time needed to fill tools as well as to identify any possible obstacles that may hinder the data collection. The pilot study was included as no modifications were done.

Ethical considerations

All ethical issues were assured; an oral consent was obtained from each firefighter to participate in the study and withdraw at any time when needed during the study. The aim of the study was explained to each firefighter before applying the tools to gain their confidence and trust. The study hadn't any physical, social or psychological risks. Privacy and confidentiality were assured. Ethics, values and cultures were respected.

Field work

Data were collected over a period of 7 months from the beginning of June 2020 to the end of December 2020. Approvals were obtained orally after the investigator introduced himself to each firefighter and after explaining the purpose of the study. The study was carried out in the selected settings. The investigator visited the fire station 2 days/week from 10.00 a.m. to 12.00 p.m. to collect the data, taking

into consideration the use of simple language to suit the understanding level of firefighters. The average time needed for the sheet was around 30 minutes, the average number of interviewed firefighter at benha fire station was 4 persons.

Statistical analysis:

All data collected were organized, tabulated and analyzed using appropriate statistical test. The data were analyzed by using the Statistical Package for Social Science (SPSS) version 21, which was applied to calculate frequencies and percentages as well as test statistical significance and associations by using chi-square test and person correlation test to detect the relation between the variables for (p value). The observation differences and associations were considered as the following:

Highly significant (HS)	$p < 0.001$
Significant (S)	$p \leq 0.05$
Not significant (NS)	$p > 0.05$

Results:

Table (1): Shows that, 59.2% of the firefighters aged 30 years or more with mean age 33.9 ± 6.45 , 58.4% of them have basic education and 82.8% of them were married. Regarding residence, 53.6% of them lived in rural areas, 64% of them have family member of (3-5) members and 64.8% of them had enough family income.

Table (2): Shows that, 55.2%, 61.2% and 63.2% of firefighters had average total knowledge regarding heat stress, occupational health problems and occupational health hazards respectively.

Figure (1): Shows that, 58.0% of firefighters had average total knowledge score and 31.2%

had poor total knowledge score while only 10.8% had good total knowledge score.

Table (3): Shows that, 54.8%, 64%, 66% and 67.2% of firefighters had total unsatisfactory practices regarding personal protective equipment, falling, burn and heat stress practices respectively.

Figure (2): Shows that, 74% of firefighters had total unsatisfactory practices score while 26% of them had total satisfactory practices score.

Table (4): Shows that, there was highly statistically significant relation between total firefighters' knowledge and their total practices (p- value < 0.001).

Table (1): Frequency distribution of studied firefighters regarding to their demographic characteristics (n=250).

Demographic characteristics	no	%
Age		
20 < 25	19	7.6
25 < 30	83	33.2
≥35	148	59.2
Mean ± SD	33.9 ± 7.45	
Educational level		
Read and write	47	18.8
Basic education	146	58.4
Secondary education or technical diploma	45	18.0
University education	12	4.8
Marital status		
Single	43	17.2
Married	207	82.8
Residence		
Rural	134	53.6
Urban	116	46.4
Family member number		
< 3	60	24.0
3 - 5	160	64.0
> 5	30	12.0
Family income		
Enough and saving	15	6.0
Enough	162	64.8
Not enough	73	29.2

Occupational Health Hazards among Firefighters at Benha City

Table (2): Frequency distribution of studied firefighters regarding total knowledge items about occupational health hazards, heat stress and occupational health problems (n=250).

Total knowledge items	Good		Average		Poor	
	No	%	No	%	No	%
Occupational health hazards	27	10.8	158	63.2	65	26.0
Heat stress	15	6.0	138	55.2	97	38.8
Occupational health problems	42	16.8	153	61.2	55	22.0

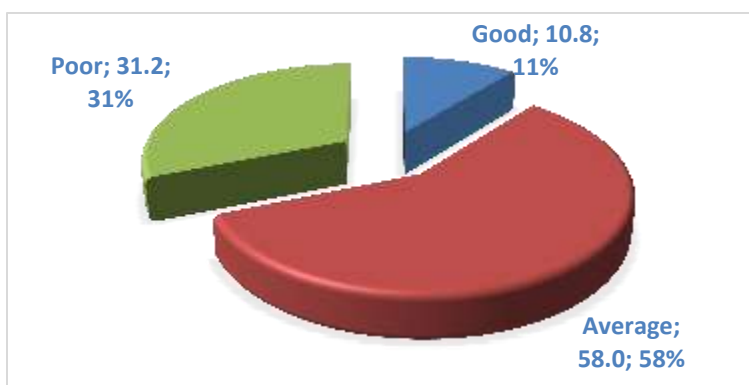


Figure (1): Frequency distribution of studied firefighters regarding their total knowledge score (n=250).

Table (3): Frequency distribution of studied firefighter's total practices regarding personal protective equipment, heat stress, burn and falling practices (n=250).

Total practices	Satisfactory		Unsatisfactory	
	No	%	No	%
Personal protective equipment practices	113	45.2	137	54.8
Heat stress practices	82	32.8	168	67.2
Burn practices	85	34.0	165	66.0
Falling practices	90	36.0	160	64.0

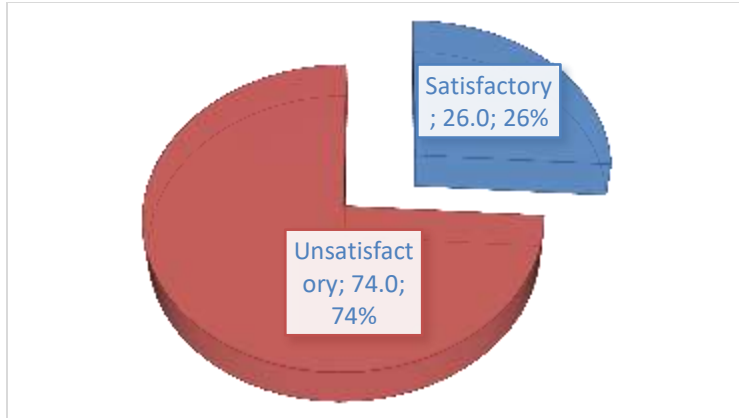


Figure (2): Frequency distribution of studied firefighters regarding their total practices score (n=250).

Table (4): Statistically relation between total firefighter’s knowledge and their total practices (n=250).

Total knowledge	Total practices					X ²	p-value
	Unsatisfactory (n=185)		Satisfactory (n=65)				
	No	%	No	%			
Poor (n=78)	65	35.1	13	20.0	20.34	0.000**	
Average (n=145)	93	50.3	52	80.0			
Good (n=27)	27	14.6	13	20.0			

Discussion

Firefighting is a hazardous occupation with an injury rate that has been estimated at four times that of other workers. Although there are multiple work settings in which firefighters are at risk of injury including in transit and even in the firehouse itself. The fire ground represents an especially perilous environment for firefighters. Besides the obvious exposure to fire and explosion hazards, firefighters routinely carry heavy equipment, work on

slippery and uneven surfaces are exposed to a variety of fall hazards and structural collapses, work in conditions with poor visibility and engage in activities that require awkward postures or repetitive motion (Campbell, 2018).

This descriptive study was conducted with the aim to assess the occupational health hazards among firefighters at Benha City through assessing firefighter’s knowledge and

Occupational Health Hazards among Firefighters at Benha City

practices regarding occupational health hazards at their work.

Regarding to demographic characteristics of firefighters working at Benha fire station, the present study revealed that slightly less than two third of the firefighters aged 35 years or more. Also two third of studied firefighters had enough family income and the most of them were married. These results were in agreement with **(Albertson et al. 2017)**, who studied "Occupational health hazards among firefighters, Australia" and reported that slightly more than half of studied firefighters (54.4%) aged over 30 years old. In addition, 66.6% of them were married and had enough family income.

In relation to the educational level of firefighters, the present study revealed that slightly less than three fifth of them have basic education (table 1). This finding was in contrast with **(Rahimi, 2018)**, who studied "Investigation of educational program and affecting factors on firefighter's knowledge and attitude in Tehran" and reported that slightly more than two thirds of firefighters (62%) had high school diploma.

Concerning total knowledge of firefighters about heat stress, the results of the current study showed that slightly less than three fifth of firefighters had average total knowledge regarding heat stress,. This finding was in contrast with **(Harper et al. 2019)**, who studied " Australian firefighter's perceptions of heat stress during fire-fighting tasks in extreme environments, Australia " and reported that slightly less than two fifth of firefighters had good total knowledge regarding heat stress. This might be due to lack of educational courses about heat stress for firefighters.

Regarding total knowledge of firefighters about occupational health problems, the results of the current study displayed that slightly more than three fifth of firefighters had average total knowledge regarding occupational health problems. This finding agreed with **(Jindal & Dudeja (2018)**, who studied "behavioural and occupational health in military firefighters, United Kingdom "and represented that more than three fifth of firefighters had average total knowledge regarding occupational health problems.

According to the research question number three: What are firefighter's knowledge regarding occupational hazards related to their work? the results of the current study clarified that slightly more than three fifth of firefighters had average total knowledge about occupational hazards. This finding agreed with **(Palmer & Yoos 2019)**, who studied "Health promotion in volunteer firefighters, Florida" and reported that almost two thirds of firefighters had average total knowledge about occupational hazards related to their work.

According to the research question number four: What are firefighters reported practices regarding usage of preventive measures related to their work? the results of the current study showed that more than two thirds of firefighters had total unsatisfactory practices score. This finding was in contrast with **(Barker et al. 2018)**, who studied " Assessing user needs and perceptions of firefighter's PPE, Switzerland " and reported that majority of firefighter's had total satisfactory score with their practices.

With reference to correlation between firefighter's total knowledge and their total practices, the results of the current study displayed that there was a positive correlation

between total firefighters' knowledge and their total practices. This finding harmonized with (Moore et al. 2019), who studied "Relationship between firefighters Knowledge and their practices among Florida firefighters, Florida" and reported that there was a positive correlation between the firefighter's total knowledge and their total practices.

Conclusion

Approximately slightly less than two third of firefighters aged 30 years or more with mean age 33.9 ± 6.45 , more than two third of them were exposed to occupational problems, eye problems, bone and nerve problems. Moreover, slightly more than three fifth of firefighters had average total knowledge score while more than two thirds of them had total unsatisfactory practices and there was highly statistically significant relation between total firefighters' knowledge and their total practices (p - value < 0.001).

Recommendations

Continuous training courses about occupational health hazards should be provided for Benha firefighters to improve their knowledge about it. Booklets should be available at fire stations and distributed to all firefighters about occupational health hazards and first aids items. A special place should be prepared at all fire Stations for providing health education.

References

Albertson, L., Chang, L., & Conrad, C. (2017). Occupational health hazards among firefighters, Elsevier ,61(4): Pp163-166.

Altshuler, S., Zhang, Q., Kleinman, M., & Menendez, I. (2020). Wildfire and prescribed

burning impacts on air quality in the United States. Journal of Health Sciences, 70(10) Pp:961–970.

Barker, J., Boorady, L., Lin, S., & Ashdown, S., (2018). Assessing user needs and perceptions of firefighter PPE. Available at: <https://doi.org/>. Accessed on 23 December 2020.

Campbell, R. (2018). US firefighter injuries on the fire ground. Safety and health journal; 54(2):Pp 461-477.

Harper, A., Conrad, D., & Walton, J. (2019). Australian firefighter's perceptions of heat stress, fatigue and recovery practices during fire-fighting tasks in extreme environments. Safety and Fire Technology journal; 54(4):Pp 177-195

Jindal, W., & Dudeja, A. (2018). Risk by choice: Regulating health and safety in the workplace, Harvard University. Available at: <https://www.harvard.edu/> . Accessed on 12 January 2021.

Marico, O., & Paulo, P. (2020). Factors in the Sharing of Tacit Knowledge among Volunteer Firefighters. International journal of business and management, 14(9) Pp: 1-54.

Moore, J., Koru-Sengul, T., Alvarez, N., & Caban-Martinez, J. (2019). Relationship between firefighter's knowledge and their practices among Florida firefighters. Workplace health & safety journal; 66(11): Pp 522-529.

Moore, A., Judkins, L., Dyal, A. & Schlenk, M. (2021). Behavioral and Occupational Health in Military Firefighters: An Understudied Population. Elsevier, 3th ed, Pp:243-250.

Nahar, N. & Begum, F. (2019). Occupational health hazards in garment sector. Springer; 1(2): Pp 322-365.

Palmer, A., & Yoos, L. (2019). Health promotion in volunteer firefighters. Assessing knowledge of risk for developing cardiovascular disease. Workplace health & safety journal; 67(12):Pp 579-583.

Pandeya, P., Mishra, D., Khanal, P., Joshi, Y. & Deo, N. (2020). Occupational Health Risk among Selected firefighters in Nepal, a retrospective analysis of occupational health and safety mining reports. Safety and health journal, 12(2)Pp: 201-208.

Paterson, J., Aisbett, B., Kovac, K., & Ferguson, A. (2021). Informal management of health and safety risks associated with alarm response by Australian firefighters. Springer, 53(11) Pp: 1-20.

Rahimi, S. (2018). Investigation of educational program and affecting factors on firefighter's knowledge and attitude in Tehran. Available at: <http://www.cred.be/sites/default/>. Accessed on 19 March 2018.

مخاطر الصحة المهنية بين رجال الإطفاء بمدينة بنها

مجمد جمال الدياسطي- ابتسام محمد عبدالعال – وفاء عطا محمد

تتميز مهنة الإطفاء بضغوط عالية ومخاطر صحية كثيرة وتحكم منخفض في المهام المتعلقة بالوظيفة. يمكن تصنيف المخاطر المهنية التي يتعرض لها رجال الإطفاء على أنها فيزيائية وحرارية وكيميائية ونفسية. لذلك هدفت هذه الدراسة الي تقييم مخاطر الصحة المهنية بين رجال الإطفاء بمدينة بنها. وقد أجريت الدراسة الدراسة بمحطة الإطفاء ببنا الواقعة بمدينة بنها. تم استخدام عينة عشوائية منهجية في الدراسة ، وبلغ العدد الإجمالي لرجال الإطفاء في المكان السابق ذكره ٨٩٠ رجل إطفاء. يتم وضع أسماء رجال الإطفاء في قائمة برقم تسلسلي ، ثم يتم اختيار نقطة البداية بشكل عشوائي ، وبعد ذلك يتم اختيار كل عضو كل ٤ أعضاء ليكونوا في العينة. وبلغ عدد أفراد العينة ٢٢٢ رجل إطفاء. حيث أظهرت النتائج بان ٥٩٪ من رجال الإطفاء الذين تبلغ أعمارهم ٣٠ سنة فأكثر بمتوسط عمر 33.9 ± 6.45 ، ٧٦٪ منهم تعرضوا لمخاطر مهنية مثل الحروق والحرمان من النوم والإجهاد الحراري واستنشاق الدخان والغازات السامة ، ٥٨٪ منهم يعانون من مشاكل صحية مهنية مثل مشاكل في الجهاز التنفسي ، مشاكل في العين ، مشاكل في العظام والأعصاب. علاوة على ذلك ، فان ٥٨٪ منهم لديهم متوسط إجمالي درجات المعرفة بينما ٧٤٪ منهم لديهم إجمالي ممارسات غير مرضية وكانت هناك علاقة ذات دلالة إحصائية عالية بين المعرفة الإجمالية لرجال الإطفاء وممارساتهم الإجمالية. كما اوصت الدراسة باستمرارية تقديم دورات تدريبية حول مخاطر الصحة المهنية لرجال إطفاء بنها لتحسين معرفتهم بها.