



OPEN ACCESS

EDITED BY

Xianhai Meng,
Queen's University Belfast, United Kingdom

REVIEWED BY

Dimitris Ipsakis,
Technical University of Crete, Greece
Peter Nwaichi,
Universiti Malaysia Pahang Al-Sultan Abdullah
Institut Pengajian Siswazah, Malaysia

*CORRESPONDENCE

Dumebi R. Udeze,
✉ dumebi.udezepgs@stu.cu.edu.ng

RECEIVED 07 August 2025

ACCEPTED 22 September 2025

PUBLISHED 13 October 2025

CITATION

Olagunju OO and Udeze DR (2025) Users' awareness of fire safety in selected Pentecostal churches in Abuja, Nigeria. *Front. Built Environ.* 11:1681580. doi: 10.3389/fbuil.2025.1681580

COPYRIGHT

© 2025 Olagunju and Udeze. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Users' awareness of fire safety in selected Pentecostal churches in Abuja, Nigeria

Omoniye O. Olagunju and Dumebi R. Udeze*

Department of Architecture, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria

Pentecostal megachurches represent some of the most densely occupied worship environments, where spatial configurations and collective behaviours can heighten fire-risk exposure and complicate evacuation dynamics. However, scholarly attention to congregant engagement with fire-safety provisions in these contexts remains limited. This study investigates fire-safety awareness, perceptions of system functionality, and confidence in emergency response among worshippers in four major Pentecostal churches in Abuja, Nigeria. The study employed a quantitative approach using structured questionnaires, which collected survey data from 325 participants. Descriptive and inferential statistical analyses of the data were used, which included frequency counts and percentages. The study reveals a general familiarity with exit routes and basic hazards but limited knowledge of formal evacuation protocols and reduced self-efficacy in operating fire-safety equipment. While active protection systems were viewed as functional and reliable, critical passive features such as fire doors, compartmentation, and smoke-control infrastructure were largely absent, resulting in an overreliance on mechanical systems. These findings underscore the need for structured fire-safety education, mandatory evacuation drills, and routine maintenance regimes, alongside the systematic incorporation of certified passive strategies into both new and retrofitted church facilities. The study advances fire-safety research by foregrounding the unique challenges of megachurch settings and calls for comparative, cross-denominational inquiry to evaluate how integrated active-passive approaches can enhance evacuation efficacy and occupant resilience.

KEYWORDS

fire safety, active fire measures, Pentecostal church, passive fire measures, users' awareness, Abuja, Nigeria

1 Introduction

Natural fire has been utilised for cooking and landscape burning since prehistoric times. According to [Keeley and Pausas \(2022\)](#), fire is an ecological process that depends on the flammability of plant communities and the existence of ongoing biomass to spread throughout a region. This demonstrates, as noted by [Onyekwere et al. \(2024\)](#), its importance in man's day-to-day activities. Despite its potential benefits, it also carries a substantial risk.

The safety of life is essential for the use of public facilities, including Pentecostal churches. More than 74 million Nigerians identify as Christians, accounting for more than half of the nation's total population, according to [McKinnon \(2021\)](#). This places a great deal of responsibility on architects, as emphasised by [Sholanke et al. \(2025\)](#),

to create church architecture that is safe and functional for its original purpose. Nonetheless, over the last 10 years, there has been a notable increase in fire outbreaks.

A fire outbreak is defined by Babatunde et al. (2020) as an uncontrolled and frequently unexpected fire event. For example, the fire at the Christ Embassy Headquarters in Oregun, Lagos, in June 2024, began in the main auditorium of the church, according to PM News. Following an attempt at self-management, the church promptly summoned the Lagos State Fire and Rescue Service to contain the escalating fire. Many measures of the church's assets and equipment were severely damaged in this fire. A fire broke out at the Household of David Church in Ikeja, Lagos, in January 2024. People walking along the road observed the fire, which had begun at around 11 a.m. near the back of the church, but the church workers were unaware of it. The church suffered a significant loss of worship equipment due to the fire.

Furthermore, Negedu (2024) noted that over 266 occurrences of fire outbreaks were reported in the first half of 2024. According to Addai et al. (2016), fire outbreaks identified between 2013 and 2018 demonstrated a marked increase in the frequency of fire catastrophes and fatalities, making building fires in Nigeria, particularly in public buildings, a significant issue. To ensure the safety of both people and property, children must understand the basics of evacuation, which reduces the likelihood of confusion (Dare et al., 2022).

Therefore, the paper aimed to investigate users' awareness of the fire safety measures implemented in selected Pentecostal church buildings in Abuja, Nigeria. To develop effective fire safety management, this aids in identifying areas that require improvement. Additionally, this study supports two (2) of the Sustainable Development Goals (SDGs): the ninth target, "industry, innovation, and infrastructure", encourages resilient infrastructure, inclusivity of sustainable industrialization, and innovative prowess in the built environment, and the eleventh target, "sustainable cities and communities", addresses the habitability of human settlements that are safe, resilient, inclusive, and sustainable.

A case study methodology was used in this research. This suggests that a limited number of Pentecostal churches in Abuja are the focus of the study. The Pentecostal churches include Family Worship Centre, House on the Rock, Commonwealth of Zion Assembly, and Summit Bible Church. Because they make up a larger portion of the users, the study's sample population is further limited to the opinions of the congregation members and church employees of the chosen Pentecostal churches. It is important because it sheds light on users' understanding of fire safety.

2 Literature review

2.1 Fire safety in church design

Large gatherings are frequently held in churches, which are places of worship. According to Vovk et al. (2021), if proper safety precautions are not included in the building design, this raises the possibility of harm or death in the case of a fire. Given the rising number of fire incidents in both old and contemporary churches, as noted by Cucco et al. (2023), fire safety concepts need to be appropriately included in the architecture of any church building.

Fire safety has been extensively examined in a variety of public-use buildings, including commercial (Adekunle et al., 2020;

Obasa et al., 2020; Nouban and Yunusa, 2020; Sholanke et al., 2018), educational (Kamel et al., 2022; Dowlati et al., 2020; Morozov, 2019), and residential (Sholanke et al., 2018) settings, yet religious structures, particularly Pentecostal churches in Nigeria, remain under-investigated. Several studies have highlighted the alarming gaps in fire preparedness within religious institutions. A nationwide assessment by Adeleye (2020) revealed that more than 60% of churches in Nigeria lack basic fire detection systems, including alarms and smoke detectors (Adeleye, 2020). Similarly, research in Port Harcourt by Yemi-Jonathan et al. (2023) found that while some churches possessed fire extinguishers, fewer than 30% had designated evacuation routes, and even fewer had signage or trained fire wardens on-site.

Aderonmu and Eghobamien (2021) highlighted that building material consideration is a fundamental component of fire safety in church design. Materials that are non-flammable and fireproof ought to be given priority, especially in places that get a lot of traffic, including sanctuaries, hallways, and entrances. Many older churches were built with wood, which is prone to spreading fire quickly (Law and Bisby, 2020). Fire-retardant building materials, which can withstand the spread of fire and provide residents enough time to evacuate safely, should be used in modern church designs (Falola and Agbola, 2022).

A church's spatial design must also allow for rapid evacuation. Wide corridors, multiple clearly designated exits, spacious open areas, and well-defined escape routes are all necessary to guarantee that users evacuate the building promptly in the event of an emergency, as explained by Kuldeep and Virendra (2023). To avoid bottlenecks, exits must be clear, reachable from every area of the building, and have doors that open in the direction of departure. Emergency lighting and signage are essential for larger churches, particularly in case of a power outage. Even in low-visibility situations brought on by smoke, people can find their way out thanks to illuminated exit signs and walkway lighting (Rahardjo and Prihanton, 2020).

The management of occupancy load is another important factor (Oloke et al., 2021). Every church needs to be built to safely hold as many people as possible while having fire prevention strategies that can manage the associated risk. Because overcrowding increases the risk of panic and stampedes during emergencies, it can seriously impede evacuation operations.

Controlling the circulation of smoke, which is often more hazardous than the flames themselves in indoor fires, is another key function of ventilation design, as explained by Rahardjo and Prihanton (2020). Appropriate smoke ventilation systems prolong smoke fall and preserve tenable conditions in escape routes, saving crucial time for evacuation and firefighting operations. It comes before fire detection and alarm systems, which are essential for church architecture.

To guarantee that fires are discovered quickly, early warning devices such as heat sensors, smoke detectors, and manual alarm activation points must be positioned thoughtfully throughout the structure, as elucidated by Khan et al. (2022). To be heard above background noise, such as music, sermons, or the loud congregational singing that characterises Pentecostal worship sessions, an audible alarm should be sufficiently loud. Flashing lights and other complementary visual warnings can help warn those who are hard of hearing. Since church kitchens and fellowship rooms are standard fireplaces, their layout should also adhere to fire safety regulations, which include installing fire blankets, providing adequate ventilation,

and having easily accessible extinguishers. Church workers should have proper training on how to use firefighting equipment, and its location should be straightforward and easy to find (Kuldeep and Virendra, 2023).

Emergency preparedness planning must be considered in church fire safety design, in addition to the actual building components. To make sure that both church workers and members are aware of the protocols, an appropriate space should be set aside for assembly points outside the structure. Evacuation plans, as outlined by Adeleye (2020), should also be prominently displayed and frequently practiced during fire drills. This is especially crucial in Pentecostal churches, where emotionally intense worship sessions may cause members to become confused or hesitant in emergencies if clear procedures and leadership are not in place.

Pentecostal churches often utilise advanced lighting, sound, and projection equipment; therefore, electrical safety is of the utmost importance. Da Rocha et al. (2024) discussed that the risk of a fire is significantly increased by using inferior electrical appliances, overloaded circuits, and defective wiring. Electrical installations must closely follow safety regulations at the design stage, and plans for routine maintenance and inspection must be included. The proper handling and storage of flammable products, sundries, incense, cleaning supplies, and any transient decorations that might be used during special services or events should also be considered by churches.

To guarantee routine inspections and acquire the required certificates, churches must also collaborate with the local fire department (David et al., 2019). The congregation's cultural and behavioural traits, such as their awareness of fire safety procedures and alert response, should also be taken into account in the design. To strengthen a fire safety culture, the church may occasionally need to integrate more educational signage or conduct safety awareness campaigns into its regular events. To create a worship space that is both physically safe and spiritually enlightening, church design must take into account a variety of factors, including building materials, spatial planning, detection and suppression systems, electrical safety, occupant management, accessibility, and regulatory compliance (Himoto, 2020).

While prior research emphasises the installation of active and passive fire-safety features, there is growing recognition that fire resilience must be addressed through performance-based design frameworks. International codes such as NFPA 101 (Life Safety Code) and ISO fire-safety standards, as well as the Nigerian National Building Code (NBC), advocate not only minimum compliance but adaptive, performance-driven strategies that integrate evacuation modelling, fire dynamics simulation, and sustainability principles into architectural design. Embedding these approaches within Nigerian church architecture could enhance resilience while reducing the environmental costs associated with the lifecycle.

2.2 The role of user awareness in fire safety for church buildings

Given the unique nature of church occupancy, which typically includes peak usage during weekends or special religious events, fire safety designs must anticipate varying risk levels depending on the time and scale of activities. For example, musical concerts,

all-night prayer vigils, and packed revival services require even more robust fire safety considerations compared to smaller weekday gatherings. As a result, the following describes typical fire safety practices associated with user awareness.

2.2.1 Observance and maintenance of clear exit routes

Aware users usually take care to keep chairs, musical instruments, and decorations away from emergency exits, especially during big gatherings where space management can be complex (Amon et al., 2020). In an emergency, blocked exits can result in trapped individuals and fatal stampedes; thus, this basic procedure is crucial. As they enter the building, fire-aware churchgoers usually follow the marked evacuation notices and become familiar with the exits. This is especially vital in churches with intricate layouts or numerous floors.

Access routes must accommodate fire trucks and emergency responders, and the placement of landscaping features, fences, or other barriers should not impede emergency services, as noted by Kuldeep and Virendra (2023). Churches should avoid excessive vegetation or flammable decorations near entry points to reduce the risk of external fire hazards (Rahardjo and Prihanton, 2020).

2.2.2 Proper management of electrical equipment

Pentecostal churches typically rely heavily on sound systems, large displays, stage lighting, and air conditioning units, which, if mismanaged, can become significant fire hazards. Users with fire safety awareness are more likely to ensure that these devices are switched off when not in use, avoid daisy-chaining multiple appliances into a single power outlet, and refrain from using substandard extension cords that could overheat (Amon et al., 2020). In churches where users lack such awareness, it is common to see the unsafe overloading of electrical circuits, which dramatically increases the risk of electrical fires. In contrast, safety-conscious users not only practice safe electrical usage but also report faulty wiring or unusual electrical smells promptly to facility managers to prevent potential ignition sources from escalating (Da Rocha et al., 2024).

2.2.3 Careful handling of open flames

Candles, incense, and other flame-based rituals are still occasionally utilised during special ceremonies, even though their use has decreased in many contemporary churches. Users who are aware of the fire hazards posed by open flames will make sure that candles are kept out of reach of drapes and paper products, in sturdy, non-flammable holders, and completely extinguished before departing the area (Amon et al., 2020). Similar to this, people who are concerned about fire safety make sure that gas cylinders are kept safely, avoid leaving cooking equipment in church kitchens unattended, and regularly check these spaces for fire threats, particularly following significant church gatherings that involve food preparation (Muico et al., 2024).

2.2.4 Vigilance in Identifying and reporting potential fire hazards

The improper use of temporary decorations made of easily flammable materials or the improper storage of flammable liquids in

inappropriate locations are both possible fire dangers, as explained by [Rahardjo and Prihanton \(2020\)](#). Extensive stage setups and high-energy events are common in Pentecostal churches, which can create additional fire hazards. Users who possess a strong understanding of fire safety are more likely to challenge and rectify risky behaviours in these situations ([Amon et al., 2020](#)).

2.2.5 Correct and responsible use of fire extinguishers and other fire suppression tools

Churches that regularly conduct fire safety training often have users who are not only aware of where firefighting equipment is located but are also confident in using it when necessary. Conversely, in churches where fire safety is not prioritised, such equipment is frequently misused or neglected. Some users, ignorant of the dangers, even block access to fire extinguishers with furniture or decorations. Users who are concerned about fire safety also encourage regular extinguisher inspections to make sure they are current, charged, and easily accessible ([Amon et al., 2020](#)).

They should also be integrated into church designs. [Kodur et al. \(2019\)](#) stated that they may include sprinkler systems, fire extinguishers, and, in some cases, gaseous fire suppression systems for sensitive areas like electrical rooms or multimedia centres. Although sprinkler systems are sometimes resisted in heritage or decorative churches due to aesthetic concerns, modern concealed sprinkler heads can minimise visual disruption while still providing adequate fire protection.

2.2.6 Fire drills and emergency evacuation procedures

Churches that prioritise fire safety encourage their members to participate in planned fire drills actively. They do not disregard alarms as untrue without confirmation, and they recognize the need for evacuation drills, as explained by [Muico et al. \(2024\)](#). Conversely, congregations in churches with low fire safety awareness frequently report that members are reluctant to participate in drills, with many ignoring fire safety readiness as superfluous or unlikely to be significant in a religious context.

Promoting the idea that emergencies can occur anywhere, especially in places of worship, is a crucial part of user awareness. By being conscious of this, building users form habits like remembering assembly locations, checking the closest exit when entering the church, and being ready to help those who are vulnerable, such as children, the elderly, or those with disabilities, in the event of an evacuation ([Amon et al., 2020](#)).

2.2.7 Proper crowd management and adherence to occupancy limits

Particularly during large events, church workers and fire-conscious users actively endeavour to avoid hazardous crowds. Keeping the number of people in the facility below the legally advised capacity and controlling seating arrangements are two ways to accomplish this. Following safe capacity limitations in Pentecostal churches, whose services can draw extraordinarily huge crowds, can mean the difference between life and death in the case of a fire.

Users who are concerned about their safety are also more likely to obey marked no-smoking areas, particularly those near storage facilities, electrical rooms, and entrances, which are high-risk zones ([Amon et al., 2020](#)). Users who are knowledgeable about

fire safety encourage appropriate behaviour among their fellow attendees, encouraging safety as a shared duty rather than leaving it primarily to church authorities or fire marshals.

2.2.8 Immediate and accurate communication during emergencies

[Muico et al. \(2024\)](#) highlighted that users benefit from knowing how to immediately activate alarms, notify emergency services, and offer clear information to responders about the location and scope of the fire. Congregants in these settings realise the dangers of spreading misinformation or inciting panic, so they adhere to established rules that facilitate orderly departure.

Users who are knowledgeable about fire safety pay attention to fire notices, evacuation maps, and directions offered by church safety personnel, incorporating this knowledge into their behaviour during regular services and activities ([Amon et al., 2020](#)). Public address (PA) systems must remain functional during power outages, and it is advisable to install backup power sources to support emergency lighting, alarms, and communication devices ([Cleef et al., 2024](#)). In multi-level structures, calculated using the [Yamane \(1967\)](#) formula for sample size determination, measures are to be incorporated to prevent the rapid spread of fire and smoke between floors.

2.2.9 Inclusivity in fire safety practices

Well-informed church users understand the necessity of assisting persons with disabilities and ensuring that emergency procedures account for all members of the congregation ([Ediae et al., 2023](#)). They understand the importance of maintaining open routes for wheelchair users and assisting those with mobility impairments during evacuations, as explained by [Sholanke et al. \(2016\)](#). Churches that encourage user awareness frequently appoint specific people to help vulnerable populations. Only when users are actively involved and conscious of their duties does this technique become effective.

Furthermore, fire safety-conscious parents and guardians regularly ensure that children understand the basics of evacuation, which reduces the likelihood of confusion in real-world situations. Moreover, modern church designs must include provisions for people with disabilities in their fire evacuation plans. Wheelchair-accessible routes, evacuation chairs, and specially designated refuge areas can ensure that all individuals, regardless of mobility, can escape or be assisted during a fire emergency.

2.2.10 Proactive engagement with fire safety authorities

Because they know how important fire safety is, fire-conscious users frequently urge their church leadership to engage local fire service professionals for safety briefings, fire drills, and inspections ([Amon et al., 2020](#)). They support programs that increase the general safety of the church environment and push for the routine update of fire safety equipment. To summarise, the basis for these standard fire safety procedures is user awareness.

Even the best-equipped church structure can turn into a high-risk environment if there is a lack of user awareness. Emergency protocols may be disregarded, escape routes may be blocked, and fire safety equipment may be misused or compromised. Compliance with national and international fire safety codes is non-negotiable. In Nigeria, this includes adherence to the Fire Safety Code and the National Building Code, which set minimum safety standards for

public buildings (Dirisu et al., 2019; Alao et al., 2021). By raising user awareness, churches can incorporate safety into their everyday operations and ensure that their members are actively involved in maintaining a fire-safe building, rather than merely being passive occupants. Kobes et al. (2009) explained that this preventive strategy strengthens the church community's resistance to fire crises.

3 Methodology

3.1 Research design

The paper aimed to investigate users' awareness of the fire safety measures implemented in selected Pentecostal church buildings in Abuja, Nigeria. To achieve the aim of the study, a survey research approach that relied on quantitative research methods was utilised. This necessitated collecting data from the respondents due to the significant number of respondents participating. A closed-end structured questionnaire was employed to gather data from the various churches. The survey questionnaire was designed in four sections to collect data on the awareness of the users. Data was collected on gender, age, educational qualification, role in the church, and length of church attendance. The second section of the questionnaire asked respondents to rate their level of awareness of fire safety using eight variables on a 5-point Likert scale, where 1 indicated being highly unaware, 2 indicated unawareness, 3 indicated neutrality, 4 indicated awareness, and 5 indicated being highly aware. The third section of the questionnaire requested respondents to rate their awareness of the availability and functionality of basic fire safety elements with 8 variables using 5-point Likert scales, 1 being not present, 2 present but not functional, 3 neutral, 4 functional but limited, 5 fully functional. The fourth section of the questionnaire asked respondents to rate their level of awareness regarding basic fire safety protocols using 7 variables on a 5-point Likert scale, where 1 indicated being highly unaware, 2 indicated being unaware, 3 indicated being neutral, 4 indicated being aware, and 5 indicated being highly aware. The data collected for this study were analysed using both descriptive and inferential statistics. The treatment presented descriptive data using tables, frequency counts, percentages, mean, and charts. This approach aligns with established methods of questionnaire-based data analysis (Zlokovich et al., 2023).

3.2 Data collection

For this study, Multi-stage sampling was used as it combined two sampling techniques to gather data from the selected Pentecostal churches. Purposive sampling was utilised; churches were selected based on two primary criteria: seating capacity and the construction date of the buildings. Specifically, churches with a seating capacity of at least 3,000 were chosen, and the buildings selected were those that were erected within the last 15 years. These criteria were used to ensure that the churches included in the study represented a modern and diverse sample in terms of size and recent construction practices. This method enabled practical and efficient access to the sample, despite logistical constraints. Additionally, simple random sampling was employed to select participants for

TABLE 1 Sampling frame across four selected Pentecostal churches in FCT, Nigeria.

S/N	Name of church	Capacity
1.	Family Worship Centre	5000
2.	House on the Rock (The Refuge)	5000
3.	COZA Auditorium (The Commonwealth of Zion Assembly)	4000
4.	Summit Bible Church	3000
	Total	17000

assessing their satisfaction with the fire safety provisions in place at these churches. This approach ensured that every individual within the study population had an equal chance of being included, thereby minimising selection bias and increasing the representativeness of the sample. Through these combined techniques, the study aimed to obtain a balanced and reliable understanding of the experiences and perceptions regarding fire safety systems in the selected churches.

The sample size for the determination of users to be examined using questionnaires was calculated using the Yamane (1967) formula for sample size determination, as listed in Table 1. The equation is represented as.

$$n = \frac{N}{1 + N(e^2)}$$

Where

n = required sample size.

N = Population size.

e = maximum acceptable error of margin 5%.

The sample size for this study is 391. The data gathering took place over 7 weeks, during the two services held on Sundays, and evening services on Wednesdays. Questionnaire administration began on 13 December 2024, and concluded on 5 February 2025.

A total of 391 questionnaires were distributed among the selected churches, and a total of 325 filled responses were retrieved, with 94 questionnaires distributed to Family Worship Centre, 89 questionnaires distributed to House on the Rock Assembly, 82 questionnaires distributed to COZA, and 60 questionnaires distributed to Summit Bible Church. The data collection tool was validated through expert review, and the data reliability was verified through reliability checks. Ethical approval was obtained before the survey from the Covenant Health Research Ethics Committee, Covenant University, on the use of human subjects for research. Participants engaged voluntarily with informed consent.

3.3 Data analysis

3.3.1 Socio-demographic analysis

Figure 1 presents the socio-demographic analysis of the respondents, derived from the distribution of 325 respondents, offering a comprehensive overview of their attributes. In terms of gender, the distribution revealed a slightly higher proportion of

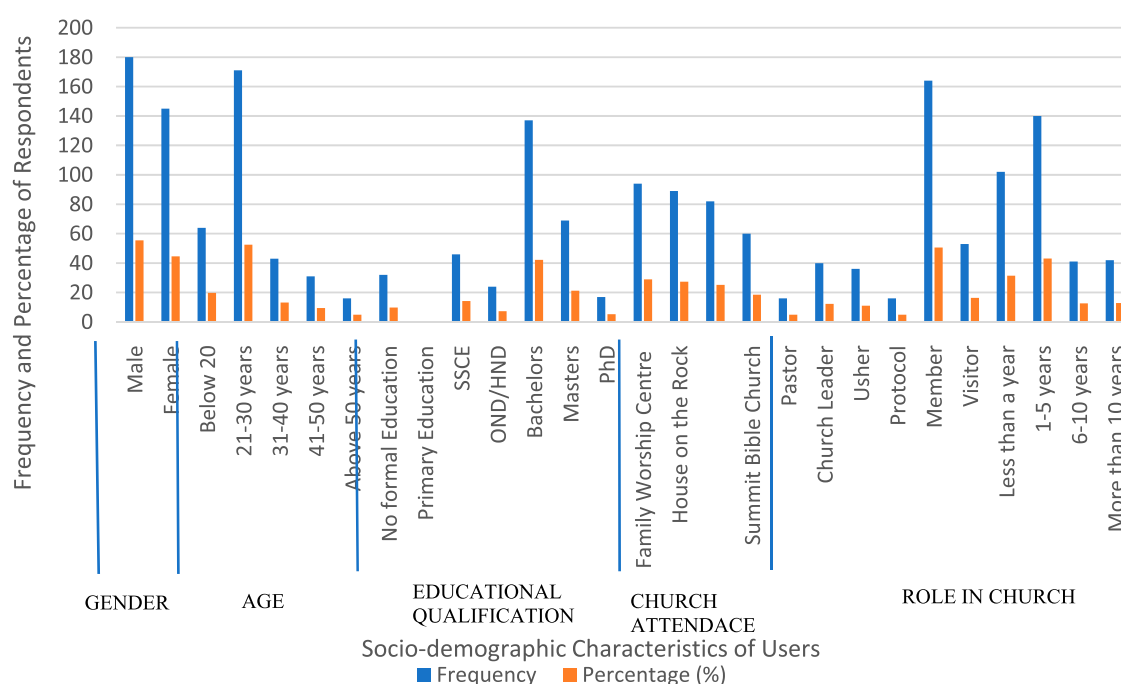


FIGURE 1
Stacked column chart on socio-demographic characteristics of the respondents.

male respondents, constituting 55.4%, while female respondents accounted for 44.6%. This moderate predominance of male participants underscores their significant representation within the survey population.

The analysis of age distribution indicated that the largest segment of respondents, comprising 52.6%, fell within the 21–30 years age bracket. Respondents aged 20 years and below followed, representing 19.7% of the total. Individuals within the 31–40 years category made up 13.2%, while 9.5% of respondents were between 41 and 50 years. Those above 50 years formed the smallest age group, accounting for 4.9%. This distribution reflects a youthful demographic, with a considerable concentration of respondents in their early adult years.

Regarding educational qualifications, the data revealed a high level of academic attainment among the respondents. The majority, 42.2%, possessed a Bachelor's degree, indicating a strong representation of individuals with undergraduate education. Master's degree holders accounted for 21.2%, while 14.2% of respondents had obtained the Senior School Certificate Examination (SSCE). Those with OND/HND qualifications represented 7.2% and 9.8% of respondents reported having no formal education. The smallest academic category was that of PhD holders, who made up 5.2% of the sample. Notably, there were no respondents who indicated Primary Education as their highest level attained.

In terms of church affiliation, the Family Worship Centre recorded the highest number of participants, with 28.9% of the total responses. This was followed closely by House on the Rock, with 27.4%, and the Commonwealth of Zion Assembly, with 25.2%. Summit Bible Church comprised 18.5% of the respondents. These

figures demonstrate a relatively balanced representation across the selected churches.

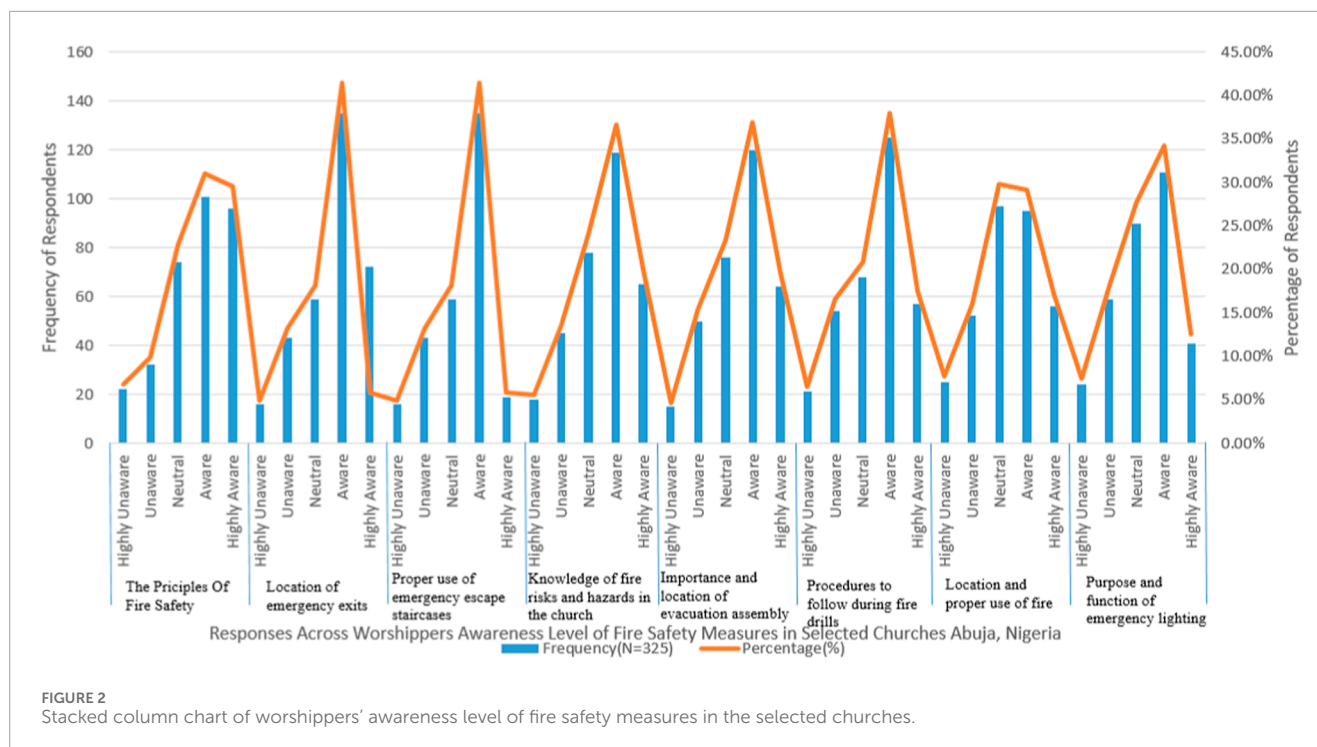
The data on roles within the church showed that a majority of respondents identified as Members, comprising 50.5% of the sample. Visitors represented 16.3%, indicating a notable presence of non-regular attendees. Church Leaders accounted for 12.3%, and Ushers for 11.1%. Both Pastors and those in the Protocol unit each constituted 4.9% of the respondents. This distribution highlights the predominance of general membership among the church populations surveyed.

When asked about their length of church attendance, the majority of respondents, 43.1%, indicated a duration of 1–5 years. Those who had attended their churches for less than 1 year comprised 31.4%, reflecting a substantial group of newer attendees. Respondents who had been members for 6–10 years represented 12.6%, while 12.9% reported an attendance span of more than 10 years. This range suggests both emerging and long-standing commitments within the respective congregations.

Overall, this diverse demographic landscape underscores the rich variety of experiences and backgrounds that respondents bring to their environments.

4 Results

The data analysis is anchored on the specific research objectives established in the study. These objectives entail a critical evaluation, adopted within selected Pentecostal churches, and an assessment of their effectiveness in promoting occupant safety and risk reduction. The presentation of findings is systematically structured



to correspond with the outlined objectives, ensuring coherence and analytical depth.

4.1 Worshippers' awareness level of fire safety measures in selected churches, Abuja, Nigeria

Based on the demographic characteristics of the respondents, Figure 2 on fire safety awareness reveals a generally moderate to high level of understanding shaped mainly by their educational background and youthful profile. With a significant proportion holding Bachelor's (42.2%) and Master's degrees (21.2%), the respondents demonstrated strong foundational knowledge of key safety principles. This is evident in the high levels of awareness recorded for the principles of fire safety and the location of emergency exits, with over 60% of respondents reporting awareness or a high level of understanding. The concentration of respondents within the 21–30 age bracket (52.6%), a group more likely to be alert and responsive to safety messaging, further supports this trend.

However, while general awareness was commendable, the data also highlighted specific areas where practical fire safety knowledge was lacking. Awareness of how to properly use emergency escape staircases, for instance, was relatively low, with only 5.8% indicating they were highly aware. This may be linked to the large number of newer attendees (31.4%) who might not have received adequate orientation or exposure to such procedures. Similarly, the understanding of procedures during fire drills and knowledge of evacuation assembly points, though moderately high, showed room for improvement, particularly given the number of respondents who remained neutral, suggesting limited hands-on experience or communication gaps.

Further patterns emerged concerning specific safety infrastructure, such as fire extinguishers and emergency lighting. While about 46.4% expressed awareness or high awareness of fire extinguishers, a significant portion remained neutral, possibly reflecting a lack of training or practical demonstrations, especially among those who had attended the church for less than 5 years. Emergency lighting stood out as the least understood feature, with only 12.6% of respondents being highly aware, indicating that it may be inadequately emphasised or poorly maintained within church buildings.

Overall, the results from Figure 2 show that users were mainly aware of the principles of fire safety, the location of fire exits, and the proper use of emergency escape routes, taking the top three positions. While the users were least aware of the procedures to follow during fire drills, as well as the location and proper use of fire extinguishers and the purpose and function of emergency lighting, they took the bottom three positions.

4.2 Worshippers' level of awareness on the availability and functionality of the basic fire safety elements

Table 2 shows that the users were mainly aware of the availability of emergency exits, the availability and functionality of emergency escape stairs, and the availability of properly designated evacuation points, taking the top three positions. While the users were least aware of the presence of visible and clear fire safety signs, the functionality of fire alarms and the availability and performance of smoke detectors took the bottom three positions.

Further analysis of the table depicts that the accessibility of emergency exits scored relatively well, with 60% of respondents

TABLE 2 Frequency and percentage distribution of worshippers' awareness rating on the availability and functionality of basic fire safety elements.

Variables	Likert scale response	Frequency (N = 325)	Percentage (%)
Accessibility of emergency exits	Not Present	38	11.7%
	Present but not Functional	6	1.8%
	Neutral	86	26.5%
	Functional but Limited	99	30.5%
	Fully Functional	96	29.5%
Availability and functionality of emergency escape stairs	Not Present	42	12.9%
	Present but not Functional	16	4.9%
	Neutral	76	23.4%
	Functional but Limited	106	32.6%
	Fully Functional	85	26.2%
Availability of properly designated evacuation points	Not Present	35	10.8%
	Present but not Functional	14	4.3%
	Neutral	97	29.8%
	Functional but Limited	111	34.2%
	Fully Functional	68	20.9%
Accessibility and visibility of fire extinguishers	Not Present	47	14.5%
	Present but not Functional	18	5.5%
	Neutral	82	25.2%
	Functional but Limited	96	29.5%
	Fully Functional	82	25.2%
Emergency lighting in key areas of the church	Not Present	40	12.3%
	Present but not Functional	20	6.2%
	Neutral	107	32.9%
	Functional but Limited	95	29.2%
	Fully Functional	63	19.4%
Presence of visible and clear fire safety signs	Not Present	59	18.2%
	Present but not Functional	19	5.8%
	Neutral	91	28%
	Functional but Limited	77	23.7%
	Fully Functional	79	24.3%

(Continued on the following page)

TABLE 2 (Continued) Frequency and percentage distribution of worshippers' awareness rating on the availability and functionality of basic fire safety elements.

Variables	Likert scale response	Frequency (N = 325)	Percentage (%)
Availability and performance of fire alarms	Not Present	50	15.4%
	Present but not Functional	18	5.5%
	Neutral	113	34.8%
	Functional but Limited	82	25.2%
	Fully Functional	62	19.1%
Availability and performance of smoke detectors	Not Present	55	16.9%
	Present but not Functional	11	3.4%
	Neutral	115	35.4%
	Functional but Limited	85	26.2%
	Fully Functional	59	18.2%

indicating they were either aware or highly aware of their ease of access. This suggests that exits are generally well-placed and known, likely a result of basic safety protocols and visible signage. However, a small portion still reported being highly unaware (11.7%), indicating inconsistencies in visibility or maintenance across different church buildings.

Emergency escape staircases followed a similar trend, with 58.8% of respondents affirming their availability and functionality. The presence of 23.4% neutral responses and a combined 17.8% reporting unawareness suggests that these staircases may be underutilised or not clearly marked, potentially putting newer or less engaged members at risk in emergencies.

Designated evacuation assembly points were moderately well-reported, with 55.1% indicating awareness. However, the 29.8% neutral responses and 15.1% expressing unawareness point to inadequate signage or inconsistent communication, especially among respondents who may not participate regularly in fire drills or safety briefings.

The accessibility and visibility of fire extinguishers presented more divided responses. While 54.7% of respondents confirmed awareness or high awareness, a substantial portion remained neutral (25.2%), and 20% were unaware or highly unaware. This gap suggests that fire extinguishers, although present, may not be placed in clearly visible or easily accessible locations, highlighting a need for better placement and orientation practices.

Emergency lighting in key areas showed moderate awareness, with 48.6% rating it positively. However, a considerable number of respondents (32.9%) selected neutral, possibly due to unfamiliarity with how these systems function or because they are not activated or tested frequently. The presence of 18.5% reporting unawareness also raises questions about maintenance and visibility during non-emergency conditions.

Awareness of fire safety signage varied widely, with just under half of the respondents indicating strong visibility (48%). However, 28% were neutral and 24% expressed unawareness, suggesting that

while signs may be present, they might not be strategically placed or clear enough to draw attention.

Fire alarm functionality received a relatively even spread of responses. While 44.3% acknowledged their presence and effectiveness, a large share of respondents (34.8%) were neutral, likely reflecting that alarms are not regularly tested or emphasized during services or events. The 20.9% who were unaware further underscore the lack of routine checks or drills involving alarms.

Finally, smoke detectors, although critical to early warning systems, appeared to be one of the least emphasized safety features. Only 44.4% reported awareness or high awareness of their availability and performance, while a striking 35.4% remained neutral, and 20.3% indicated unawareness. This suggests a significant oversight in both implementation and communication around this vital safety component.

In summary, the data reflects notable shortcomings in practical visibility, maintenance, and functionality of essential systems like alarms, extinguishers, and emergency lighting. These findings call for churches to not only install these features but also to regularly inspect, maintain, and raise awareness of them through visible cues and training.

4.3 Worshippers' level of awareness of basic fire safety protocols

Table 3 shows that the users were mostly confident in operating fire extinguishers, in their personal preparedness to respond during fire emergencies, and in operating fire alarms, taking the top three positions. While the users were least confident in the level of fire safety training received, the frequency of fire drills conducted, and the familiarity with fire service or emergency contact numbers took the bottom three positions.

For further analysis, the confidence in operating fire extinguishers was mixed. Though 50.2% rated themselves as moderately or very confident, a considerable 31.1% said they were

TABLE 3 Frequency and percentage distribution of responses for worshippers' level of awareness of fire safety protocols.

Variables	Likert scale response	Frequency (N = 325)	Percentage (%)
Confidence in operating fire extinguishers	Highly Unaware	61	18.8%
	Unaware	40	12.3%
	Neutral	61	18.8%
	Aware	73	22.5%
	Highly Aware	90	27.7%
Personal preparedness to respond during fire emergencies	Highly Unaware	54	16.6%
	Unaware	47	14.5%
	Neutral	67	20.6%
	Aware	106	32.6%
	Highly Aware	51	15.7%
Confidence in operating fire alarms	Highly Unaware	65	20%
	Unaware	40	12.3%
	Neutral	66	20.3%
	Aware	114	35.1%
	Highly Aware	40	12.3%
Familiarity with emergency evacuation plans in your church	Highly Unaware	96	29.5%
	Unaware	40	12.3%
	Neutral	60	18.5%
	Aware	77	23.7%
	Highly Aware	52	16%
Level of fire safety training received	Highly Unaware	83	25.5%
	Unaware	52	16%
	Neutral	49	15.1%
	Aware	96	29.5%
	Highly Aware	45	13.8%
Frequency of fire drills conducted in your church	Highly Unaware	105	32.3%
	Unaware	30	9.2%
	Neutral	58	17.8%
	Aware	73	22.5%
	Highly Aware	59	18.2%

(Continued on the following page)

TABLE 3 (Continued) Frequency and percentage distribution of responses for worshippers' level of awareness of fire safety protocols.

Variables	Likert scale response	Frequency (N = 325)	Percentage (%)
Familiarity with fire service or emergency contact numbers	Highly Unaware	83	25.5%
	Unaware	50	15.4%
	Neutral	53	16.3%
	Aware	86	26.5%
	Highly Aware	53	16.3%

not at all or only slightly confident, and 18.8% remained uncertain. This suggests that while fire extinguishers are visible in many churches, few people have actually been trained to use them. The relatively high proportion of newer church attendees (31.4%) likely contributes to this shortfall.

A similar pattern emerged in terms of personal preparedness to respond during fire emergencies. While 48.3% felt moderately or very prepared, a notable 31.1% did not feel prepared, and 20.6% were neutral. Despite many respondents being young and potentially quick to respond, the limited preparedness underscores the absence of formal training or fire emergency simulations.

When asked about confidence in operating fire alarms, 35.1% reported moderate confidence, but only 12.3% felt very confident. Meanwhile, 20% were not at all confident, and another 20.3% were uncertain. This suggests that alarms are either unfamiliar to many or rarely demonstrated, which limits user competence.

Familiarity with emergency evacuation plans scored low overall. Only 39.7% expressed familiarity (moderately or very), while 41.8% said they were either not at all familiar or only slightly so. A significant 18.5% remained uncertain. This suggests that evacuation plans are not well publicised or are inconsistently communicated, especially to regular members (50.5%) who are likely to benefit most from such information.

Responses on the level of fire safety training received also pointed to a concerning lack of preparedness. While 29.5% reported receiving moderate training, just 13.8% claimed to have had very adequate training. In contrast, 41.5% indicated they had little or no training. This training gap may explain the lack of confidence in practical fire safety tasks.

The frequency of fire drills conducted in churches appeared particularly weak. Just 40.7% stated fire drills occurred moderately or very often, while a significant 41.5% noted they rarely happened or were not held at all. Fire drills, being one of the most effective means of reinforcing safety habits, seem underutilised despite the presence of large, engaged congregations.

Finally, familiarity with fire service or emergency contact numbers was split. A slight majority (42.8%) said they were moderately or very familiar with such numbers, but 40.9% indicated they were not at all or slightly familiar. The 16.3% who were uncertain further suggest that churches are not emphasising this critical emergency information in signage or orientation.

In essence, there is a notable shortfall in actual training, hands-on experience, and procedural clarity. Churches would benefit from structured fire safety programs that include frequent drills, clear communication, and practical training to bridge the gap between awareness and action.

TABLE 4 Descriptive statistics and ranking of fire safety principles and associated measures.

S/N	Variables	Mean	Rank
1	The principles of fire safety	3.6677	1st
2	Location of emergency exits	3.6277	2nd
3	Proper use of emergency escape staircases	3.5815	3rd
4	Knowledge of fire risks and hazards in the church	3.5169	4th
5	Importance and location of evacuation assembly points	3.5169	5th
6	Procedures to follow during fire drills	3.4400	6th
7	Location and proper use of fire extinguishers	3.3231	7th
8	Purpose and function of emergency lighting	3.2646	8th

4.4 The impact of availability and functionality of the basic fire safety elements on improving worshippers' awareness level of fire safety measures

This section presents the results of the categorical regression analysis, which quantifies categorical data by assigning numerical values to categories, thereby producing an optimal linear regression model for the transformed fire safety measures. In this study, "Principles of Fire Safety" serves as the dependent variable because it embodies the overarching framework into which all specific measures are conceptually integrated. Table 4 shows that it also commands the highest mean rating (3.6677) and perceived salience among the eight items, indicating respondents view it as the most central construct, and this makes it statistically well-suited to be explained by the more concrete, lower-ranked measures, thereby aligning both the theoretical hierarchy and the quantitative properties of the data with the regression model. The independent variables (predictors) were the availability and functionality of these fire safety elements, as detailed in Table 2, section C of this questionnaire. The analysis aimed to examine the impact of the availability and functionality of the basic fire safety elements on improving worshippers' awareness level of fire safety.

TABLE 5 Model summary of categorical regression analysis on worshippers' awareness level of fire safety measures.

R	R square	Adjusted R square	Apparent prediction error
0.650	0.423	0.408	0.91696

4.5 Analysing the impact of worshippers' awareness level of fire safety measures in Pentecostal churches using descriptive and inferential statistics

The analysis began by computing worshippers' awareness level of fire-safety measures, with the "principles of fire safety" treated as the dependent variable and the availability and functionality of fire-safety elements entered as independent variables in IBM SPSS Statistics 27.

As shown in Table 5, the model yielded $R = 0.650$, $R^2 = 0.423$, adjusted $R^2 = 0.408$, and a standard error of estimate = 0.917. This indicates that the independent variables collectively explain approximately 42% of the variance in worshippers' fire-safety awareness levels. ANOVA results further confirmed overall model significance ($F = 28.90$, $p < 0.001$).

As displayed in Table 6, several fire-safety measures exert statistically significant positive effects on the overall "principles of fire safety" score. The availability of properly designated evacuation points exerts the strongest influence ($\beta = 0.369$, $p < 0.001$), followed by the availability and performance of smoke detectors ($\beta = 0.274$, $p = 0.002$), accessibility of emergency exits ($\beta = 0.242$, $p = 0.005$), and presence of visible and clear fire-safety signs ($\beta = 0.208$, $p = 0.010$). Fire alarms, extinguishers, escape stairs, and emergency lighting were not significant predictors.

The regression analysis demonstrates that improvements in tangible, infrastructural fire-safety elements particularly designated evacuation points, functional smoke detectors, and accessible emergency exits significantly enhance worshippers' awareness of fire-safety principles. This suggests that awareness is not only a matter of education but also strongly shaped by the visibility and reliability of the built environment. Conversely, non-significant predictors (e.g., extinguishers, escape stairs, emergency lighting) highlight areas where features may exist but fail to translate into improved awareness due to poor visibility, irregular use, or limited emphasis in safety training. These findings underscore the need for churches to prioritize evacuation planning, smoke-detection systems, and exit accessibility as immediate strategies for strengthening safety culture.

The descriptive results, while informative, gain greater significance when interpreted through the lens of performance-based design, which prioritises measurable outcomes such as safe evacuation times, controlled smoke spread, and system reliability. This perspective allows churches to translate statistical findings into actionable architectural interventions.

5 Discussion

The findings suggest that while conceptual understanding of basic fire-safety principles, such as the identification of exits and

recognition of hazards, was relatively high, respondents reported lower levels of practical readiness, including limited participation in evacuation drills and low confidence in using firefighting equipment. This disparity between knowledge and practice echoes previous research, which has shown that awareness alone is insufficient to guarantee effective response without repeated drills and experiential learning (Paton, 2003; Babatunde et al., 2020).

A key contribution of this study lies in its focus on churches, which differ in essential respects from other public facilities such as schools, libraries, or shopping centres. Churches experience highly variable peak occupancies, with large gatherings concentrated during services and special events. Worship activities often involve collective behaviours such as singing, movement, or emotional intensity that may complicate orderly evacuation. In addition, the frequent use of electrical equipment, stage lighting, and temporary decorative materials increases ignition risk and smoke spread compared with more regulated institutional settings. These features suggest that mitigation strategies effective in schools or libraries, such as routine class-based drills or fixed occupancy planning, require adaptation for worship environments. Performance-based design approaches, including evacuation modelling and smoke dynamics analysis, may therefore be especially relevant for churches (Kobes et al., 2009; Kuldeep and Virendra, 2023).

The results also align with findings from studies of schools, commercial centres, and other public buildings, which similarly report gaps between theoretical knowledge and practical preparedness (Adeleye, 2020; Daramola et al., 2024; Kamel et al., 2022). For example, Adeleye (2020) noted that while schools often have fire extinguishers installed, few staff or students receive adequate training on their use. In the present study, although 50.2% of respondents expressed confidence in operating fire extinguishers, a considerable proportion remained unsure or untrained, underscoring similar challenges of converting awareness into competence. Likewise, inconsistent perceptions of functionality for alarms, detectors, and emergency lighting mirror concerns reported in other public facilities, where poor maintenance undermines the protective value of installed systems (Khan et al., 2022).

The responses further highlight a critical imbalance between active and passive fire-safety measures. Active systems such as alarms and lighting were present but inconsistently maintained, while passive measures, including compartmentation, fire doors, and smoke-control systems, were often absent. This under-adoption of passive protections is significant because international best practice emphasises the integration of active and passive strategies to ensure redundancy and resilience (Law and Bisby, 2020; Kodur et al., 2019). The overreliance on active systems in the sampled churches, therefore, represents a design vulnerability that could compromise evacuation safety in the event of system failures.

Taken together, these findings point to the need for targeted, evidence-based interventions. Routine evacuation drills, ideally conducted quarterly, could strengthen readiness by providing

TABLE 6 Regression coefficients for the impact of availability and functionality of the basic fire safety elements on improving worshippers' awareness level of fire safety measures.

Fire safety elements	Unstandardised coefficient (B)	Standard error	Standardised coefficient (Beta)	T-value	P-value (Sig)
(Constant)	1.373	0.172		7.960	0.000
Presence of visible and clear fire safety signs	0.179	0.069	0.208	2.591	0.010
Functionality of fire alarms	−0.292	0.085	−0.311	−3.447	0.001
Availability and performance of smoke detectors	0.255	0.083	0.274	3.071	0.002
Accessibility of emergency exits	0.230	0.081	0.242	2.836	0.005
Accessibility and visibility of fire extinguishers	−0.110	0.077	−0.121	−1.423	0.156
Availability of properly designated evacuation points	0.371	0.078	0.369	4.764	0.000
Emergency lighting in key areas of the church	1.635	0.074	0.000	0.000	1.000
Availability and functionality of emergency escape stairs	0.019	0.085	0.021	0.228	0.820

experiential familiarity with exits and assembly points. Hands-on training for church volunteers and staff in the use of extinguishers, alarms, and crowd management would address reported confidence gaps. At the same time, systematic maintenance schedules overseen by designated safety stewards are necessary to ensure the ongoing functionality of active systems. Churches should also consider adopting performance-based verification approaches, such as evacuation timing and smoke modelling, particularly in larger congregations or newly built facilities. Aligning such efforts with the Nigerian National Building Code (NBC) and benchmarking against NFPA and ISO standards would situate local practice within global frameworks while promoting sustainable, resilient church architecture.

These implications, however, must be interpreted in light of the study's scope and design constraints. The research was geographically limited to Abuja and denominationally focused on Pentecostal churches, relied on self-reported data, and employed a cross-sectional survey design without simulation-based validation. These limitations are discussed in the following section, along with prospects for future research that may address them.

6 Study limitations, challenges, and prospects

While the study makes an essential contribution to understanding fire-safety awareness in Nigerian Pentecostal

churches, several limitations must be acknowledged. First, the research is geographically limited to Abuja and denominationally restricted to Pentecostal churches, which constrains the generalisability of the findings across Nigeria's diverse religious and regional contexts. Second, the cross-sectional survey design does not capture temporal changes in awareness or preparedness, nor does it employ simulation-based fire modelling or performance-based analysis that could have provided more profound insight into evacuation dynamics and design resilience.

Future research should address these limitations by expanding to multi-city and cross-denominational studies, adopting longitudinal designs to assess changes over time, and integrating fire modelling and evacuation simulations. Such approaches would enable a performance-based, empirically validated understanding of fire safety in religious spaces, strengthening both local application and international comparison.

7 Conclusion and recommendations

This study provides an empirical assessment of worshippers' fire-safety awareness in Pentecostal churches in Abuja, highlighting a persistent gap between conceptual knowledge and practical readiness. While most congregants could identify emergency exits, evacuation points, and everyday hazards, confidence in operating extinguishers, alarms, and other systems remained modest, and participation in drills was limited. Active systems, such as emergency

lighting and smoke detectors, were inconsistently maintained, while passive protections, including fire doors, smoke-control ducts, and compartmentation barriers, were largely absent. This imbalance reflects a patchy adoption of fire-safety provisions that place undue reliance on mechanical systems and leave congregations underprepared for emergencies.

The novelty of this study lies in its focus on churches as distinct public assembly settings. Unlike schools or libraries, churches experience fluctuating peak occupancies, emotionally intense collective behaviours, and heavy reliance on stage and electrical systems. These characteristics complicate evacuation and increase ignition risks, underscoring the need for performance-based fire-safety design and simulation-based evaluation in worship environments.

The research is not without limitations. Its scope is restricted to Abuja and to Pentecostal churches, relies on self-reported data subject to social desirability bias, and employs a cross-sectional design without drill observations or fire modelling. Nevertheless, it provides an essential baseline for future studies that should adopt multi-city and cross-denominational comparisons, employ longitudinal methods to track awareness and behaviour over time, and incorporate fire-modelling simulations to validate evacuation strategies and design choices.

Practical implications follow at three levels. For practitioners, quarterly drills integrated into service schedules, accompanied by hands-on training in extinguisher use, alarm activation, and guided evacuation, would help translate awareness into competence. For policymakers and regulators, enforcing the Nigerian National Building Code in parallel with adapting NFPA and ISO frameworks would ensure consistency with global best practice, while requiring regular passive fire-safety audits and retrofits in existing worship facilities. For designers and architects, embedding certified fire doors, compartmentation, and smoke-control systems alongside active equipment, supported by fire-modelling simulations at the design stage, will reduce reliance on mechanical interventions and promote resilient, sustainable church architecture.

In sum, this study advances understanding of how worship environments present unique fire-safety challenges, demonstrates the imbalance between awareness, preparedness, and design provisions, and outlines practical pathways for improving resilience. By integrating behavioural training, regulatory enforcement, and performance-based design, churches can transform abstract awareness into practised readiness and create safer, more sustainable worship spaces.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Covenant Health Research Ethics Committee (CHREC) Covenant University

CHREC NHREC reg. number NHREC/CU-HREC/1/01/2025 HREC Protocol Assigned Number CHREC/1070/2025. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

OO: Conceptualization, Investigation, Methodology, Supervision, Writing – original draft, Writing – review and editing. DU: Conceptualization, Data curation, Investigation, Methodology, Writing – original draft, Writing – review and editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Acknowledgments

The authors express gratitude for the assistance extended by the Covenant University Centre for Research, Innovation, and Discovery (CUCRID) in facilitating the publication of this work.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that Generative AI was used in the creation of this manuscript. The author(s) verify and take full responsibility for the use of generative AI in the preparation of this manuscript. Generative AI was used for grammatical purpose only.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Addai, E. K., Tulashe, S. K., Annan, J., and Yeboah, I. (2016). Trend of fire outbreaks in Ghana and ways to prevent these incidents. *Saf. Health Work* 7 (4), 284–292. doi:10.1016/j.shaw.2016.02.004
- Adekunle, A., Arowolo, T., Omojola, O., and Ibrahim, H. (2020). Structural fire analysis in residential and commercial buildings based on ignition frequency, fire extinguisher performance, and fire risk indexes in the South-East zone of Nigeria from 2010 to 2019. *Int. J. Adv. Acad. Res.*, 52–71. doi:10.46654/ij.24889849.e61011
- Adeleye, O. I. (2020). Fire disaster preparedness of public buildings in Ibadan metropolis, Nigeria. *Open Sci. J.* 5 (2). doi:10.23954/osj.v5i2.2249
- Aderonmu, P. A., and Eghobamien, O. (2021). Didactic analysis of active-passive fire safety measures in Tejuosho ultra-modern market complex, Yaba, Lagos. *IOP Conf. Ser. Mater. Sci. Eng.* 1107 (1), 012204. doi:10.1088/1757-899X/1107/1/012204
- Alao, K. M., Yatim, Y. M., and Mahmood, W. Y. W. (2021). Fire safety management strategy in Nigerian public buildings. *J. Kejuruter.* 33 (3), 663–671. doi:10.17576/jkukm-2021-33(3)-24
- Amon, F., Gehandler, J., McNamee, R., McNamee, M., and Vilic, A. (2020). Fire impact tool measuring the impact of fire suppression operations on the environment. *Fire Saf. J.* 120, 103071. doi:10.1016/j.firesaf.2020.103071
- Babatunde, S. A., Oche, A. G., and Paul, O. (2020). Fire emergency safety preparedness in the college of leadership development studies building in covenant university, Ota, Nigeria. *Civ. Eng. Archit.* 8 (6), 1463–1480. doi:10.13189/cea.2020.080628
- Cleef, L., Yang, M., Bouchaut, B., and Reniers, G. (2024). Fire risk assessment tools for the built environment an explorative study through a developers' survey. *Fire Saf. J.* 146, 104169. doi:10.1016/j.firesaf.2024.104169
- Cucco, P., Di Ruocco, G., and La Rana, L. (2023). Proposal of an innovative model for fire prevention assessment in cultural heritage protection: research study in Italy. *Int. J. Disaster Risk Reduct.* 97, 104066. doi:10.1016/j.ijdrr.2023.104066
- Da Rocha, G. S., Rodrigues, J. P. C., and Da Silva Gazzana, D. (2024). Fire risk of electrical installations: a fuzzy Petri net approach applied to the National Museum of Brazil. *Archit. Struct. Constr.* 5 (1), 4. doi:10.1007/s44150-024-00121-3
- Daramola, O. F., Bakare, A. J., and Owabumowa, I. S. (2024). Assessment of fire safety preparedness and risk management in Caleb University hostels. *Deleted J.* 17 (1), 57–68. doi:10.62154/ajesre.2024.017.010449
- Dare, A. A., Okeghenemaro, A. D., Okwori, O. J., Oluwadamilola, T. A., Ademola, G. Y., Olakunle, A. O., et al. (2022). Assessment of fire risk for mike Adenuga library, bells university, OTA, Nigeria. *Int. J. Innov. Res. Dev.* 11 (8). doi:10.24940/ijird/2022/v11/i8/aug22017
- David, A. I., Mlangi, V., Kyauta, M., and Dickson, P. (2019). Building design practice and fire codes for buildings in Nigeria (issues, effects and solutions). *Int. J. Innov. Res. Dev.* 8 (8). doi:10.24940/ijird/2019/v8/i8/aug19075
- Dirisu, J., Fayomi, O., Oyedepo, S., and Mmuokebe, J. (2019). Performance assessment of the firefighting personal protective tunic. *Energy Procedia* 157, 405–418. doi:10.1016/j.egypro.2018.11.205
- Dowlati, M., Seyedin, H., Moslehi, S., and Sakhaei, F. (2020). Health, safety, and education measures for fire in schools: a review article. *J. Educ. Health Promot.* 9 (1), 121. doi:10.4103/jehp.jehp_665_19
- Ediae, O. J., Babalola, O. D., Onakoya, A. O., Aderonmu, P. A., Sholanke, A. B., Olagunju, O., et al. (2023). Users perception on need for universal design in recreation centres in Ogun state, Nigeria. *Int. J. Res. Publ. Rev.* 4 (4), 2798–2812. doi:10.55248/gengpi.4.423.30401
- Falola, O. J., and Agbola, S. B. (2022). Institutional capacity and the roles of key actors in fire disaster risk reduction: the case of Ibadan, Nigeria. *Int. J. Disaster Risk Sci.* 13 (5), 716–728. doi:10.1007/s13753-022-00440-3
- Himoto, K. (2020). Conceptual framework for quantifying fire resilience a new perspective on fire safety performance of buildings. *Fire Saf. J.* 120, 103052. doi:10.1016/j.firesaf.2020.103052
- Kamel, S., Jamal, A., Omri, K., and Khayyat, M. (2022). An IoT-based fire safety management system for educational buildings: a case study. *Int. J. Adv. Comput. Sci. Appl.* 13 (7). doi:10.14569/ijacsa.2022.0130789
- Keeley, J. E., and Pausas, J. G. (2022). Evolutionary ecology of fire. *Annu. Rev. Ecol. Evol. Syst.* 53 (1), 203–225. doi:10.1146/annurev-ecolsys-102320-095612
- Khan, F., Xu, Z., Sun, J., Khan, F. M., Ahmed, A., and Zhao, Y. (2022). Recent advances in sensors for fire detection. *Sensors* 22 (9), 3310. doi:10.3390/s22093310
- Kobes, M., Helsloot, I., De Vries, B., and Post, J. G. (2009). Building safety and human behaviour in fire: a literature review. *Fire Saf. J.* 45 (1), 1–11. doi:10.1016/j.firesaf.2009.08.005
- Kodur, V., Kumar, P., and Rafi, M. M. (2019). Fire hazard in buildings: review, assessment and strategies for improving fire safety. *PSU Res. Rev.* 4 (1), 1–23. doi:10.1108/PRR-12-2018-0033
- Kuldeep, K., and Virendra, K. P. (2023). A critical review of risk factors and reliability assessment issues of fire and life safety in buildings. *J. Real Estate Constr. Manage.* 37 (3), 23–33. doi:10.1177/2977657020220303
- Law, A., and Bisby, L. (2020). The rise and rise of fire resistance. *Fire Saf. J.* 116, 103188. doi:10.1016/j.firesaf.2020.103188
- McKinnon, A. (2021). Christians, Muslims and traditional worshippers in Nigeria: estimating the relative proportions from eleven nationally representative social surveys. *Rev. Relig. Res.* 63 (2), 303–315. doi:10.1007/s13644-021-00450-5
- Morozov, R. V. (2019). A fire safety control system of educational institutions. *J. Phys. Conf. Ser.* 1399 (3), 033065. doi:10.1088/1742-6596/1399/3/033065
- Muico, E. J. G., Canalija, J. K., Ronald, D., and Lucero, J. (2024). Evaluation of fire safety measures in Barangay San Roque, municipality of Maco: basis for intervention scheme. *J. Healthc. Treat. Dev.* 42, 1–5. doi:10.55529/jhtd.42.1.5
- Negedu, S. (2024). Abuja records 266 fire incidents in six months. *The Abuja Inquirer*. Available online at: <https://theabujainquirer.com/2024/07/07/abuja-records-266-fire-incidents-in-six-months>.
- Nouban, F., and Yunusa, N. (2020). Engr. Abdulkadir Abdullahi Kure ultra-modern market fire safety assessment. *Int. J. Innov. Sci. Res. Technol.* 5 (7), 192–199. doi:10.38124/ijisrt20jul190
- Obasa, O. O. S., Mbamali, I., and Okolie, K. C. (2020). Assessment of fire disaster preparedness of commercial buildings in Imo State, Nigeria. *IOSR J. Environ. Sci. Toxicol. Food Technol.* 14 (5), 56–67. doi:10.9790/2402-1405015667
- Oloke, O., Oluwunmi, O., Oyeyemi, K., Ayedun, C., and Peter, N. (2021). Fire risk exposure and preparedness of peri-urban neighbourhoods in Ibadan, Oyo State, Nigeria. *IOP Conf. Ser. Earth Environ. Sci.* 655 (1), 012079. doi:10.1088/1755-1315/655/1/012079
- Onyekwere, W. C., Ajayi, O. O., and Owolabi, T. O. S. (2024). Assessment of fire safety measures in on-campus housing facilities. *Deleted J.* 16 (1), 71–83. doi:10.62154/ajesre.2024.016.010377
- Paton, D. (2003). Disaster preparedness: a social-cognitive perspective. *Disaster Prevention and Management an International Journal* 12 (3), 210–216. doi:10.1108/09653560310480686
- Rahardjo, H. A., and Prihanton, M. (2020). The most critical issues and challenges of fire safety for building sustainability in Jakarta. *J. Build. Eng.* 29, 101133. doi:10.1016/j.jobbe.2019.101133
- Shokouhi, M., Nasiriani, K., Cheraghi, Z., Ardalani, A., Khankeh, H., Fallahzadeh, H., et al. (2018). Preventive measures for fire-related injuries and their risk factors in residential buildings: a systematic review. *J. Inj. Violence Res.* 11 (1), 1–14. doi:10.5249/jivr.v11i1.1057
- Sholanke, A. B., Adeboye, A. B., Oluwatayo, A. A., and Alagbe, O. A. (2016). "Evaluation of universal design compliance at the main entrance of selected public buildings in Covenant University, Ota, Ogun State, Nigeria", in *3rd Int. Conf. Afr. Dev. Issues (CU-ICADI)*, 188–192.
- Sholanke, A., Dimuna, K., and Olukayode, B. (2025). Evaluation of fire safety management strategies in selected shopping malls in Abuja, Nigeria. *F1000Res* 14, 471. doi:10.12688/f1000research.163375.1
- Vovk, S., Ferents, N., and Lyn, A. (2021). Religious buildings fire safety in Ukraine. *Fire Saf. J.* 37, 24–30. doi:10.32447/20786662.37.2020.04
- Yamane, T. (1967). *Statistics: an introductory analysis (2nd ed.)*. New York: Harper & Row.
- Yemi-Jonathan, O. I. T., Obafemi, A. A., and Eludoyin, O. S. (2023). Elements and dimensions of emergencies preparedness and response among large worship centres in South-South Region of Nigeria. *South Asian J. Soc. Stud. Econ.* 20 (2), 79–88. doi:10.9734/sajsse/2023/v20i2702
- Zlokovich, M. S., Corts, D. P., and Rogers, M. M. (2023). Descriptive and inferential statistics. In *Cambridge University Press eBooks*, 468–493. doi:10.1017/9781009010054.023