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ARTIGO ORIGINAL DE TEMA LIVRE

"AMONG DEAD AND WOUNDED": MAPPING, CHARACTERIZATION AND ANALYSIS OF FIRES WITH VICTIMS IN RECIFE'S METROPOLITAN ZONE

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Abstract

This article presents the mapping and analysis of fires with dead and wounded people in the Metropolitan Region of Recife (MRR) served by the Firefighters Department from 2013 to 2016. There was an average rate of 1 death per million inhabitants, similar to countries such as Singapore and Vietnam. The weighted number of fires per wounded or dead person results in rates of 0.5 and 1.7 per 100 recorded fires, respectively. These numbers are concerning, especially when compared to rates from other regions in the world. The victims of fires in MRR were shown to generally not be a perceivable problem in terms of common sense, yet they are real and require accurate analysis and effective measures.

Keywords: Fires. Deaths. Injured people. Metropolitan Region of Recife. Residential buildings.

"ENTRE MORTOS E FERIDOS": MAPEAMENTO, CARACTERIZAÇÃO E ANÁLISE DOS INCÊNDIOS COM VÍTIMAS NA REGIÃO METROPOLITANA DO RECIFE

Resumo

Este artigo apresenta o mapeamento e a análise de incêndios com mortes e feridos na Região Metropolitana do Recife – RMR, atendidos pelo Corpo de Bombeiros, no período de

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2013 a 2016. Verificou-se uma taxa média de 1 morte por milhão de habitantes, semelhante a países como Singapura e Vietnam. Quando se pondera a quantidade de incêndios para que haja um ferido ou morto, as taxas se apresentam respectivamente em 0,5 e 1,7 por 100 incêndios registrados – sendo estes números preocupantes, principalmente quando comparados com taxas de outras regiões no mundo. Conclui-se que as vítimas de incêndios na Região (RMR) são um problema silente ao senso comum, mas real e que exige análise acurada e providências efetivas.

Palavras-chave: Incêndios. Mortes. Feridos. Região Metropolitana do Recife. Edificações residenciais.

"ENTRE MUERTOS Y HERIDOS": CARTOGRAFÍA, CARACTERIZACIÓN Y ANÁLISIS DE LOS INCENDIOS CON VÍCTIMAS EN LA ZONA METROPOLITANA DE RECIFE

Resumen

Este artículo presenta la cartografía y análisis de incendios con muertes y heridos en la Zona Metropolitana de Recife (ZMR), atendidos por el Cuerpo de Bomberos, en el período de 2013 a 2016. Se ha verificado un promedio de 1 muerte por millón de habitantes, semejante a países como Singapur y Vietnam. Cuando se examina la cantidad de incendios para que haya un herido o muerto, los promedios se presentan respectivamente de 0,5 y 1,7 por 100 incendios registrados, lo cual es preocupante, principalmente en comparación con los promedios de otras regiones del mundo. Se concluye que las víctimas de incendios en la ZMR son un problema silencioso y real, lo que exige un análisis cuidadoso y diligencias efectivas.

Palabras clave: Incendios. Muertes. Heridos. Zona Metropolitana de Recife. Edificaciones residenciales.

INTRODUCTION

Despite its importance for the development of civilizations, fire has always been a serious threat to human beings when out of control. The great tragedies lived during the last centuries were the milestone in the search to know better the behavior of fires and its consequences. In urban centers, fires often causes major tragedies with a considerable loss of patrimony and, more importantly, human lives, especially in crowded areas.

Our study was conducted in the Metropolitan Region of Recife (MRR), state of Pernambuco, located in the Northeast Brazil and formed by 14 municipalities, including the capital city. MRR has a population of more than 3.7 million people, representing over 45% of the population of the entire state of Pernambuco, residing in a territory that corresponds to less than 3% of the state extension (IBGE, 2016).

Besides this high population density, there are substandard constructions, known as favelas and slums, as well as tall buildings not always accompanied by the precautionary concerns appropriate to the risks. These factors catalyze the outbreak of fires and represent a challenge for fire safety in terms of minimizing deaths and injuries. During the triennium 2011-2013, the number of fires in the MRR increased more than 15%[1]. Nevertheless, the losses that affect not only the economy, but also social welfare, point to the cruelest aspect of these fires, that is, the victims: people who died or were wounded in fires[2].

Regarding fire-related mortality and lethality, Paes[3] points out that a statistical control would be very useful. However, this tool is underused in several Latin American countries, providing incomplete, outdated and imprecise data. In a global study performed by IAFRS/CTIF[4], no data from Brazil or from another Latin American country was described, which can be interpreted as the non-existence or inconsistency of data.

In 2016 alone, 2,503 fires were registered in the Metropolitan Region of Recife, of which 835 were fires in buildings, representing 33.3% of the total number of fires in the MRR[5]. The high population density is a catalytic factor. Therefore, analyzing the fires in buildings by their mapping, constructive peculiarities, type of occupation, local estimation of primary foci, as well as the existing fire load, can effectively contribute to the implementation of public policies aimed at reducing the problem[6].

METHODOLOGY

The method used in our research to measure and present data is based on the tabulation of data on events in MRR buildings that caused deaths and wounded people in the period from 2013 to 2016 obtained from the Military Firefighters Department of Pernambuco.

Thus, our study is based on the hypothetical deductive logic proposed by Lakatos and Marconi[7]. They suggest that the research hypothesis should collect subsidies for proof, considering the possible relation between lethal fires and their characterization in the area studied.

For such purpose, we selected all the occurrence reports of fires in buildings in the MRR from the Military Firefighters Department of Pernambuco between 2011 and 2013, and analyzed those that resulted in deaths and wounded people.

The analysis of the selected occurrence reports follows a pattern established in Brazil and allows a better appreciation of the fires, as well as the drawing of a profile of the scenario. Among the points observed are: victim's information (gender and age), emergency address, event characteristics, rescue vehicles used, distance, response time, occurrence history, building characteristics, existing preventive systems, presumed origin of the fire, affected area, type of construction, and fields for observations, which may include, the place where the victim was found, injury site, damaged furniture, victims' schooling, among other data judged important by the on-site team leader.

Some information received by the Fire Department was not collected directly with the affected family, but with neighbors and friends due to the emotional state of the relatives of the deceased or injured persons. In some cases, this result in the absence of some information. Furthermore, in a few cases, there was no one present to provide the data to firefighters, thus resulting in a limited number of information about the occurrence.

Demographic databases of the Brazilian Institute of Geography and Statistics (IBGE) were also used in our research.

DISCUSSION AND RESULTS

Fires in Brazilian urban centers result from the disorderly growth and the insufficient fire safety infrastructure of cities. Other factor is the creation and maintenance of favelas or conglomeration of sub-dwellings, composed of precarious constructions made almost exclusively of very flammable materials, with precarious facilities and equipment, becoming a "powder keg"[8].

Out of the 3,961 fires in the state of Pernambuco assisted by the Firefighters Department in 2016, 2,503 occurred in the MRR, of which 835 (33.3%) corresponded to fires in buildings, that is, in residences, shops, warehouses, hospitals, factories, schools, among others.

The predominance of fires in buildings is evident; with a percentage very close to that worldwide (38.8%), according to IAFRS/CTIF[4].

By computing the analyzed data of fires in buildings that caused deaths from 2013 to 2016, we found 16 occurrences with 16 deaths. Fires that resulted in wounded people, in turn, consisted in 49 occurrences with 61 victims, according to **Table 1**.

Table 1 – Occurrences with deaths and injuries from 2013 to 2016 in the MRR

(continued)

Occurrences with deaths (2013 – 2016)						
Fire	**Date**	**City**	**Type of building**	**Number of deaths**	**Gender**	**Age**
Occurrence1	21FEB13	Olinda	Single-family	01	Male	01 year
Occurrence 2	16MAR13	Recife	Single-family	01	Male	×*
Occurrence 3	26DEC13	Olinda	Single-family	01	Male	~ 45 years **
Occurrence 4	05FEB14	Recife	Single-family	01	Male	66 years
Occurrence 5	22MAR14	Recife	Single-family	01	Female	28 years
Occurrence 6	17OCT14	Recife	Multifamily	01	Female	77 years
Occurrence 7	22DEC14	Recife	Single-family	01	Male	01 years
Occurrence 8	07MAY15	Olinda	Single-family	01	Male	41 years
Occurrence 9	25OCT15	Recife	Single-family	01	Female	~ 40 years **
Occurrence 10	26OCT15	Abreu e Lima	Single-family	01	Male	47 years
Occurrence 11	08DEC15	Jaboatão dos Guararapes	Single-family	01	Female	6 years
Occurrence 12	11DEC15	São Lourenço da Mata	Single-family	01	Male	41 years
Occurrence 13	01AUG16	Recife	Single-family	01	Female	4 years
Occurrence 14	03AUG16	Jaboatão dos Guararapes	Single-family	01	Male	10 months
Occurrence 15	05AUG16	Cabo de S. Agostinho	Single-family	01	Male	~ 40 years **
Occurrence 16	21DEC16	Jaboatão dos Guararapes	Single-family	01	Male	43 years
Occurrences with wounded people from 2013 to 2016 in the MRR						
Fire	**Date**	**City**	**Type of building**	**Amount of wounded individuals**	**Gender**	**Age**
Occurrence 1	03FEB13	Paulista	Multifamily	01	×*	×*
Occurrence 2	17FEB13	Olinda	Single-family	01	Male	×*
Occurrence 3	21FEB13	Olinda	Single-family	01	Female	62 years
Occurrence 4	26MAR13	Recife	Single-family	01	Male	× *
Occurrence 5	07JUN13	Recife	Single-family	01	Male	× *
Occurrence 6	16SEPT13	Recife	Single-family	01	×*	× *
Occurrence 7	27SEPT13	Olinda	Single-family	01	Male	63 years
Occurrence 8	01NOV13	Recife	Single-family	01	Male	× *
Occurrence 9	18NOV13	Recife	Single-family	01	Male	82 years
Occurrence 10	06DEC13	Olinda	Single-family	01	Male	~ 35 years **

Table 1 – Occurrences with deaths and injuries from 2013 to 2016 in the MRR

(continued)

Occurrences with wounded people from 2013 to 2016 in the MRR						
Fire	**Date**	**City**	**Type of building**	**Amount of wounded individuals**	**Gender**	**Age**
Occurrence 11	08JAN14	Recife	Single-family	01	Female	94 years
Occurrence 12	21JAN14	Recife	Single-family	01	Male	35 years
Occurrence 13	05FEB14	Recife	Single-family	01	Female	× *
Occurrence 14	17FEV14	Recife	Multifamily	02	Female and Female	65 and 32 years
Occurrence 15	22FEB14	Recife	Single-family	01	Female	31 years
Occurrence 16	17MAR14	Recife	Single-family	01	Female	× *
Occurrence 17	22MAR14	Recife	Single-family	01	Male	49 years
Occurrence 18	27MAR14	Recife	Single-family	01	×*	× *
Occurrence 19	01JUL14	Recife	Single-family	01	Female	59 years old
Occurrence 20	14AUG14	Paulista	Single-family	02	Male and Female	× * and × *
Occurrence 21	07SEPT14	Olinda	Single-family	02	Female and Female	35 and 40 years
Occurrence 22	11DEC14	Recife	Single-family	02	Female and Male	× * and 4 years
Occurrence 23	15DEC14	Paulista	Single-family	01	Male	~ 40 years **
Occurrence 24	03JAN15	Olinda	Single-family	01	Female	42 years
Occurrence 25	16JAN15	Recife	Single-family	01	Male	~ 45 years **
Occurrence 26	26MAR15	Olinda	Single-family	02	Male and Female	× * and × *
Occurrence 27	19APR15	Recife	Single-family	01	Female	× *
Occurrence 28	07MAIO15	Olinda	Single-family	01	Female	63 years
Occurrence 29	08MAY15	Olinda	Single-family	03	2 Male and 1 Female	4, × * and × * years
Occurrence 30	12MAY15	Olinda	Single-family	01	Female	× *
Occurrence 31	11SEPT15	Paulista	Single-family	01	Male	33 years
Occurrence 32	19SEPT15	Recife	Single-family	01	Female	58 years
Occurrence 33	22OCT15	Recife	Multifamily	01	Male	× *
Occurrence 34	14NOV15	Jaboatão dos Guararapes	Single-family	02	2 male	3 and 4 years
Occurrence 35	16NOV15	Recife	Single-family	02	Female and male	25 and 17 years
Occurrence 36	08DEC15	Recife	Single-family	01	Male	~ 15 years **
Occurrence 37	20JAN16	Jaboatão dos Guararapes	Single-family	01	Male	× *
Occurrence 38	24FEB16	Recife	Multifamily	01	Female	39 years

Table 1 – Occurrences with deaths and injuries from 2013 to 2016 in the MRR

(conclusion)

Occurrences with wounded people from 2013 to 2016 in the MRR						
Fire	**Date**	**City**	**Type of building**	**Amount of wounded individuals**	**Gender**	**Age**
Occurrence 39	27FEB16	Recife	Multifamily	02	Male and Female	66 and 60 years
Occurrence 40	24MAR16	Jaboatão dos Guararapes	Single-family	01	Female	82 years
Occurrence 41	25MAR16	Recife	Single-family	02	2 female	46 and 21 years
Occurrence 42	27MAR16	Recife	Single-family	01	Male	× *
Occurrence 43	30MAR16	Jaboatão dos Guararapes	Single-family	01	Female	41 years
Occurrence 44	20JUL16	Ipojuca	Single-family	02	Female and Male	49 and 53 years
Occurrence 45	28AUG16	Jaboatão dos Guararapes	Single-family	01	Male	× *
Occurrence 46	02SEPT16	Olinda	Single-family	02	Female and Male	49 and 57 years
Occurrence 47	26SET16	Recife	Multifamily	01	Male	× *
Occurrence 48	15NOV16	Recife	Single-family	01	×*	× *
Occurrence 49	26DEC16	Itapissuma	Single-family	01	Female	22 years

Source: Research data.

* Information not given to the MFDPE and not known by the community during the completion of the report.

** Approximate ages due to lack of documents for confirmation.

Among the cases that resulted in death, 15 of the 16 buildings involved single-family residences, corresponding to 94% of the cases. Of those that resulted in wounded people, 88% were single-family residences, whereas 12% were classified as multifamily residences.

We can clearly observe the predominance of lethal fires in the MRR in single-family residences, or simply "houses", usually built with a single floor and intended for single-family housing. We emphasize that this is the only Type of Building (TYPE A)[9] without a preventive system against fires, according to the main laws and standards of fire safety in Brazil[10]. Fires in these households out of standards are characterized by confinement of flames in the rooms and free spread of smoke throughout the environment, thus generating a greater probability of injuries and even deaths[11].

In a study by Santos[11], in which he compared general fires with residential fires in the state of São Paulo in 2014. The author demonstrated that, although there is a small proportion of fires in households, the percentage of deaths in this type of building was high, close to 90%, in line with the data shown in **Table 1**. He also mentions that, in some countries, the strategy of using fire detectors as primary prevention is well accepted to mitigate fires with deaths, mainly night fires and those involving older adults and vulnerable people. The primary prevention of deaths in residential fires in Brazil is public education, seeking to avoid the main causes of fire.

For Zago et al.[12], the likelihood of a fire to spread is reduced in buildings with smoke detectors, automatic showers, fire brigade and adequate divisions, which are not found in the houses.

According to Corrêa et al.[6], fires in single-family buildings account for almost 3/4 of household fires.

Table 2 shows some other observations made during data analysis.

Table 2 – Fires with deaths and injuries in the MRR from 2013 to 2016

(continued)

Fires with deaths					
Date	**City**	**Schedule warning**	**Distance from the MFDPE**	**Response time**	**Type of building**
21FEB13	Olinda	11:40 h	25 Km	15 min	wood
16MAR13	Recife	08:20 h	11 Km	10 min	× *
26DEC13	Olinda	14:45 h	23 Km	13 min	Masonry
05FEB14	Recife	01:13 h	8 Km	7 min	Masonry
22MAR14	Recife	15:11 h	11 Km	26 min	Masonry
17OCT14	Recife	03:04 h	5 Km	10 min	Masonry + Concrete
22DEC14	Recife	03:50 h	3 Km	4 min	Masonry
07MAY15	Olinda	02:59 h	4 Km	8 min	Masonry
25OCT15	Recife	03:59 h	22 Km	19 min	Masonry
26OCT15	Abreu e Lima	11:20 h	16 Km	24 min	Masonry
08DEC15	Jaboatão dos Guararapes	23:20 h	4 Km	16 min	Masonry
11DEC15	São Lourenço da Mata	22:43 h	3 Km	6 min	Masonry
01AUG16	Recife	21:05 h	6 Km	16 min	Masonry
03AUG16	Jaboatão dos Guararapes	21:01 h	6 Km	12 min	Masonry
05AUG16	Cabo de S. Agostinho	21:00 h	19 Km	24 min	wood
21DEC16	Jaboatão dos Guararapes	23:19 h	2 Km	3 min	Masonry

Fires with wounded people in the MRR from 2013 to 2016					
Date	**City**	**Time of the call**	**Distance from the MFDPE**	**Response time**	**Type of building**
03FEB13	Paulista	11:36 h	25 Km	27 min	Masonry + Concrete
17FEB13	Olinda	21:35 h	10 Km	24 min	Masonry
21FEB13	Olinda	11:40 h	25 Km	15 min	wood
26MAR13	Recife	19:00 h	10 Km	23 min	Masonry
07JUN13	Recife	19:47 h	7 Km	17 min	Masonry
16SEPT13	Recife	16:05 h	7 Km	12 min	Masonry

Table 2 – Fires with deaths and injuries in the MRR from 2013 to 2016

(continued)

Fires with wounded people in the MRR from 2013 to 2016					
Date	**City**	**Time of the call**	**Distance from the MFDPE**	**Response time**	**Type of building**
27SEPT13	Olinda	12:55 h	6 Km	17 min	Masonry
01NOV13	Recife	21:28 h	13 Km	17 min	Masonry
18NOV13	Recife	12:20 h	7 Km	16 min	Masonry
06DEC13	Olinda	08:00 h	2 Km	5 min	Masonry
08JAN14	Recife	15:17 h	7 Km	17 min	Masonry
21JAN14	Recife	08:14 h	4 Km	5 min	Masonry
05FEB14	Recife	01:13 h	8 Km	7 min	Masonry
17FEB14	Recife	03:00 h	3 Km	7 min	Masonry + Concrete
22FEB14	Recife	03:50 h	6 Km	20 min	Masonry
17MAR14	Recife	18:20 h	16 Km	30 min	Masonry
22MAR14	Recife	15:11 h	11 Km	26 min	Masonry
27MAR14	Recife	13:52 h	9 Km	27 min	Masonry + Wood
01JUL14	Recife	06:14 h	6 Km	10 min	Masonry
14AUG14	Paulista	12:10 h	10 Km	17 min	Masonry
07SEPT14	Olinda	13:59 h	9 Km	20 min	Masonry
11DEC14	Recife	10:17 h	9 Km	17 min	Masonry
15DEC14	Paulista	23:03 h	14 Km	19 min	Masonry
03JAN15	Olinda	00:08 h	12 Km	20 min	Masonry
16JAN15	Recife	13:15 h	2 Km	6 min	Masonry
26MAR15	Olinda	00:20 h	4 Km	8 min	Masonry
19APR15	Recife	20:09 h	18 Km	18 min	wood
07MAY15	Olinda	02:59 h	4 Km	8 min	Masonry
08MAY15	Olinda	01:49 h	2 Km	10 min	Masonry
12MAY15	Olinda	00:15 h	8 Km	14 min	Masonry
11SEPT15	Paulista	18:27 h	12 Km	21 min	Masonry
19SEPT15	Recife	13:05 h	8 Km	15 min	Masonry
22OCT15	Recife	10:27 h	1 Km	1 min	Masonry + Concrete
14NOV15	Jaboatão dos Guararapes	14:21 h	7 Km	20 min	Masonry

Table 2 – Fires with deaths and injuries in the MRR from 2013 to 2016

(conclusion)

Fires with wounded people in the MRR from 2013 to 2016					
Date	**City**	**Time of the call**	**Distance from the MFDPE**	**Response time**	**Type of building**
16NOV15	Recife	02:05 h	9 Km	14 min	Masonry
08DEC15	Recife	×*	×*	×*	Masonry
20JAN16	Jaboatão dos Guararapes	13:10 h	3 Km	6 min	Masonry
24FEV16	Recife	01:10 h	5 Km	17 min	Masonry + Concrete
27FEV16	Recife	03:40 h	4 Km	6 min	Masonry + Concrete
24MAR16	Jaboatão dos Guararapes	10:48 h	5 Km	16 min	Masonry
25MAR16	Recife	14:55 h	10 Km	9 min	Masonry
27MAR16	Recife	20:42 h	3 Km	9 min	Masonry
30MAR16	Jaboatão dos Guararapes	23:23 h	23 Km	34 min	Masonry
20JUL16	Ipojuca	18:36 h	13 Km	18 min	Masonry
28AUG16	Jaboatão dos Guararapes	22:35 h	12 Km	35 min	Masonry
02SEPT16	Olinda	09:02 h	15 Km	16 min	Masonry
26SEPT16	Recife	20:34 h	4 Km	38 min	Masonry + Concrete
15NOV16	Recife	01:50 h	15 Km	26 min	Masonry
26DEC16	Itapissuma	12:50 h	10 Km	25 min	Masonry

Source: Research data.

* Occurrence disclosed through the media, but not assisted by the MFDPE because the firefighters rescued the victim immediately. At the time of the visit for checking the truthfulness of the information there was no one in the residence, but the occurrence was confirmed.

In **Table 2**, we can verify that fires involving dead and injured people occurred mostly from 21:00 to 06:00h, representing 43% of the total number of occurrences. This often shows the fragility of residential buildings, mainly single-family dwellings. This type of house does not have internal preventive systems to recognize the beginning of a fire and equipment to control it, especially in hours when a large part of the population is already sleeping or less attentive, resting after an intense day of activities. However, 25% of the occurrences began between 10h and 14h, when many people cook, largely due to negligence and malpractice in the handling of gas cylinders.

The buildings that were burned in fires in the MRR during the studied period had diverse construction modalities. However, residential buildings, either single- or multi-family, were mostly made of masonry.

Masonry buildings have walls with structural and divisive function in the environments (structural masonry, resistant masonry). In the MRR, masonry buildings are mostly made of ceramic bricks, according to **Figure 1**.

Figure 1 – Damage caused in the structural masonry of some houses due to fire and some access way to sites where fires happened

Source: Research data.

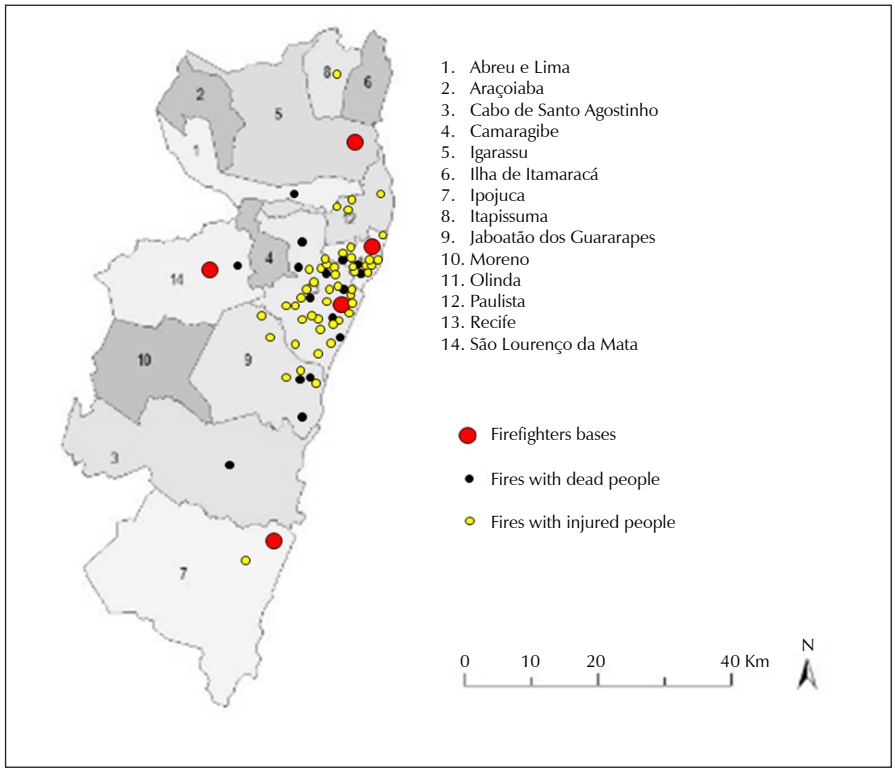
Figure 1 shows that the resistance of the structure is compromised not only by the absence of the coating layer, but also by the damages caused in the ceramic bricks. According to Leite et al.[13], resistance to fires consists in the ability of a structural element to maintain the functions for which it was designed after a certain time on fire. Moreover, the building must remain fire resistant to ensure safe escape of occupants, as well as to ensure the safety of firefighting operations by firefighters and minimize the damage to adjacent buildings and to public infrastructure.

An average response time of approximately 13 minutes is seen for occurrences with fatalities, and 17 minutes for those, in which victims had only injuries. The average displacement was 10.5 km for fires with dead people and 8.8 km for those with injured people. Most of the occurrences happened between the night and dawn, which favors a low response time due to a smaller flow of vehicles. However, the night period hinders the aid of passers-by to access the affected places, which is important for the military firefighters, since the place is unknown in a considerable number of fires. Another complicating factor is the likelihood of risk related to the firefighters' own physical safety when they arrive at the place of the fire, and the support and presence of the Military Police is required to enter certain neighborhoods; this specific situation can lead to a delay in the response time. Furthermore, almost half of the reports filled by firefighters pointed out the distance of more than 6 km from the base to the place of the fire as a difficulty in the response, followed by 20% that pointed out the lack of data and signs to find the address of the occurrence.

In the occurrences in the morning or afternoon, the heavy flow of vehicles combined with small streets makes the transit of large vehicles difficult. For Corrêa et al.[14], the response to fires in buildings in the MRR comes from the base of the Military Firefighter Department of Pernambuco – MFDPE. These bases or barracks with fire fighting vehicles arrive to only six addresses, which is obviously a limiting factor, especially with the increase of the vehicle fleet in the MRR of more than 380% in 24 years (1990-2014), from 251.420 to 1.22 million motor vehicles, resulting in mobility difficulties[15].

It is noteworthy that among the deaths, five of the sixteen victims were less than 10 years old, showing the risk of both lack of knowledge and limitations in distinguishing and evaluating the danger. **Table 2** shows the fire of November 14, 2015, in which the two children involved were 3 and 4 years old and the fire started when the two boys played with a cigarette lighter in a room. This case exemplifies the preponderant factor of harmful events of fires when children are involved, which is mainly their lack of awareness of the danger and their limitations to take action in the beginning of a tragedy.

Figure 2 – Location of occurrences with dead and injured people from 2013 to 2016 in the MRR



Source: Research data.

Another factor associated with deaths is criminal action. This was the case of the fire that caused the death of a woman aged approximately 40 years, on October 25, 2015; a man apparently 40 years old, on August 05, 2016; and a man aged 43 years, on December 21, 2016. Another point to be mentioned is the involvement of people with mental disorders that can lead to suicidal actions, such as the case in five occurrences involving deaths and other five involving wounded people. Regarding the fire-generating factors, 20% of the reports indicated that the fire started due to bad handling of the cooking gas cylinders.

Among the 65 occurrences involving deaths and injured people, only 10% occurred in multi-family residences, whereas 90% occurred in single-family residences, mostly located on the suburb of cities. In addition to the existence of preventive systems, although restricted, in multifamily buildings, is another characteristic favorable to lower percentage of lethal events is the profile of the people living in these buildings, generally located in rich areas of the cities. These people have a higher schooling when compared with the population living in

the suburbs, in houses with poor facilities[16]. The higher level of schooling and, consequently, the knowledge of what to do in emergencies were possibly factors that minimized greater damages to these people.

Since wounds and deaths caused by fires are a concern not only of the local Firefighter Department, we tried to compare the MRR with other countries and cities. Regarding the number of deaths, the MRR presents a proportion of 0.1 deaths per 100,000 inhabitants (2014), very close to the figures in countries such as Singapore and Vietnam[4]. Regarding injured victims, the MRR presented close values to those in Ukraine and Bulgaria, and worse values than Singapore, Vietnam, Croatia and Slovenia, with a proportion of 0.35 per 100,000 inhabitants.

In an analysis that estimates the proportion of the number of dead and injured people in relation to the number of fires assisted in the MRR, it was seen the proportion of 1 death each 195.5 fires and 1 wounded person each 60.1 fires. Compared to **Table 3**, regarding the number of deaths per 100 fires, the MRR has the worst rate among all countries/regions listed, whereas in the case of the number of injured individuals per 100 fires, the MRR is ahead only of France, Great Britain and Singapore.

Table 3 – Fires with dead and injured people in the MRR and in the world in 2014

Country/City/ Region	Number of fires	Number of dead people	Number of injured people	1 dead person per 100 fires	1 injury person per 100 fires
MRR*	782	4	13	0.5	1.7
USA	1.298.000	3.275	15.775	0.3	1.2
France	270.900	280	13.703	0.1	5.1
Great Britain	212.500	322	9.748	0.2	4.6
Poland	145.237	493	-	0.3	-
Singapore	4.724	8	111	0.2	2.3
Croatia	7.317	21	71	0.3	1.0
Slovenia	5.917	0	53	0.0	0.9
New York	42.043	71	-	0.2	-
Hong Kong	767.215	23	295	0.1	0.8
Berlin	6.456	27	-	0.4	-

Source: Report 21 International Association Fire and Rescue Services[4].
* Results of search.

CONCLUSION

With a considerable number of fires that have generated deaths and injured people over the last 4 years, compared to other places in the world, the probability of the occurrence of new events in the Metropolitan Region of Recife is not low, mainly due to the high population density allied to substandard constructions and vertical constructions that are not always planned considering the precautionary concerns appropriate to the risks.

Present in 1/3 of all fires recorded in the MRR, house fires stand out as the leading cause of dead and injured people. The lack of preventive systems in single-family buildings is a catalytic factor. According to the data collected in our research, single-family residences were involved in 94% of the fires that resulted in deaths and 88% of those that caused injuries to the victims.

A factor that must be improved to provide more accurate data for possible studies is the completion of the reports by the Firefighter Department. Despite the absence of documents of some fires, all information collected should be considered in the report of the occurrence, including those provided by informants, even in the fields of observations.

Thus, the population's awareness on preventive measures to be adopted is an important task of the Military Firefighter Department of Pernambuco in the fight against the minimization of problems produced by the fires. Moreover, it is necessary to work with children so that they not only pass on the knowledge to their families, but also develop the perception of risks and dangers from fire-propagating actions, since they are statistically the most involved in this scenario of human losses.

Therefore, the monitoring and evaluation of public strategies and policies that strengthen the mitigation of problems are essential to minimize fire-related accidents, especially those involving residential buildings.

Due to the high risk of fires in single-family and multi-family dwellings, we recommend to study a technical standard for this type of buildings, raising questions such as equipment that may contribute to the identification of the beginning of a fire, the attitude of the population in response to the incident, and improved response time of firefighting teams and other measures that preserve people's integrity.

Further studies are needed to deepen questions related to fatality related to fires and to ratify the figures presented in our study by quantitative and qualitative assessments, thus allowing us to increasingly provide information to managers for decision making to reduce the number of dead and injured people.

AUTHORS' CONTRIBUTION

1. Study conception, data analysis and interpretation: Roberto Ryanne Ferraz de Menezes, Cristiano Corrêa, José Jéferson Rêgo e Silva and Tiago Ancelmo Pires.

2. Article writing and critical review: Roberto Ryanne Ferraz de Menezes and Cristiano Corrêa.

3. Critical review and/or approval of final version: José Jéferson Rêgo e Silva and Tiago Ancelmo Pires.

4. Public responsibility of the intellectual content: Roberto Ryanne Ferraz de Menezes.

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