

BEHAVIORS OF BRAZILIAN FIREFIGHTERS REGARDING POLYCYCLIC AROMATIC HYDROCARBONS AND THEIR HEALTH: A STUDY IN THE FEDERAL DISTRICT AND PERNAMBUCO

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ABSTRACT

Firefighting is a high-risk career, partly because cancer incidence is higher among firefighters than in the general population. This elevated risk is associated with exposure to toxic compounds, such as polycyclic aromatic hydrocarbons (PAHs). However, few studies have examined firefighters' practices and habits related to cancer risk and its reduction. This research aimed to map some of these habits and their possible impact on health, focusing on personal protective equipment (PPE) use, storage, cleaning, and awareness of cancer risks. The study involved 137 Brazilian firefighters from the Federal District and Pernambuco. Results indicate that firefighters demonstrate good awareness of cancer risks and recognize that proper PPE use and frequent cleaning can reduce exposure. Nonetheless, challenges remain in adopting these practices, often due to inadequate infrastructure. The findings highlight areas needing improvement, including low frequency of PPE cleaning, unsuitable storage conditions, and insufficient decontamination procedures.

Keywords: firefighter, cancer, polycyclic aromatic hydrocarbons, personal protective equipment, health promotion.

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COMPORTAMENTOS DE BOMBEIROS BRASILEIROS EM RELAÇÃO AOS HIDROCARBONETOS POLICÍCLICOS AROMÁTICOS E SUA SAÚDE: UM ESTUDO NO DISTRITO FEDERAL E PERNAMBUCO

RESUMO

A carreira de bombeiro é de alto risco, em parte porque a incidência de câncer é maior entre bombeiros do que na população em geral. Esse risco elevado está associado à exposição a compostos tóxicos, como os hidrocarbonetos policíclicos aromáticos (HPAs). No entanto, poucos estudos investigaram as práticas e hábitos dos bombeiros relacionados ao risco de câncer e sua redução. Esta pesquisa teve como objetivo mapear alguns desses hábitos e seus possíveis impactos na saúde, com foco no uso, armazenamento, limpeza dos equipamentos de proteção individual (EPIs) e na conscientização sobre os riscos de câncer. O estudo envolveu 137 bombeiros brasileiros do Distrito Federal e de Pernambuco. Os resultados indicam que os bombeiros apresentam boa conscientização sobre os riscos de câncer e reconhecem que o uso adequado dos EPIs e a limpeza frequente podem reduzir a exposição. Contudo, ainda existem desafios na adoção dessas práticas, muitas vezes devido à infraestrutura inadequada. Os achados destacam áreas que necessitam de melhorias, incluindo a baixa frequência de limpeza dos EPIs, condições inadequadas de armazenamento e procedimentos insuficientes de descontaminação.

Palavras-chave: bombeiro, câncer, hidrocarbonetos policíclicos aromáticos, equipamento de proteção individual, promoção da saúde.

COMPORTAMIENTOS DE BOMBEROS BRASILEÑOS EN RELACIÓN CON LOS HIDROCARBUROS AROMÁTICOS POLICÍCLICOS Y SU SALUD: UN ESTUDIO EN EL DISTRITO FEDERAL Y PERNAMBUCO

RESUMEN

La carrera de bombero es de alto riesgo, en parte porque la incidencia de cáncer es mayor entre los bomberos que en la población general. Este riesgo elevado está asociado con la exposición a compuestos tóxicos, como los hidrocarburos aromáticos policíclicos (HAPs). Sin embargo, pocos estudios han investigado las prácticas y hábitos de los bomberos relacionados con el riesgo de cáncer y su reducción. Esta investigación tuvo como objetivo mapear algunos de estos hábitos y su posible impacto en la salud, centrados en el uso, almacenamiento, limpieza de los equipos de protección personal (EPP) y en la concienciación sobre los riesgos de cáncer. El estudio incluyó a 137 bomberos brasileños del Distrito Federal y de Pernambuco. Los resultados indican que los bomberos presentan una buena concienciación sobre los riesgos de cáncer y reconocen que el uso adecuado de los EPP y la limpieza frecuente pueden reducir la exposición. No obstante, persisten desafíos en la adopción de estas prácticas, a menudo debido a una infraestructura inadecuada. Los hallazgos resaltan áreas que requieren mejoras, entre ellas la baja frecuencia de limpieza de los EPP, las condiciones inadecuadas de almacenamiento y los procedimientos insuficientes de descontaminación.

Palabras clave: bombero, cáncer, hidrocarburos aromáticos policíclicos, equipo de protección personal, promoción de la salud.

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1 INTRODUCTION

Firefighting is a high-risk career that, in addition to the risk of rescue or firefighting situations, may harm workers' health. Several studies, including some epidemiological ones, show that the incidence of cancer is higher amongst firefighters compared to the general population.¹⁻⁵ According to Daniels *et al.*,¹ U.S. firefighters have a 9% higher risk of being diagnosed with cancer and a 14.9% higher risk of dying from cancer than the general U.S. population. The International Agency for Research on Cancer (IARC) classified firefighter exposures in Group I, in other words, carcinogenic to humans.⁶

Urban or forest fires are characterized by incomplete combustion reactions that might produce toxic and carcinogenic substances. Some of these substances identified in fire smoke include polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), hydrogen cyanide (HCN) and several other organic and inorganic compounds.⁷⁻¹¹

PAHs can be classified as one of the most harmful groups in the environment. The U.S. Environmental Protection Agency (U.S. EPA) included 16 PAH molecules in the priority pollutants list, which involves carcinogenic and/or mutagenic compounds.¹² PAHs can enter the environment by different pathways, as oil spill and oil seepage. Nevertheless, the incomplete combustion of modern biomass and fossil fuels is the most prominent source of PAHs in the environment.¹³ Several studies show that firefighters are subjected to high levels of PAH both through the air during fires and after the fire, through personal protective equipment (PPE) and skin¹⁴⁻¹⁶.

For many years, firefighters' organizational culture has associated dirty turnout gear to a symbol of hard work.¹⁷ A British report¹⁸ showed that the "badge of honor attitude" still prevails among firefighters in the UK. The authors define the "badge of honor attitude" as pride in having soiled PPE because it implies in hardworking. On the other hand, the use and proper cleaning of personal protection equipment of the firefighter can considerably reduce the risk of cancer

among workers and it is perceived that there is a growing awareness in this regard^{19,20}. The correct use of PPE can avoid the direct contact of these substances with the skin, and its effective cleaning can remove most of the carcinogenic substances⁸. Consequently, it is important to assess firefighters' awareness of risks, their reduction procedures, and, ultimately, whether there is an ongoing change in organizational culture. In fact, some works already indicate a change in the organizational culture of firefighters, despite this change being very dependent on the region, whether there are internal norms and other peculiarities of each group²¹.

The studies of Hwang *et al.*²² evaluated variables related to PPE use, storage, and cleaning practices in Northwestern Kentucky (USA). The research sheds light on some issues. For instance, volunteer firefighters tended to use older turnout gear than career firefighters (which have it more frequently replaced); 21% of career firefighters' and 53% of volunteer's store their turnout gear in a personal vehicle, which is not recommended by the National Fire Protection Association (NFPA); and the advanced PPE cleaning recommended by NFPA is not followed in small rural fire departments. On the other hand, another research carried out by Macy *et al.*¹⁹ with rural firefighters from Kentucky (USA) exposed that most of the participants were compliant with NFPA Standards, reporting to adopt attitudes as cleaning their gear as needed, storing it in the fire station and PPE retiring within 10 years of use. Also, most of the participants were aware of job-related exposures risks and felt susceptible to cancer and respiratory illness.

In literature, most studies are focused on actual rates of firefighter cancer and the mechanisms of exposure^{1,11,23–25}, but few have focused on firefighter awareness about cancer and adoption of good occupational practices.²⁶ This research seeks to map some Brazilian firefighters' habits and the impact in their habits and health (considering occupational risk of developing cancer). Hence, a study focused on issues such as PPE cleaning and storing and firefighter cancer risk awareness was carried out with firefighters from Distrito Federal (CBMDF) and

Pernambuco (CBMPE) fire departments. To the best of our knowledge, it is the first study concerning Brazilian firefighters' habits in PPE storage and cleaning, as well as their awareness about contamination risk.

2 METHODOLOGY

A form with twenty-eight questions was conceived to investigate firefighters' routines and habits, focused on PPE cleaning and storing. The main objectives of this questionnaire are to infer about the awareness of firefighters about the risks of exposure to fire residues and about PPE cleaning routines. Therefore, the form has two parts: the first one analyzed firefighters' profile and habits related to suits storage and cleaning, and the second one evaluated the participants' awareness of cancer risk and training programs. The form design involves multiple choice questions followed by a question of 5-point Likert scale, with the options strongly agree, agree, neutral, disagree and strongly disagree.

It was used the Google Forms platform to collect the answers. The data were collected from 14 September 2020 through 31 December 2020. 137 firefighters from two fire corporations in Brazil participated in this research. Two corporations participated in the survey: *Corpo de Bombeiros Militar do Distrito Federal* (CBMDF) (79 answers) and *Corpo de Bombeiros Militar de Pernambuco* (CBMPE) (58 answers). In Pernambuco, there is about 2500 military firefighters, therefore a sample of 58 respondents corresponds to, within 90% of confidence, about 10% of error (10.6%). In the Federal District, the contingent of military firefighters is close to 6000, so a sample of 79 respondents corresponds, with 90% confidence, also to an error close to 10% (9.2%)

All participants of this research are military professional firefighters, who received 10 months of training before starting practicing their career. The answers were collected anonymously. The form included the free and consent term and the

participants were informed that the data would be used for scientific research.

3 RESULTS AND DISCUSSION

The results were discussed in two topics. In the first one, we tried to map some habits related to cleaning and storing firefighters' suits, in addition to drawing a profile of the participants. In the second part, we seek to infer about the awareness of firefighters to the risk of developing cancer, the relationship between the increased risk of cancer and the cleaning and storage of suits and the existence of information campaigns and harm reduction policies related to this theme.

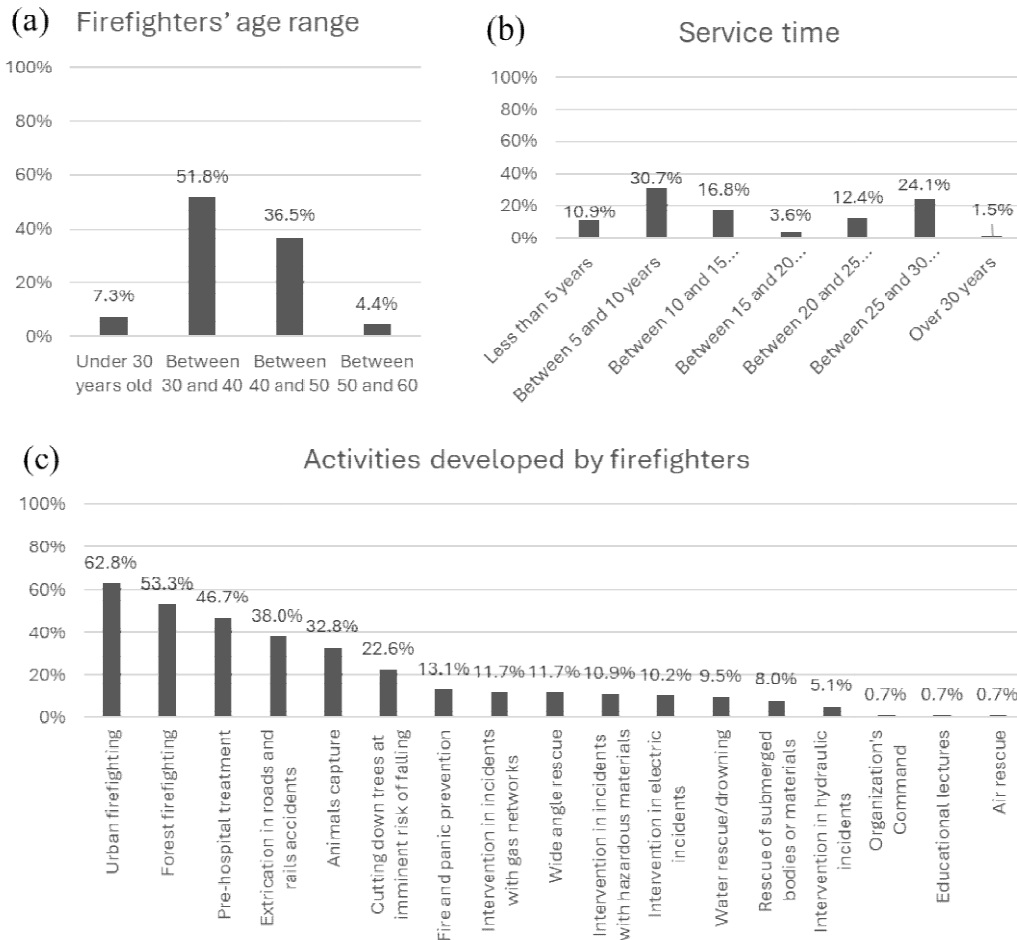
3.1 FIREFIGHTERS' HABITS RELATED TO SUITS STORAGE AND CLEANING (CBMDF AND CBMPE)

First, it was built up a profile of the participants, considering their age (**Figure 1a**), service time (**Figure 1b**) and common activity (**Figure 1c**).

It was noticed that the group is composed mainly by experienced professionals (47.5% of participants have from 5 to 15 years of service and 40.1% have from 16 to 30 years of service). Only 10.9% have less than 5 years of experience. Most of participants are between 30 and 40 years (51.8%), followed by the extract between 40 and 50 years (36.5%). Young military (under 30 years) represents only 7.3% of the sample. The most common activities performed by these firefighters are urban firefighting (62.8%), followed by forest firefighting (53.3%), and then pre-hospital treatment (46.7%). Therefore, we can state that these firefighters are frequently exposed to carcinogenic compounds that arose from combustion. This finding can be explained by the fact that most participants in the study are primarily engaged in firefighting activities, both wildland and structural, compared to other operational duties. Considering that the main source of

contamination is exposure to byproducts generated during combustion, these professionals may be at increased risk.

Figure 1. Participants profile: (a) Firefighters’ age, (b) service time and (c) most common activities developed by firefighters.



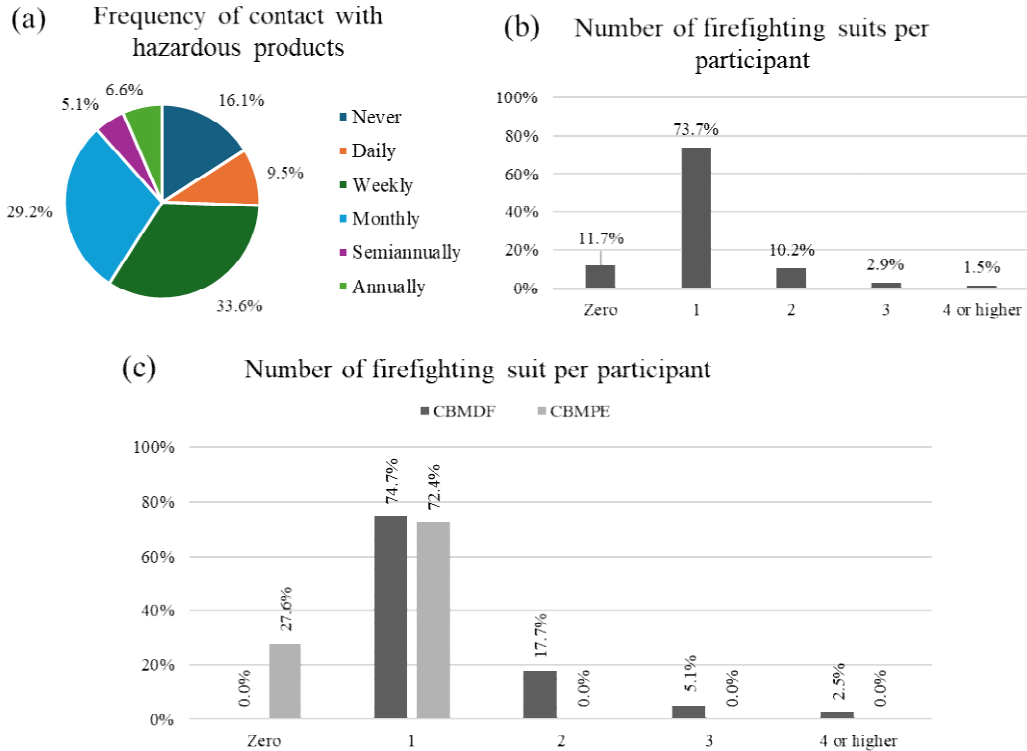
Furthermore, most firefighters (62.8%) have declared, at least, a monthly contact with hazardous products (e.g., flammable liquid, oxidizing agent, toxic gases, toxic substances), with 33.6% stating having a weekly contact with them (Figure 2a). Considering that the most frequent activity of the group is firefighting, we can assume that these firefighters are frequently exposed to the presence of contaminants such as PAH and, therefore, are exposed to a higher risk of

developing cancer.

It was also asked how many suits each firefighter has (and whether they could rotate between them, **Figure 2b**). Most firefighters possess only one suit (73.7%) and 11.7% do not have any. This last percentage includes those who do not fight fires (5.1%) and those who do it but still do not own a personal fire suit (i.e., suits are for collective use), corresponding to 6.6%. Only 14.6% possess more than one suit. It is important to notice that it was already expected each firefighter own only one fire suit due to the high cost. Possessing only one suit, of course, reduces the possibility of frequent washing, because of the drying time required.

When considering both corporations separately (**Figure 2c**), it was observed that all people who have more than one firefighting suit are from Federal District. This may be related to the Federal District being the capital of the country, but also to the fact that it is in a drier region and has more frequent fires. Moreover, in Pernambuco 27.6% declare to have no suit. Considering that only 6.9% of firefighters in Pernambuco said to not carry out activities related to fire combat, we can conclude that the remaining 20.7% are regularly fighting fires and still do not have their own personal suit. This information suggests that these firefighters (20.7%) share collective suits or eventually do not use a proper fire suit. This information reveals an inhomogeneity englobing all the fire departments of Brazil. Therefore, structural issues as PPE cost and accessibility can be more worrying in some Brazilian states than the others.

Figure 2. (a) firefighters’ frequency of contact with hazardous products, (b) number of firefighting suits per participant and (c) number of firefighting suits per participant by corporation.

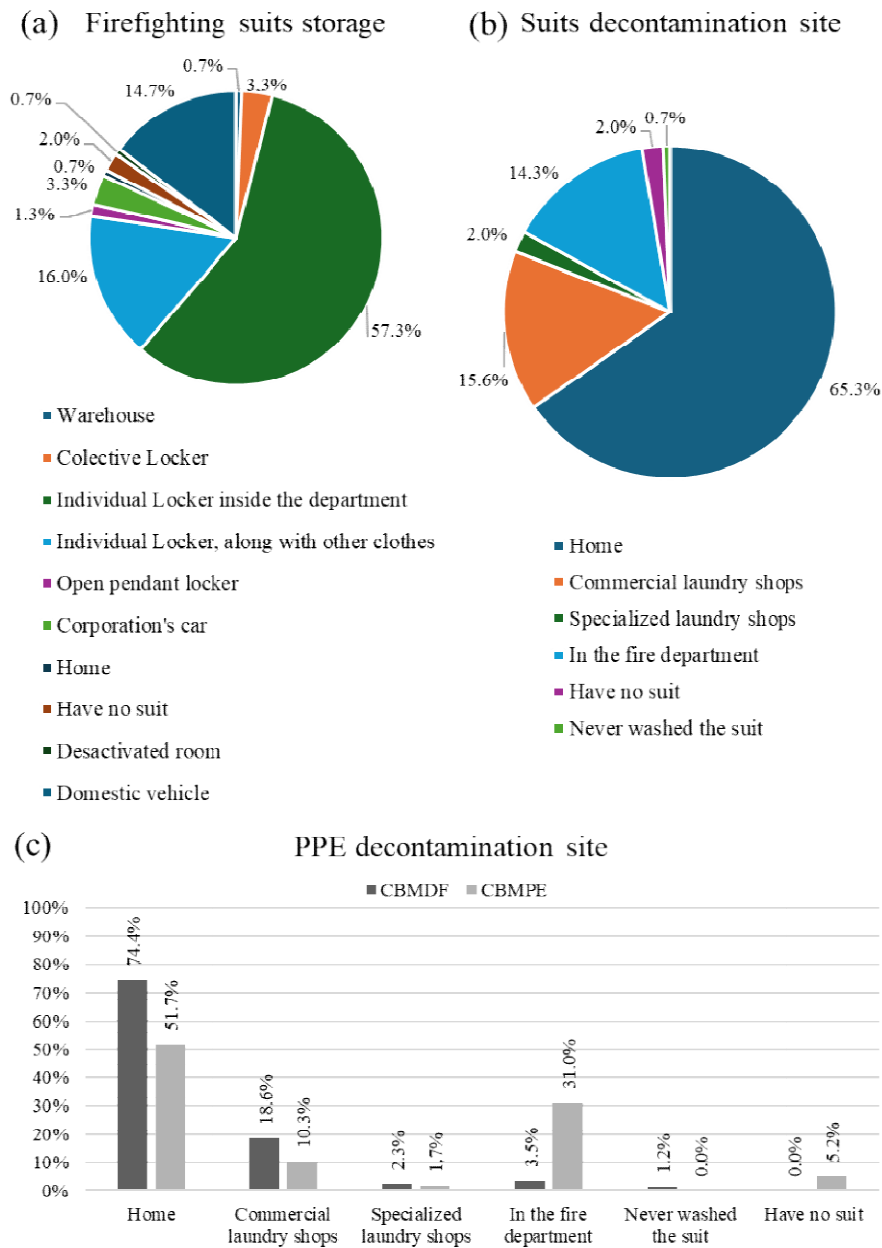


Considering this scenario, PPE handling, storage, and decontamination is an important topic which can directly relate to cancer risk in firefighters. Handling dirt PPE and its inappropriate storage increases the risk of developing cancer by long-term contact with carcinogenic substances.^{19,22} It was asked to participants where they store their firefighting suits. Most participants (57.3%) declared to have a specific locker inside the fire department to suit storage (**Figure 3a**), which means adequate storage that avoids cross contamination with personal items. Nevertheless, 16.0% store their suits and personal clothes together in the same locker and 14.7% store the suits inside their personal vehicles. This unappropriated storage promotes longer and unnecessary contact with contaminated suits for 30.7% of firefighters and suggests the lack of structure inside fire departments to provide PPE lockers to all firefighters. Hwang *et al.*²⁷ analyzed cross-contamination in fire trucks and personal vehicles that had

contact with contaminated gear. In both cases, residues of carcinogenic contaminants were found, indicating the danger related to storing the PPE in these vehicles.

Another important issue is related to suits cleaning routine. The firefighters were asked where they clean their suits (**Figure 3b**). Most participants clean their suits at home (65.3%), which is contraindicated because it increases the risk of cross-contamination not only for the firefighter him/herself but also for other family members and/or residents. About 16% uses commercial laundry shops, which could be a greater problem due to the risk of contaminating other clients' clothes. Mayer et al.²⁸ demonstrated the cross-contamination risk when cleaning firefighter gear and different clothes in the same laundry cycle. They laundered firefighters' hoods (used in firefighting) and new hoods (never used) in the same cycle and, as result, toxic compounds were detected in the new hoods. Only 2% use specialized laundry shops and 14.3% use fire departments facilities for suits laundering, which are the most recommended decontamination sites. This data seems to show that there is still a lack of infrastructure and appropriate regulations in the Brazilian fire departments regarding the cleaning/decontamination of suits (at least, in the Federal District and Pernambuco, which are the two states involved in this work). If we consider the two corporations separately (**Figure 3c**), we will see that there is a difference in the place where the suits are washed. Although washing at home is more frequent in both cases, in Pernambuco, washing within the fire department stands out (35% versus 3.5% in the Federal District). This variation likely reflects regional heterogeneity and is therefore expected. However, the sample is limited to two fire departments (CBMDF and CBMPE), which does not allow full generalization to the reality of all Brazilian states, given the country's structural, operational, and climatic diversity. Nevertheless, both corporations are still far from the ideal scenario, and even in CBMPE the percentage of suit cleaning inside fire departments is quite low.

Figure 3. (a) Firefighting suits storage location after use in firefighting, **(b)** place where firefighting suits are commonly washed and **(c)** place where firefighting suits are commonly washed per corporation.



In sequence, it was asked about the cleaning methods and frequency. The results are shown in **Figure 4**. Most participants declared to use soap and water to

clean their suits. Further than conventional laundering, some firefighters make decontamination at the combat scene with pressurized water and neutral soap. Washing with soap and water (or detergent) is considered the most effective way to remove PAHs and other contaminants⁶. Keir et al.²⁰ had compared, after fighting the fire, the removal of PAH from the skin with water and soap or commercial wipes. Only washing with soap and water was effective for removing most of the PAH, although the results were not as good for removing naphthalene. Fent *et al.*⁸ compared three types of suits cleaning methods: wet-soap method, which had 85% of PAH reduction; dry-brush method, with 23% of PAH reduction and air-based decontamination method, removing only 2% of the present PAH. Although most respondents indicated washing with soap and water, some respondents indicated using only water (7.6%).

Concerning cleaning frequency, approximately 27% of firefighters say they wash their suits monthly or semi-annually (totaling 54.7%), followed by 21.2% who clean it every time after firefighting (**Figure 4b**). NFPA recommends that suits should be cleaned just after being used to reduce the risk of contamination by handling or storage, and the advanced cleaning should be done, at least, once in a year. However, it might be incompatible with firefighters' routine since wet suits are unavailable for use and most only have one suit. It is noteworthy that 11.7% of the participants had answered "none of the previous options", which could include a very low and worrying frequency of cleaning the clothes. Of course, the hypothesis cannot be ruled out that, at least a part of this percentage, does not act or act occasionally in situations that require cleaning of the suit.

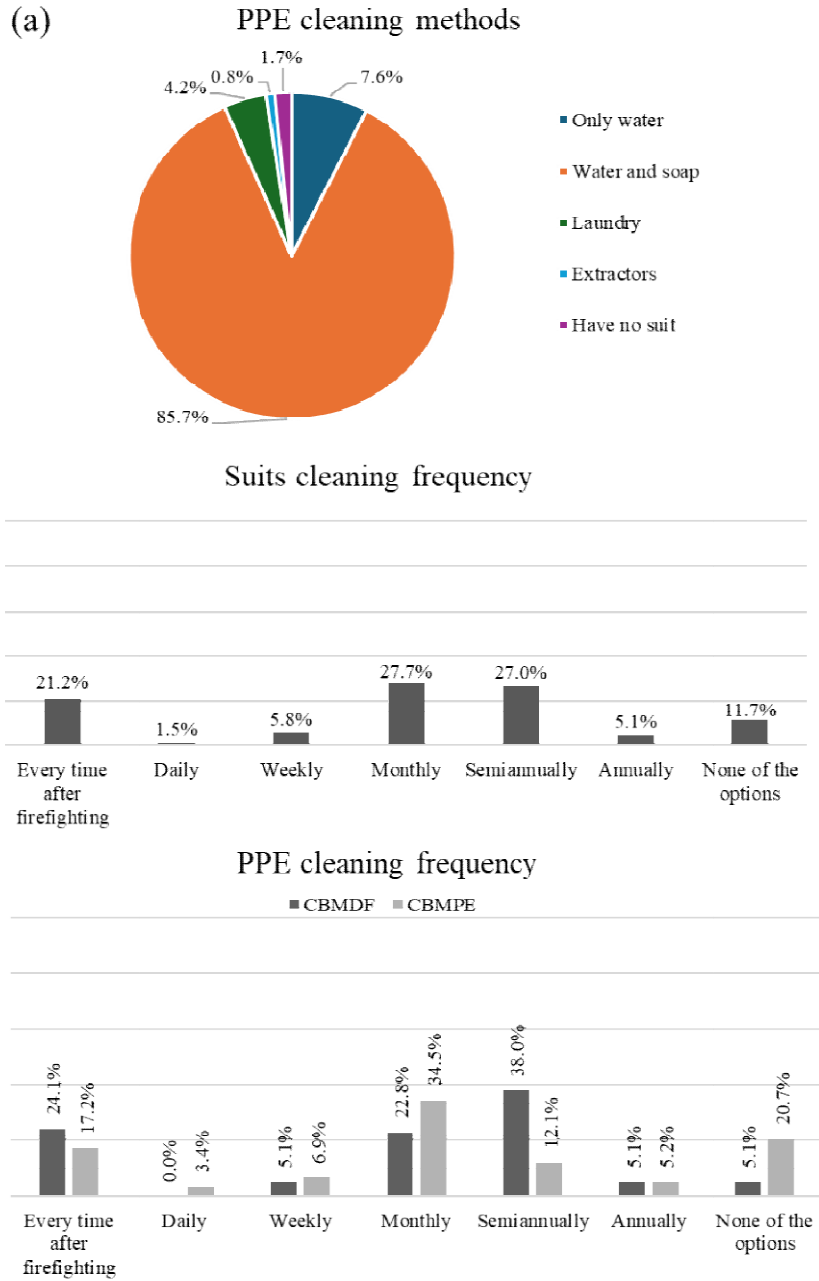
Considering the corporations separately (**Figure 4c**), we see that in Pernambuco there is a higher percentage of monthly washing (34.5%) than in the Federal District (22.8%). Once again, the local organizational culture, as well as the climate (Pernambuco tends to be hotter and more humid than the Federal District), could explain these differences. In the Federal District, the most frequent answer is the semiannually washing. Semiannually cleaning is a large time

window for cleaning (of course, if suits had been used) and can contribute to chronic exposure to PAHs. Conversely, there is a higher percentage of DF firefighters who clean their suits every time after a fire (24.1% from CBMDF versus 17.2% from CBMPE). This variation likely reflects regional heterogeneity and cultural differences.

It is interesting to point out that there was no standardization in the procedure for cleaning or for cleaning frequency, due to the large number of divergent responses. This suggests the need for procedure guides, which together with information campaigns and training, can help to promote the health of firefighters.

How often to wash the suit is a delicate issue. On the one hand, there is an indication of frequent washing (immediately after use) to reduce the chance of prolonged exposure to toxic and carcinogenic products.^{29, 30} On the other hand, frequent washing can damage the suit. It was demonstrated by Stull *et al.*²⁹, who showed a decrease in waterproofing, an increase in after flame time for Nomex III outer shell, and an important decrease in thermal protective performance. However, the study did not specify how many washing cycles are required to achieve the loss of the suits' performance.

Figure 4. (a) Firefighting suit cleaning methods, **(b)** its cleaning frequency and **(c)** cleaning frequency separated by corporation.



3.2 FIREFIGHTERS' AWARENESS OF CANCER RISK AND TRAINING PROGRAMS (CBMDF AND CBMPE)

The second part of this work was focused on mapping the participants' awareness about the risk and the relationship between the development of cancer and some attitudes after firefighting.

First, they were asked about the existence of training on the importance of using PPE and its relevance. About 74,5% said they received training (**Figure 5a**). The percentage of firefighters who claim to have not received training seems to be large and draws attention to the need for constant qualification. Regarding the percentage of participants who had received training, 59.9% considered it relevant, while 14.6% stated that it was not relevant.

Participants were also asked whether their fire departments provide guidelines aimed at reducing cancer risk. As shown in **Figure 5b**, 75.9% of the participants reported that no such guidelines exist, while 2.2% stated that they were unaware of any guidelines addressing cancer risk reduction. This result highlights a lack of information and guidance inside fire departments, which can be a worrying factor for firefighters' health and may contribute to the non-adoption of good practices.

In the last section, we presented 6 affirmations to be evaluated by a 5-point Likert scale. The affirmatives were related to the risk of developing cancer involving the correct use, storage, and cleaning of PPE. Results are shown in **Figure 5d**. In this topic, a good awareness related to risk of cancer and basic skills to reduce that risk was identified, which suggest that the old organizational culture that relates dirty turnout gear as a symbol of hard work has been changing.

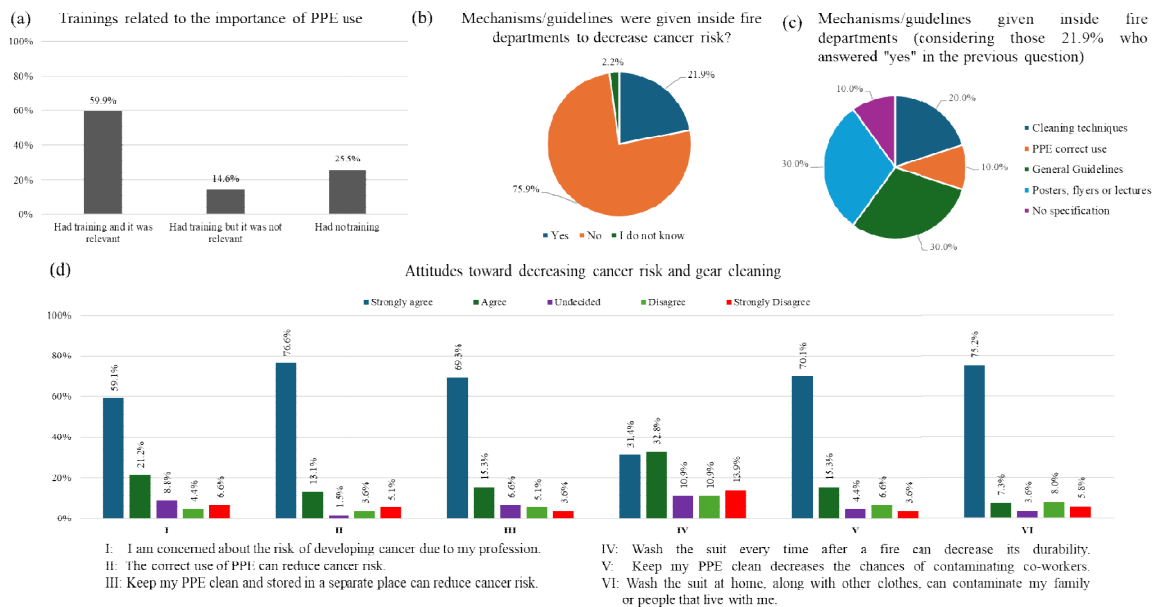
- 59.1% of participants strongly agreed and 21.2% agreed that firefighting carries a higher cancer risk compared to other professions, indicating that most participants are aware of the increased cancer risk associated with this occupation. It is noteworthy that there is a percentage that strongly disagrees (6.6%), disagrees

(4.4%) or has a neutral opinion (8.8%) about it. This percentage can indicate firefighters who did not have access to information that confirms the problem of cancer development in the career. Also, it suggests the need for frequent and continuous information campaigns.

- 76.6% strongly agree that the correct use of PPE can reduce cancer risk, and it can be related to the idea of a lower exposure to PAHs during fire fights. It suggests that the participants are concerned about using PPE correctly during fire combats.
- 84.6% strongly agree or agree that a specific place to PPE storage contributes to reducing cancer risk. Nonetheless, only 57.3% have a specific locker inside the fire department for PPE storage. This result shows us that there is a disparity between awareness and the available infrastructure, as was previously shown in relation to the place for cleaning the suits.
- 24.8% of participants strongly disagreed or disagreed that frequent washing could reduce the durability of protective suits, while 10.9% were neutral regarding this statement. This result suggests a possible lack of awareness of current literature, which may contribute to inappropriate practices related to the maintenance of protective gear. Educational campaigns addressing both the risks associated with handling and storing contaminated gear and concerns about potential damage caused by washing would therefore be valuable.
- 70.1% strongly agree that keeping the PPE clean contributes not only with the firefighter's personal health, but also with his/her co-worker's health, demonstrating, as expected, a concern for the well-being of their co-workers.
- 75.2% strongly agree that cleaning the suits at home can cause harm. It is remarkable because 65.3% said to clean their PPE at

home. Once again, there is evidence of a discrepancy between the awareness of the participants related to good practices and the available infrastructure.

Figure 5. (a) Receiving training and perceiving its importance, (b) questioning if fire departments provide guidelines to decrease cancer risk, (c) guidelines inside fire departments to decrease cancer risk (for those who had some type of guideline) and (d) Likert scale related to the risk of developing cancer involving the correct use, storage and cleaning of PPE.



4 CONCLUSIONS

This study sought to shed light on Brazilian firefighters' awareness regarding the increased risk of cancer associated with their profession, as well as their habits related to the cleaning and storage of firefighting suits. The results indicate that firefighters generally demonstrate a good level of awareness about occupational cancer risk and recognize that practices such as the correct use of PPE and proper decontamination procedures can reduce exposure to hazardous

compounds, including polycyclic aromatic hydrocarbons (PAHs).

However, despite this awareness, the adoption of recommended practices remains limited. Structural and organizational barriers appear to play a significant role, particularly the lack of adequate infrastructure for PPE storage and laundering. In addition, the fact that most firefighters possess only one suit may discourage frequent cleaning, since the gear becomes temporarily unavailable for operational use. As a result, PPE is often stored or washed in inappropriate locations, such as personal vehicles or private homes, potentially increasing both occupational and secondary exposure risks.

Another important finding is the discrepancy between firefighters' knowledge of best practices and their actual routines. While most participants recognize the importance of proper PPE cleaning and the risks associated with domestic laundering, a substantial proportion still report cleaning their gear at home. This gap suggests that awareness alone is insufficient to promote behavioral change when institutional support and infrastructure are lacking.

Overall, the results highlight the need for greater institutional efforts aimed at improving firefighters' occupational health conditions in Brazil. Investments in adequate decontamination facilities, standardized cleaning protocols, and continuous training programs may contribute to reducing exposure to carcinogenic substances. Future studies involving a larger number of Brazilian fire departments would also be valuable to better understand regional differences and to support the development of national policies focused on cancer prevention among firefighters.

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Supplementary Information

Form Applied to the Firefighters with all the answers

Obs.1: The numbers showed inside the parentheses correspond to the number of answers for each alternative. The number showed in the left position (inside parentheses) represent the answers from CBMDF, while the numbers in right (inside parentheses) represent the answers from CBMPE.

Obs.2: Some items had more than 137 answers (total of the participants) due to the possibility to choose more than one alternative in the same question.

1. Firefighters' age range

(7 | 3) Under 30 yearsold

(40 | 31) Between 30 and 40

(29 | 21) Between 40 and 50

(3 | 3) Between 50 e 60

(0 | 0) Above 60

2. Service Time

(11 | 4) Lessthan 5 years

(29 | 14) Between 5 and 10 years

(4 | 19) Between 10 and 15 years

(4 | 1) Between 15 and 20 years

(10 | 7) Between 20 and 25 years

(21 | 12) Between 25 and 30 years

(1 | 1) Over 30 years

3. Military Firefighter Group that you belong:

CBMDF:

- (2) 1º Brasília
- (1) 3º SIA
- (10) 6º Núcleo Bandeirante
- (1) 9º Planaltina
- (1) 10º Paranoá
- (1) 12º Samambaia
- (1) 15º Asa Sul
- (1) 17º São Sebastião
- (1) 18º Santa Maria
- (1) 21º Riacho Fundo
- (4) 22º Sobradinho
- (1) 34º Lago Norte
- (3) 37º Samambaia Centro
- (1) 41º St. de Indústrias de Ceilândia
- (2) 45º Octogonal/Sudoeste
- (1) CEFAP
- (1) CEMEV
- (1) CEPED
- (1) CETOP
- (1) COSEA
- (1) GAEPH
- (1) GAVOP
- (1) GBS
- (29) GPCIU
- (7) GPRAM
- (1) QCG

CBMPE:

- (18) 1º GRUPAMENTO DE BOMBEIROS
- (2) 2ª SEÇÃO DE BOMBEIROS DE INCÊNDIO
- (2) 2º GRUPAMENTO DE BOMBEIROS
- (3) 3º GRUPAMENTO DE BOMBEIROS
- (1) 5º GRUPAMENTO DE BOMBEIROS
- (10) 6º GRUPAMENTO DE BOMBEIROS
- (2) 7º GRUPAMENTO DE BOMBEIROS
- (3) 9º GRUPAMENTO DE BOMBEIROS
- (1) Academia Bombeiro Militar dos Guararapes
- (1) CAMPUS DE ENSINO METROPOLITANO II
- (1) Centro de Atividades Técnicas do Sertão 1
- (1) Centro de Justiça e Disciplina
- (1) DGP
- (1) Diespcat AGR 3
- (6) GRUPAMENTO DE BOMBEIROS DE INCÊNDIO
- (1) GRUPAMENTO DE BOMBEIROS DE SALVAMENTO
- (1) QUARTEL DO COMANDO GERAL
- (1) SEÇÃO DE BOMBEIROS DE GRAVATÁ
- (1) SEÇÃO DE BOMBEIROS DE PETROLÂNDIA

4. Graduation:

- (7 | 2) 1st Sergeant
- (15 | 3) 2nd Sergeant
- (14 | 9) 3rd Sergeant
- (6 | 7) Sergeant
- (1 | 0) Lieutenant
- (2 | 0) 1st Lieutenant
- (2 | 4) 2nd Lieutenant

(9 | 3) Warrant Officer
(8 | 13) Soldier
(1 | 8) Cable
(3 | 7) Captain
(1 | 1) Major
(1 | 0) Master
(2 | 0) Post graduated
(6 | 0) Graduated
(1 | 1) Undergraduated

5. Function:

(1 | 1) Adjunct
(0 | 6) Administrative
(0 | 1) DOP Assistant
(0 | 2) SCP Assistant
(4 | 10) SectionChief
(1 | 3) Commander
(28 | 4) Combatant
(5 | 3) Conductor
(1 | 0) Structuralfirerescueteam
(6 | 1) Instructor
(1 | 0) Area Officer
(2 | 1) Operacional
(9 | 0) Prontidão
(2 | 0) Saving
(6 | 0) Rescuer
(3 | 1) Subcommander
(0 | 2) Operator
(0 | 1) Treasurer

(10 | 22) No Reply

6. Activities developed:

(1 | 0) Organization's Command

(30 | 43) Forest firefighting

(55 | 31) Urban firefighting

(9 | 7) Wide angle rescue

(35 | 29) Pre-hospital treatment

(10 | 3) Water rescue/drowning

(25 | 27) Extrication in roads and rails accidents

(4 | 10) Intervention in electric incidents

(4 | 3) Intervention in hydraulic incidents

(6 | 9) Intervention in incidents with hazardous materials

(8 | 8) Intervention in incidents with gas networks

(23 | 8) Cutting down trees at imminent risk of falling

(22 | 23) Animals capture

(7 | 4) Rescue of submerged bodies or materials

(1 | 0) Air rescue

(7 | 9) Fire and panic prevention

(0 | 1) Educational lectures

7. Frequency of contact with hazardous products (e.g., flammable liquid, oxidizing agent, toxic gases, toxic substances):

(6 | 7) Daily

(31 | 15) Weekly

(24 | 16) Monthly

(4 | 3) Semiannually

(4 | 5) Annually

(10 | 12) Never

8. Estimate of the number of forest firefighting calls attended by you annually:

- (3 | 9) Zero
- (6 | 4) From 1 to 5
- (15 | 5) From 6 to 10
- (25 | 12) From 11 to 25
- (21 | 13) From 26 to 50
- (6 | 5) From 51 to 100
- (4 | 3) Over 100
- (0 | 3) Many

9. Estimate of the number of urban firefighting calls attended by you annually:

- (9 | 6) Zero
- (20 | 10) From 1 to 5
- (14 | 14) From 6 to 10
- (20 | 8) From 11 to 25
- (14 | 6) From 26 to 50
- (2 | 5) From 51 to 100
- (1 | 3) Over 100

10. Mark which PPE is used by you during forest firefighting:

- (62 | 23) Helmet
- (76 | 54) Hood or balaclava
- (44 | 23) Full turnout (pants and jacket)
- (77 | 48) Gloves
- (74 | 51) Boots
- (8 | 0) Disposable half-face filter respirators (PFF1) for protection of the respiratory tract against dust and mists

- (7 | 1) Disposable half-face filter respirators (PFF2) for protection of the respiratory tract against dust, mists and fumes
- (1 | 1) Disposable half-face filter respirators (PFF3) for protection of the respiratory tract against dust, mists, fumes and radionuclides
- (11 | 7) Air respirator with removable filters
- (0 | 1) Open-Circuit Escape Respirators
- (1 | 0) Closed-Circuit Escape Respirators
- (10 | 5) Bandana mask
- (7 | 1) Mask for forest fires
- (1 | 6) Breathable mask with air cylinders (RPE)
- (71 | 26) Protective goggles
- (4 | 4) Hearing protection
- (2 | 0) Forest fire PPE and F2 helmet
- (0 | 1) Leggings
- (1 | 2) Does not perform fire combat

11. Mark which PPE is used by you during urban firefighting:

- (77 | 52) Helmet
- (77 | 54) Hood or balaclava
- (78 | 54) Full turnout (pants and jacket)
- (78 | 55) Gloves
- (76 | 55) Boots
- (2 | 3) Disposable half-face filter respirators (PFF1) for protection of the respiratory tract against dust and mists
- (0 | 0) Disposable half-face filter respirators (PFF2) for protection of the respiratory tract against dust, mists and fumes
- (0 | 1) Disposable half-face filter respirators (PFF3) for protection of the respiratory tract against dust, mists, fumes and radionuclides
- (1 | 0) Air respirator with removable filters

- (7 | 1) Open-Circuit Escape Respirators
- (13 | 3) Closed-Circuit Escape Respirators
- (2 | 1) Bandana mask
- (64 | 38) Breathable mask with air cylinders (RPE)
- (26 | 14) Protective goggles
- (3 | 5) Hearing protection
- (1 | 2) Does not perform fire combat

12. Firefightingsuitsstorage:

- (56 | 30) Individual Lockerinsidethedepartment
- (14 | 8) Domesticvehicle
- (2 | 3) Corporation'scar
- (11 | 13) Individual Locker, along with other clothes
- (0 | 1) Warehouse
- (5 | 0) Colective Locker
- (0 | 2) Open pendant locker
- (1 | 0) Home
- (0 | 1) Desactivated room
- (0 | 3) Have no suit

13. Suitsdecontamination site:

- (3 | 18) In thefiredepartment
- (64 | 32) Home
- (17 | 6) Commerciallaundry shops
- (2 | 1) Specializedlaundry shops
- (0 | 3) Have no suit
- (1 | 0) Never washedthesuit

14. How do you wash the firefighting suit?

- (12 | 31) Water and soap
- (45 | 19) Water and soap, separated from other clothes
- (13 | 5) Separated from other clothes
- (2 | 0) Wash machine, separated from other clothes
- (3 | 0) Laundry
- (4 | 5) Pressurized water only
- (0 | 1) Extractors
- (0 | 2) Have no suit

15. How do you decontaminate the firefighting equipment? Describe the method, if possible.

- (0 | 6) Water and bleach
- (37 | 38) Water and soap
- (6 | 1) Bleach
- (1 | 5) Water, soap and alcohol
- (1 | 2) Water only
- (0 | 1) Depends on the type of fire
- (1 | 0) Discart
- (0 | 1) Company hired by the corporation
- (5 | 0) Misty jet
- (3 | 0) Misty jet and specific fan
- (0 | 1) Wet tissue
- (11 | 1) Washing machine
- (8 | 0) There is no decontamination
- (4 | 0) There is no standard method neither the material needed
- (0 | 2) I do not know
- (0 | 1) I do not use these equipment
- (1 | 0) Ventilation and water and soup cleaning

16. Do you have any sanitation method after firefighting a fire? If so, how?

(71 | 57) Take a bath

(5 | 1) Cleaning with wet wipes on the body

(2 | 2) Turnout cleaning with wet wipes

(19 | 7) Turnout cleaning

(8 | 0) Does not perform any type of cleaning

(0 | 3) Misty jet in the suit

(0 | 1) Masks cleaning

(0 | 1) PPE's dirty parts cleaning

(0 | 1) Cleaning of excess debris with the aid of a brush

(0 | 1) Does not fight fires

17. How many firefighting suits do you have?

(0 | 16) Zero

(59 | 42) 1

(14 | 0) 2

(4 | 0) 3

(2 | 0) 4 or more

18. What is the frequency that you wash the firefighting suits, according to your answer on the item 14?

(19 | 10) Always after a fire combat

(0 | 2) Daily

(4 | 4) Weekly

(18 | 20) Monthly

(30 | 7) Semiannually

(4 | 3) Annually

(4 | 12) None of the above

19. What is the frequency that you decontaminate the firefighting equipments, according to your answer on item 15?
- (34 | 20) Always after a fire combat
 - (0 | 3) Daily
 - (4 | 10) Weekly
 - (19 | 9) Monthly
 - (13 | 4) Weekly
 - (3 | 4) Annually
 - (6 | 8) None of the above
20. Was there any type of training on the importance of using PPE promoted inside the fire department? If so, do you believe that it was relevant?
- (53 | 29) Yes and it was relevant
 - (6 | 14) Yes but it was not relevant
 - (20 | 15) Had no training
21. Does your fire department promoted any type of mechanisms/guidelines to decrease cancer risk, if so, which ones?
- (0 | 3) I do not know
 - (55 | 49) No
 - (3 | 0) Yes
 - (6 | 0) Yes, cleaning techniques
 - (3 | 0) Yes, correct use of PPE/RPE
 - (4 | 5) Yes, general guidelines
 - (8 | 1) Yes, posters, flyers or lectures
22. Does the government promoted any type of mechanisms/guidelines to decrease cancer risk, if so, which ones?
- (3 | 1) Supplies the PPE

(7 | 6) I do not know

(55 | 50) No

(1 | 0) Biennial health inspection

(4 | 0) Yes

(7 | 1) Yes, posters, flyers or lectures

(1 | 0) Yes, general guidelines

(1 | 0) Yes, cleaning techniques

Obs.3: The next six itens (23 a 28) were statements displayed in a table, where the participants should mark the 5-point likert scale.

23. I am concerned about the risk of developing cancer due to my profession.

(6 | 3) Strongly disagree

(3 | 3) Disagree

(7 | 5) Undecided

(17 | 12) Agree

(46 | 35) Strongly agree

24. The correct use of PPE can reduce cancer risk.

(4 | 3) Strongly disagree

(3 | 2) Disagree

(0 | 2) Undecided

(11 | 7) Agree

(61 | 44) Strongly agree

25. Keep my PPE clean and stored in a separate place can reduce cancer risk.

(3 | 2) Strongly disagree

- (5 | 2) Disagree
- (5 | 4) Undecided
- (11 | 10) Agree
- (55 | 40) Strongly agree

26. Wash the suit every time after a fire can decrease its durability.

- (7 | 12) Strongly disagree
- (11 | 4) Disagree
- (8 | 7) Undecided
- (25 | 20) Agree
- (28 | 15) Strongly agree

27. Keep my PPE clean decreases the chances of contaminating co-workers.

- (3 | 2) Strongly disagree
- (7 | 2) Disagree
- (3 | 3) Undecided
- (12 | 9) Agree
- (54 | 42) Strongly agree

28. Wash the suit at home, along with other clothes, can contaminate my family or people that live with me.

- (4 | 4) Strongly disagree
- (8 | 3) Disagree
- (3 | 2) Undecided
- (3 | 7) Agree
- (61 | 42) Strongly agree