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# ANALYSIS OF FIRE RISK ASSESSMENT IN SOUTH JAKARTA 2021

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## *ABSTRACT*

*Jakarta is the capital city of Indonesia, with a dense population of more than 10 million population. DKI Jakarta Province is divided into five city areas, including South Jakarta. South Jakarta has an area of 141,17 km$^2$, with more than three million population. The scope for this study focused on two sub-districts in South Jakarta, which are Pasar Minggu and Jagakarsa. The objective of this study was to provide fire risk situations in two sub-districts of South Jakarta. The study used a descriptive method with non-probabilistic sampling. Data collection was performed from June 2021 to July 2021 through focus group discussions (FGDs) and filling out questionnaires. FGDs were performed to the Local Government Fire Brigade, and questionnaires were filled out by the head of the RW. The FGD guideline and questionnaire were developed based on the fire risk assessment checklist. The checklist instrument was developed by utilizing a disaster fire risk approach, including fire hazard, vulnerability, and fire protection, with twenty-two questions. The data was then analyzed using univariate analysis, bar, and spider chart. The results showed three RWs with severe-risk classification. The factors that increase the risk of fire are the use of combustible building materials and the high density of population and buildings. There were several recommendations contributed such as firefighters must have a list of the high-risk areas and develop a rescue evacuation plan, doing a routine inspection in each target area, and raising public awareness for the community to increase participation in fire risk management.*

***Keywords:*** *fire risk assessment, fire hazard, fire protection, South Jakarta, urban area*

## *ABSTRACT*

DKI Jakarta merupakan Ibu Kota Negara Indonesia dengan populasi yang padat, lebih dari 10 juta penduduk. Provinsi DKI Jakarta terbagi ke dalam lima wilayah, termasuk wilayah Jakarta Selatan. Di Jakarta Selatan, terdapat kurang lebih 3 juta jiwa dengan luas 141.27 km$^2$. Penelitian ini berfokus pada dua sektor di Jakarta Selatan yaitu Kecamatan Pasar Minggu dan Kecamatan Jagakarsa. Tujuan dari penelitian ini ialah menggambarkan wilayah berisiko kebakaran di Kecamatan Pasar Minggu dan Jagakarsa. Metode yang digunakan dalam penelitian ini yaitu studi deskriptif dengan prosedur sampling non-probabilistik. Pengumpulan data dilakukan pada bulan Juni 2021 hingga Juli 2021. Pengumpulan data dilakukan melalui *focus group discussion* (FGD) dan pengisian kuesioner. FGD dilakukan kepada petugas Damkar wilayah setempat dan kuesioner diberikan kepada kepala RW (rukun warga) dengan panduan *fire risk assessment checklist*. Instrumen checklist berfokus pada 3 kategori yaitu fire *hazard*, kerentanan, dan proteksi kebakaran yang terdiri dari 22 pertanyaan. Kemudian data dianalisis secara univariat dengan penyajian data melalui grafik batang dan *spider chart*. Hasil penelitian menunjukkan bahwa terdapat tiga RW dengan klasifikasi risiko kebakaran berat. Faktor yang meningkatkan risiko terjadinya kebakaran yaitu pengunaan material bangunan mudah terbakar serta tingginya tingkat kepadatan penduduk dan bangunan. Beberapa rekomendasi dari hasil penelitian diantaranya Dinas Pemadam Kebakaran perlu memiliki daftar wilayah atau bangunan yang rawan kebakaran dan berisiko tinggi serta menyusun rencana evakuasi penyelamatan, perlu adanya inspeksi rutin di setiap wilayah binaan, serta meningkatkan *awareness* masyarakat untuk terlibat dalam manajemen risiko kebakaran di wilayahnya.

**Kata kunci:** penilaian risiko kebakaran, *fire hazard*, proteksi kebakaran, Jakarta Selatan, daerah perkotaan

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## Introduction

In general, based on data from the US Fire Administration statistics during the period of 2017-2019, there have been 368,500 fires in the residential areas in the United States, with 1,900 of them causing one or more fatalities. The fatalities occurred when the residents tried to save themselves, were asleep during the fire, or were unable to take appropriate actions when the fire started that they became trapped in the fire. The same report also stated that the causes of the fires were smoking, malfunctions of electrical equipment, and cooking activities.[1]

In DKI Jakarta Province, Indonesia, there have been 5,043 cases of fire control actions and rescue during the period of 2020.[2] For fire incidents alone, 1,471 cases were recorded with a material loss of up to hundreds of millions of rupiah.[3] South Jakarta is the area in the province with the highest number of fire incidents of 397 incidents.[2] Most fires were caused by electrical faults and gas leaks. The report from the DKI Jakarta Provincial Fire and Rescue Agency stated that residential buildings are the most frequent objects experiencing fires.[2] Residential buildings that are still made of non-permanent materials and the use of gas for daily activities in this type of building make them very vulnerable to fires. Moreover, the surrounding area is classified as a fairly dense environment so that fires can easily spread to surrounding buildings.

Fires are very likely to occur in urban areas with high population density[4], especially in urbanized areas such as Jakarta. The highly dense South Jakarta area that ranks first in the areas with the most fires in 2020 is no exception. Fires that occur in buildings and residential areas are among the major disasters for these areas due to the high population density and the economic value of the buildings and properties that are destroyed by fires.[5] Fires occur due to interactions between the components of fuel, oxygen, heat sources, and chemical chain reaction (fire tetrahedrons). Components that can be used as fuel include flammable materials in solid, liquid, or gaseous forms. Some solid materials in the household that can also become fuel in fires are house frames made of wood, bamboo, or other non-permanent building materials. Furthermore, it takes a minimum of 16% oxygen in the air to create a fire reaction. Then, a sufficient energy source is required until a fuel component reaches the ignition temperature.[6,7] The use of electric cables that are not in accordance with standards and the behavior of using unsafe gas stoves can trigger fires. Fire is detrimental because it can cause fatalities and economic losses. The density of population, crowded buildings, and difficult access roads will make the evacuation process and firefighting operations to be constrained so that it takes a long time to put out the fire.[8,9]

In this study, researchers focused on the South Jakarta areas that included Pasar Minggu and Jagakarsa Sub-Districts. Pasar Minggu (21.69 $km^2$) and Jagakarsa (24.87 $km^2$) sub-districts are the two largest sub-districts in South Jakarta. The size of the South Jakarta area reaches 141.27 $km^2$ or

occupies 21.33% of the total area of DKI Jakarta Province.[10] The total population in South Jakarta is 2,294,779 people, with a population density of 16,259.79 people/km².[10] With this situation, it is important to do a fire risk analysis to provide an overview of the fire risk in the South Jakarta area. The analysis was carried out at the neighborhood unit (RW) level. With more detailed data, it is expected that the fire risk management efforts in the area could be improved.

## Methods

This study is a descriptive study using the non-probabilistic sampling procedure. The location of this study was determined based on the local government administration area, which included Pasar Minggu and Jagakarsa Sub-Districts in South Jakarta. These two areas were selected as the subjects because these two sub-districts are the largest sub-districts in South Jakarta. The analysis was carried out at the RW unit level. The study sample included 16 RWs, 7 RWs in Pasar Minggu Subdistrict, and 9 RWs in Jagakarsa Subdistrict. Data collection was performed from June 2021 to July 2021 through focus group discussions (FGDs) and filling out questionnaires. The FGD was led by a facilitator and attended by Heads of Sector and Platoon Commanders of the Firefighter Station. The FGD was conducted online through the zoom application. Questionnaires were also filled out online and were filled out by the head of the RW. The limited-time for research and the availability of resources at the RT level only allowed this study to be carried out at the RW unit level.

The FGD guideline and questionnaire were developed based on the fire risk assessment checklist that refers to laws, government regulations, and established national standards, including Law no. 28 of 2002, Regulation of the Minister of Public Works No. 20 of 2009, Regulation of the Governor of DKI Jakarta Province No. 93 of 2014, Regulation of the Governor of DKI Jakarta Province No. 90 of 2018, and SNI 03-1733-2004. The fire risk assessment checklist consists of 22 questions. The questions are divided into 3 categories: fire hazards (4 questions), vulnerability (7 questions), and fire protection (11 questions). Each question is given a score of between 1-5. All scores are summed and calculated to determine the fire risk classification. There are 5 classifications of fire risk, including very severe risk (>80%), severe risk (61-80%), moderate risk (41-60%), mild risk (21-40%), and very mild risk (<20%). This study has undergone an ethical review process at the Faculty of Public Health, Universitas Indonesia, and has received an ethical clearance number Ket-2256/UN2.F10.D11/PPM.00.02/2021.

**Table 1. Fire Risk Assessment Checklist Details**

| Categories | Element |
|---|---|
| **Fire hazard** | 1. Community activities that can cause fire |
| | 2. Electricity usage |
| | 3. Open fire usage |
| | 4. Use of toxic and hazardous materials |
| **Vulnerability** | 1. Population density |
| | 2. Building density |
| | 3. Building quality & slums rate |
| | 4. Frequency of fires |
| | 5. Affected area and the losses |
| | 6. Fire propagation and building quality |
| | 7. Obstacles faced by the fire station |
| **Fire protection** | 1. Distance between buildings |
| | 2. Implementation of SKKL (Environmental Fire Safety System - Environmental Fire Resistance System) or MKKG (Building Fire Safety Management) |
| | 3. Emergency communication |
| | 4. Early fire extinguishing |
| | 5. Fire station feasibility |
| | 6. Fire station operational access |
| | 7. Fire station response time |
| | 8. Fire stations' service |
| | 9. Operational for Further Extinguishing and Availability of water resources |
| | 10. Ease of access to fire fighting |
| | 11. City hydrants |

## Results

Based on the results of data collection in Pasar Minggu and Jagakarsa Sub-districts, there were 16 RWs participated in this study as subjects. Of the sixteen RWs, most of the RWs (81%) were included in the moderate fire risk category with a risk value range of 42.7 to 60%. There were 3 RWs (19%) that had a severe fire risk with a risk value range of 62 to 66%.

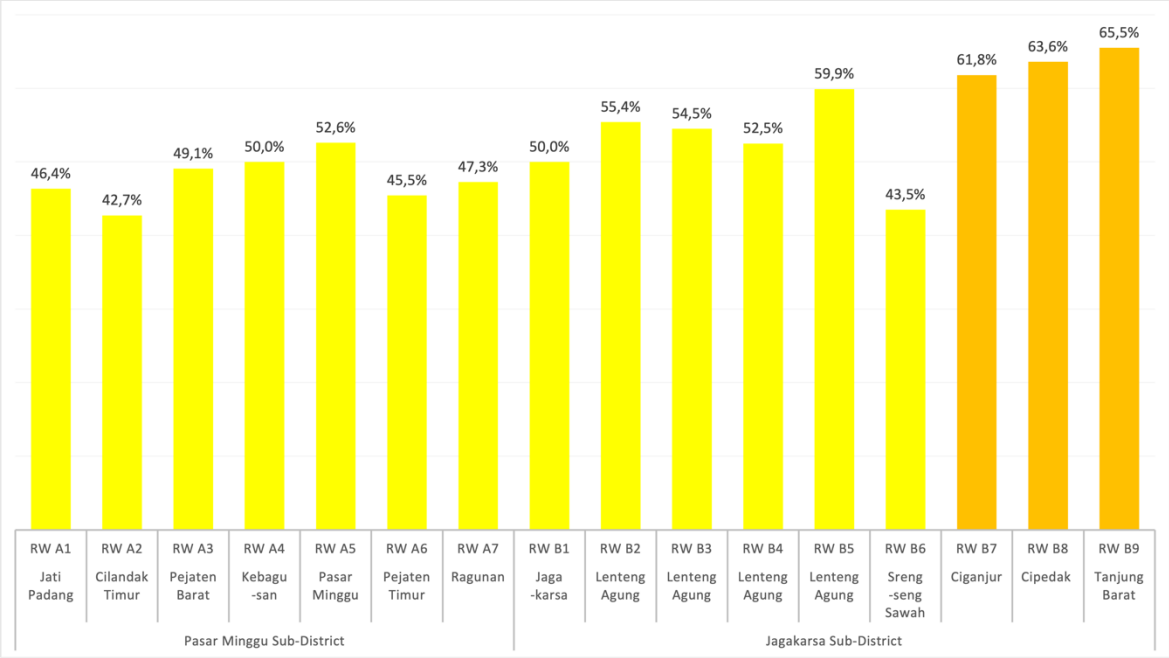


**Figure 1Risk classification in Pasar Minggu and Jagakarsa Sub-Districts by RW**

Figure 2 depicts the fire risk percentage based on the three categories of fire hazard, vulnerability, and fire protection. In the hazard category, the highest percentage (12.7%) was observed in RW A5 and B5. In the RW A5 and B5 areas, many residents' activities carry the risk of triggering fires, such as activities in workshops, home industries, gasoline retails, LPG retails, and unsafe use of electricity.

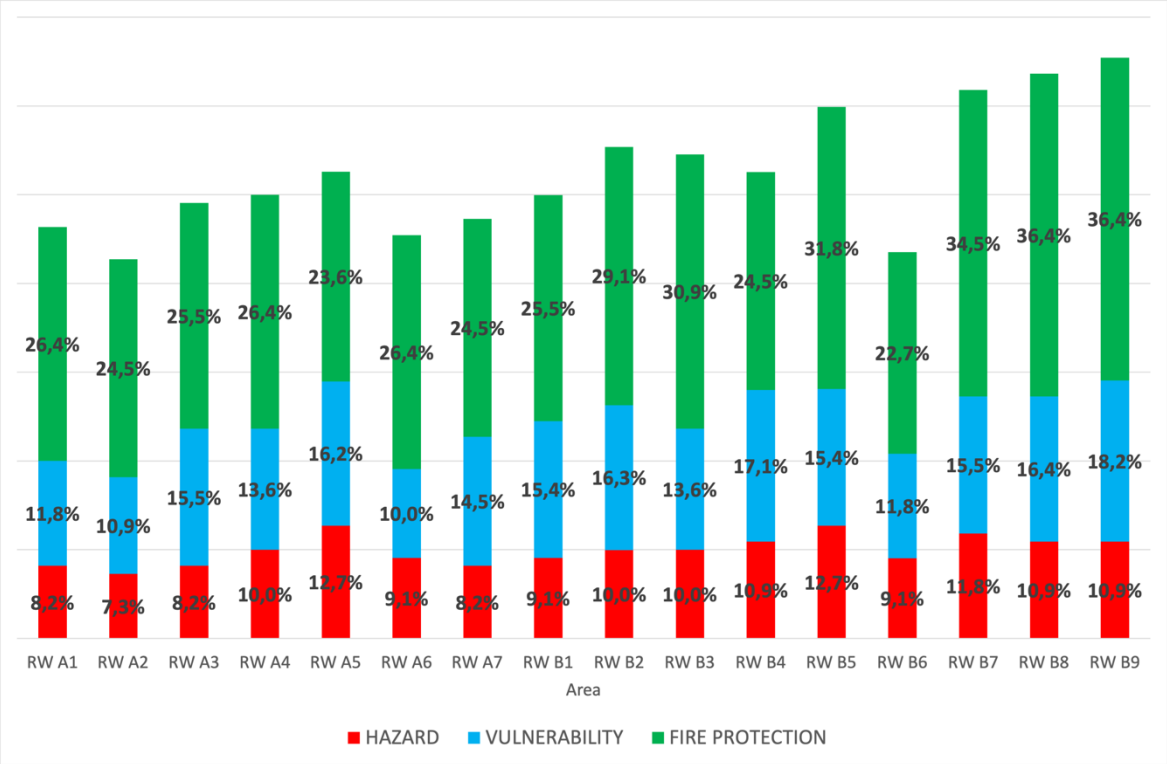


**Figure 2. Percentage of fire risk based on categories of hazard, vulnerability, fire protection**

Based on the vulnerability, RW B9, B4, and B8 had the highest percentage of vulnerability with 18.2%, 17.1%, and 16.4%, respectively. There are several elements that cause an area to be vulnerable to fires, including population density, building density, and materials in the area, a history of fire incidents and their impacts, as well as the existence of a fire station and the problems faced in educating the people in the area. In the three RWs, the population density, building density, and types of building materials used were the biggest contributors to the high vulnerability. There were still areas with semi-permanent buildings made of plywood or wood, and these areas were quite densely populated, making them very vulnerable to fires. Based on the history of fires, the three areas had never experienced a fire incident. Meanwhile, a big fire has occurred in RW A5 in 2020, which consumed one rented house and caused 2 fatalities. The material loss from this fire incident was estimated to be 500 million rupiahs. In several other RWs, fires occurred with electric short circuit incidents and garbage burning activities as the triggers. These fires then spread to adjacent buildings, such as workshops and residents' houses.

Based on the fire protection category, RW B8 and B9 had the highest score with 36.4%. This shows that fire protection in these two areas was not adequate, marked by the absence of a safe distance and separation between buildings, inadequate early fire extinguishing systems, and low community knowledge and abilities on early evacuation when a fire occurs. The performance of the Fire Station in this area was still problematic due to difficult operational access to the Fire Station, incident response times that do not meet standards, and inadequate facilities and infrastructure.

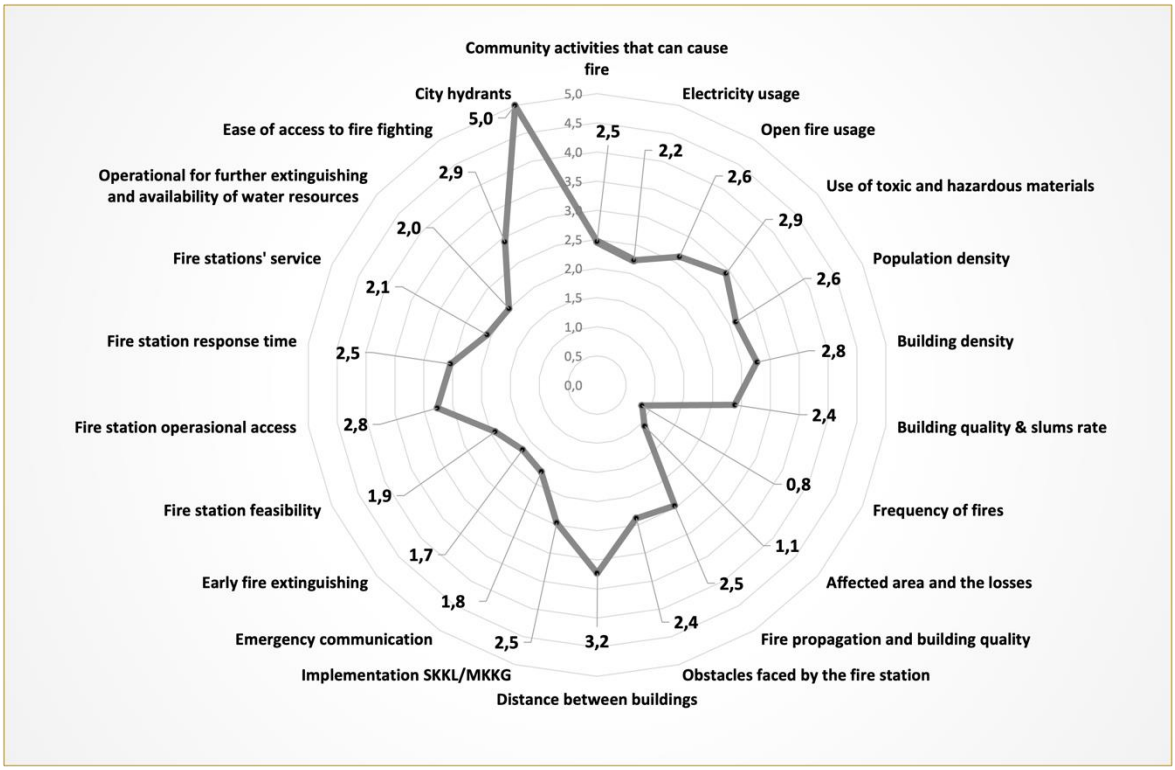


**Figure 3 Average score of each element in the fire risk assessment checklist**

Figure 3 presents a spider chart showing the average score for the 22 questions in the fire risk assessment checklist. Numbers in the spider chart demonstrate a value range of 0-5. A low value in an element indicates that the element is good and needs to be maintained. On the other hand, the score that is closer to 5 demonstrates the need for immediate improvement in the element so that the fire risk level is not getting worse. In the 16 RWs in Pasar Minggu and Jagakarsa Sub-districts, city hydrants were the main problem (5 out of 5), indicating that there were no city hydrants available in these two sub-districts. This is followed by the distance between buildings (3.2 of 5) which was also a problem. Most settlements were located very close to each other, with no double walls or separation between the buildings. This allows the fire to spread very quickly, especially if the building is made of flammable materials. The presence of Pertamina gas station, retail gasoline sellers, LPG retails, and workshops were included in the elements of using hazmat materials (2.9 out of 5) and were considered as activities that can trigger fires. The operational

access of the Firefighter Post also received a fairly high average value of 2.8 out of 5. Access from the Fire Station to several buildings was quite difficult due to narrow roads and closed portals. Most roads were only passable to the 2500 L units.

## Discussion

Pasar Minggu (21.69 $km^2$ ) and Jagakarsa (24.87 $km^2$ ) sub-districts are the two largest sub-districts in South Jakarta, which also have a fairly dense population. The study focuses on the RW unit level, where most of the area is dominated by residential houses in the form of complexes, dense dwellings, or settlements composed of semi-permanent materials. Settlements built from semi-permanent materials are located in areas near rivers. The presence of these semi-permanent settlements increases the possibility of fires that can be caused by a poor electrical system and the use of outdated, non-standard cooking equipment.[11] In addition to residential areas, there are also office buildings, book printing warehouses, homestays industry (tofu factories, crackers, fertilizer manufacture), as well as buildings used for commercial purposes such as grocery stores, food stalls, and workshops. In some RWs, there are also Pertamina gas stations, LPG retails, and gasoline retails. In terms of road access, in RW B2, there are only narrow roads that can only be passed by two-wheeled vehicles, and there are many sharp turns. In some other RWs, there are only roads that can only accommodate a 2500 L unit. Narrow road access will make it difficult for firefighters to reach the location of the fire.

In this study, the level of fire risk is determined using three categories of fire hazard, vulnerability, and fire protection. A fire hazard is an intentional or unintentional event that can cause a fire and threaten lives, buildings, and properties. All factors related to triggering fires, whether originating from inside buildings or the environment, as well as those exacerbating fire incidents, are referred to as fire hazards.[12] Activities in the household that can trigger fires include the use of stoves for cooking, non-standard use of electricity, burning garbage, and smoking. Based on the 2014-2018 NFPA report, cooking equipment is the main trigger of fires in residential areas that also cause injuries. It is stated that 49% of house fires are due to cooking activities, which contributes to 21% of deaths and 44% of injuries.[13] Up to 66% of cooking activities that lead to fires involve heating food or the use of other cooking equipment. Leaving a burning stove in the kitchen is the beginning of a firing trigger. Materials made of plastic, cleaning cloths, or curtains that are stored or placed in the kitchen can provide fuel when a fire starts. In terms of the activity of burning garbage, the results of the study show that burning garbage can cause fires and destroy the building next to it, which is evident from a past fire that involved a workshop. This incident occurred in RW B5 and caused a material loss of up to 200 million rupiahs. Judging from the amount of material loss, this fire was quite big because the workshop was filled with flammable materials, enabling the fire to spread quickly. Garbage-burning activity that is not monitored is a

behavior of human carelessness that can cause fires. According to Saladyga and Standlee[14], a fire in one of the Pennsylvania forests occurred because of careless human behavior when burning garbage. The practice of burning garbage by the community is usually related to income because those who burn their garbage are usually unable to pay waste disposal fees, so they burn their garbage.[15] Cooking activities and burning garbage are examples of human factors that can cause fires. Other human factors are, among others, intentional fire, negligence, and lack of understanding on what can cause fires including throwing cigarette butts carelessly into a trash can full of flammable materials and using stacked sockets that lead to the excessive electrical load and short circuit.[16,17] Apart from household activities, retail gasoline sales activities, LPG retails activities, as well as the presence of a Pertamina gas station also make this area vulnerable to fire. These activities involve the use of combustible materials. One negligent behavior can cause a huge fire. In most RWs, there are gasoline and LPG (liquefied petroleum gas) retails operating and, so far, it is quite safe considering that there is no history of fires caused by these commercial activities.

Efforts to anticipate fire hazards are performed by controlling fire occurrence. The firefighting agency must have a list of records of buildings with a high-risk category for fire, along with an evacuation plan that can be carried out when the firefighters have to do rescue missions in the area. In developing countries, especially in urban areas without good planning, it is necessary to place Firefighter Station in certain locations to ensure the same response time for all target areas.[7,12]

Vulnerability is a condition in the community that can exacerbate or increase the incidence of a risk, in this case, the occurrence of fire. Aspects of vulnerability to fires in this study include population and building density factors; building quality such as building materials and the level of slums that affect the possibility of fire propagation; frequency of fires, the area affected and the losses; and obstacles faced by the Firefighter Station in handling fires in the area. In most low- and middle-income countries, human settlements are built without proper planning and become densely populated areas with poor building and infrastructure qualities, as well as limited health and emergency services. This makes the environment vulnerable to fire and other hazards.[18] Fires can easily spread in the environment due to several things, such as cooking activities with open fires, unsafe use of electricity, use of flammable building materials, the density of buildings including their occupants, limited sources of water or hydrants, and difficult access to the area for Firefighters due to narrow roads.[19,20] In most of the areas under study, there is a fairly large gap between densely populated housing complexes (permanent buildings) and densely populated semi-permanent buildings that are poorly managed. Semi-permanent buildings made of wood and plywood are often found in areas near rivers, markets, and train stations, such as observed in RW A3, B4, and B5. In this area, there is no distance between one building and another, and the population in this area is also very dense. Similar to activities in residential areas in general, in this

area, there are also cooking activities with gas stoves and electricity utilization, where negligence can cause fires to spread fairly quickly to adjacent buildings. In most developing countries, building spacing rules are not implemented properly, which ultimately leads to the easy propagation of fire from one building to another.[12,21]

In addition to the density of buildings and residents, another obstacle faced by firefighters is the narrow road access (can only be passed by two-wheeled vehicles or a 2500 L unit), and it is not uncommon to find sharp turns, making it difficult for firefighters to operate vehicles to reach the scene of the incident. Not infrequently, illegal parking is also seen, blocking the access and making the operational access of fire trucks hampered. Public awareness is needed when a fire occurs by knowing the procedures for using fire extinguishers, the evacuation route, how to immediately report the incident to the firefighters, and providing the widest possible access for operational fire vehicles.[12,22] Communities are responsible for mitigation efforts in their respective environments.[12]

In relation to fire protection efforts, all RWs in Pasar Minggu Sub-district have fire extinguishers, where the number varies from 3-7 fire extinguishers in each RW. Meanwhile, in Jagakarsa Sub-district, there are still several RWs that do not have fire extinguishers. Community members such as RT/RW administrators and youth groups have been trained on the procedures for using fire extinguishers by local firefighters. In one case of fire in RW B1, the fire could be extinguished independently by the community using a fire extinguisher. Based on the results of this study, it is identified that all RWs do not have special fire volunteers and only rely on their respective RT/RW administrators to manage and maintain facilities related to fire extinguishers and firefighting. In addition to using fire extinguishers in the community, in extinguishing fires, the fire department uses water from rivers such as the Pulo River, Krukut River, Baru River, West Baru River, Ciliwung River, and Sarua River, as well as water from reservoirs and lakes. Water is supplied to the fire engine unit with the help of a portable pump. In Pasar Minggu and Jagakarsa sub-districts, there is not a single city hydrant available, so they only rely on rivers, reservoirs, and lakes. A city hydrant with a large capacity will be very useful in minimizing the impact of fires. With the rapid development of urban areas, fire risk management efforts must be considered in the urban planning system. It is necessary to plan and identify the proportions of urban areas to determine the location of city hydrants and access points to these hydrants.[23]

Prior to the COVID-19 pandemic, efforts to disseminate information about fires to the public were often carried out by firefighters. The dissemination was carried out by visiting the RW area and then conveying information about the process of fire, procedures for using fire extinguishers, and communication and coordination in the event of a fire. It is confirmed that the RT/RW management knows the emergency number and is part of the WhatsApp group to facilitate coordination and reporting. Good communication and coordination within the community and firefighters could improve emergency evacuation efforts.[24] During the COVID-19 pandemic, the

internet and cellphones can be used as media for delivering materials about fires, and communication with the public can be done through chat and broadcast messages. Interventions based on the internet and mobile phones are expected to be effective efforts in delivering messages to the public.[25]

In addition to good communication between the community and firefighters, it is necessary to have an organization in the community for fire prevention. In the Minister of Public Works Regulation Number 20/PRT/M/2009 it is stated that it is necessary to establish an Environmental Fire Safety System (or SKKL in Indonesian), which is a mechanism to utilize all components of the community in preventing and dealing with fires in a community/environment level.[26] This SKKL is included in the Urban Fire Protection Management section. The purpose of the establishment of this management section is to implement fire protection management in urban areas so that the environment is orderly, safe, and secure. The SKKL needs to be established at the community level with an organizational structure consisting of RT/RW administrators in their respective areas. The SKKL consists of the Fire Volunteer Front (BALAKAR), infrastructures, and standard procedures.[27] This organization was fostered by the Platoon Commander of the area firefighter station. In most RWs studied, the SKKL program has been established since 2018. With the establishment of the SKKL, the community is included in the fire protection management program.

This study still carries some limitations. First, data collection is only done online without any field observations in study locations. Observations cannot be carried out due to the COVID-19 pandemic situation. Second, the limitations of RW administrators in filling out questionnaires. This might be due to the limited knowledge and ability of the community to be able to completely fill out the questionnaire.

## Conclusion

The study was conducted in 16 RWs in Pasar Minggu and Jagakarsa sub-districts, South Jakarta. There are 3 RWs with a severe fire risk level, and the remaining RWs are included in the moderate risk level. The factors that increase the risk of fire in the study location are the use of combustible building materials (wood and plywood), the high density of population and buildings, the lack of safe distance between buildings that allow fires to spread quickly, the difficulty of accessing some settlements due to narrow and winding roads, and the absence of city hydrants. Therefore, there are some recommendations, such as firefighters having a list of areas or buildings prone to fire or high risk and developing a rescue evacuation plan. Also, there needs to be a routine inspection at least once a year in each target area. Inspections are carried out on community-owned fire extinguisher facilities and routine maintenance of city hydrants (if available). An inspection of electricity and gas use in residents' homes should also be performed. There is a need for further studies on fire risk in the South Jakarta area with more complete data. It is also necessary to

conduct research on the analysis of the location of city hydrants so that their placement is in line with the required coverage area.

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### Conflict of Interest

This study has no conflict of interest.

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