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AWARENESS LEVEL OF FIRE SAFETY PROVISIONS IN STUDENTS' ACCOMMODATIONS ON KNUST CAMPUS

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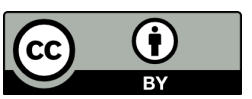
ABSTRACT

Hostels are becoming more complicated, and higher-rise buildings are becoming important because of their high land value and reduced land sizes within the urban zone where the demand for accommodation facilities has increased. This calls for critical provisions of certain facilities that will make the occupants of the hostels comfortable, hence the hostel meeting the demand of its users. The purpose of this research is to assess fire safety provisions in students' accommodations and their level of awareness. Quantitative and qualitative methodologies were used to attain the study's goal. In this paper, the primary data collection instruments were questionnaires and case studies. A sample size of 142 student participants was determined using a sample size calculator. Structured questionnaires were used in gathering data based on the literature reviewed and were analyzed statistically using mean score analysis and crosstab analysis. It was observed that some of the fire safety provisions were not functioning due to poor maintenance and management systems. With the challenges at hand, it was recommended that training and seminars on fire and fire safety management should be organized, and there should be a rapid check of the fire safety elements.

Keywords: Fire, Fire safety, Fire safety management, Fire safety provisions



INTRODUCTION

More housing facilities have been constructed to accommodate the growing student population [1]. Building structures and functions are getting increasingly complicated and new technologies and techniques are continually emerging, increasing the severity of building fires [2]. According to Watts and Hall (2016), building fires are now widely regarded as a major hazard to people's lives and an increasing issue is how to limit the risk of fire, fire damage, and loss in structures are minimized, and building fire safety is ensured. As a result, to decide whether to take action to lower the risk, proper fire safety by providing a model that delivers information through quantitative or qualitative analysis findings is essential for fire outbreaks in both private and public halls and hostels are critical [2]. More hostels are becoming more complicated, and high-rise buildings are becoming more important because of the high land value and reduced land sizes within the urban zone where the demand for accommodation facilities has increased [3]. This calls for critical provisions of certain facilities that will make the occupants of the hostels comfortable, hence the hostel meeting the demand of its users.

With the high rise and complexity of the buildings that are coming up, there is a need to create a safe use of the facility. One critical thing to consider in buildings is the fire safety provisions. Even as buildings become more complex, with higher demands on architecture and expectations of lower construction costs, buildings are still expected to be built with satisfied safety to protect humans, property, and the environment. To demonstrate that new and creative solutions fulfill the required fire safety standards, several approaches must be used in which the building's fire safety design is questioned, reviewed, and confirmed [4]. Effective management of complex complexes with mixed-use and occupancies, such as halls, hostels, and hotels, is critical to the development's fire safety because all other systems of the fire safety component may become worthless without it [5]. A well-structured and well-organized fire management system is essential to essentially guarantee all components of property for the management team's duty for fire; the development's safety management and evacuation are in place. Executed and practiced on a regular and competent basis [6]. It is well acknowledged that excellent fire safety management is critical to raising a building's fire safety level. Because of strong management and established processes, it's expected that the effectiveness of fire safety such as "older buildings," annex blocks in public halls, would not be less effective than in freshly built-in ones or private hostel buildings [4].

Regarding the foregoing discussion, there is a critical need to look at the type of provisions in various hostels arrowed toward achieving safety in buildings. As previously said, fire protection strategies are not well crafted and implemented on the KNUST campus, in Kumasi, Ghana. However, the problem emerges after this stage, when the completion of maintenance and exam preparation is frequently viewed with derision. According to [7], when confronted with a fire, a lack of inspection, testing, or maintenance causes one-third of safety systems to fail to function properly. Unfortunately, when a fire occurs and the system is needed [6]. The following questions were asked during the research;

1. What are the current fire safety strategies in the existing halls and hostels at KNUST?
2. What is the occupancies' level of awareness of fire safety?

The objectives of the research were to;

1. To identify the various fire safety provisions in student accommodation buildings.

2. To identify the awareness level of fire safety provisions of these buildings.

The scope of the research was on the KNUST campus and hostels in Ayeduase that are accredited by the Directorate of Students Affairs. This research will also serve as a background for other researchers to use. The purpose of this research is to assess the different types of fire safety strategies of both halls and hostels when it comes to evacuation.

Fire

The visible result of the combustion process, a unique kind of chemical reaction, is fire. It happens when some kind of fuel and air oxygen are combined. The result of the chemical reaction is entirely distinct from the initial component [8]. These three elements together are referred to as the "fire triangle." If any of these components are missing, the fire will either go out completely or not burn at all. By removing one or more elements from the fire triangle, fire extinguishers put out a fire [9].

Fire is the result of a chemical process in which heat from a combustible fuel is transferred to heat and light. The flame of a fire is the visible sign of light that arises after the gas is heated, and it is proof that a fire has occurred [10]. Without all of these ingredients in situ and the proper quantities, fire cannot exist. A catalyst may be required for some fuel oxygen combinations, which is a component during combustion, it is not directly involved in any chemical process, but it assists in the combustion of the reactants. Once started, a chain reaction occurs in which flames may be able to keep their heat by releasing more heat energy throughout the combustion process, and they can spread if an oxidizer and fuel are available [11]. If the oxidizer is oxygen from the surrounding air, convection, which removes combustion products and supplies oxygen to the fire, requires the existence of a force of gravity induced by an acceleration in the absence of gravity, a fire rapidly envelops itself in its combustion products and non-oxidizing airborne gases, thereby suffocating it and putting it out [12].

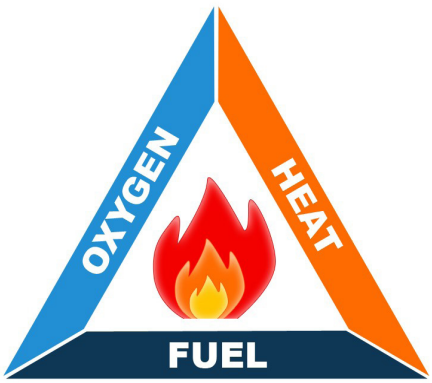


Figure 1: Fire triangle, Science Hub, 2009

Fire risk assessment

The first and most important step in fire safety is risk assessment. The possibility of a bad occurrence occurring during a specified period is described as a risk [13]. The assessment of fire risk is an important part of fire safety management; it is the most common method of enforcing rules for a company's fire safety. According to Ramachandran [14], one strategy that building managers and fire safety managers need to know how to use is fire risk assessment when dealing with fire safety concerns. Yeung [15] argued that implementing practical fire risk assessments is essential to achieving fire safety objectives. The process of assigning magnitudes and probabilities to the negative impacts of a fire in a structure is known as risk assessment [16]. The awareness that the cost of eradicating all safety and environmental repercussions from fires may be impossibly expensive, and regulatory judgments must be made based on imperfect scientific evidence, prompted

the adoption of risk assessment as a basic component of decision-making for controlling a given hazard. The recommended decision-making basis is a risk assessment that includes explicit consideration of uncertainty and provides reasonable criteria for prioritizing corrective activities [15]. Additionally, the Society of Fire Protection Engineers [17] defines "fire risk" as the potential for unintended, detrimental effects, where the fire is the hazard that may cause the loss or harm of human life, health, property, business continuity, heritage, the environment, or any combination of these. The rising worry about safety and security concerns, as well as the dramatic growth in litigation, are the primary reasons why risk management has become so important to the sector [18].

Fire safety

Fire safety is defined as a collection of procedures for preventing or reducing the spread of fire during unintentional or deliberate fires. This reduces defeats by a manageable level [19]. Recommended construction codes of practice offer this in structures, including residential amenities. There is no specific content or information about fire safety that is delivered to residential college students in any publication. Muizz [20] talked about two types of material for education on fire safety including both prevention and response. The synergistic impact of all building systems and features functioning together harmoniously, according to Kidd [21], assures the building's safety [21]. As a result, security and fire safety measures must be carefully developed, controlled, and implemented. As a result, the human interface has evolved into a valuable addition to these complex systems [22]. John L. Bryan, a renowned expert in fire safety who formerly taught fire protection engineering at the University of Maryland, examined and analyzed particular college burns (included as an appendix to the report) to inform [20] research. According to College Fire Watch's [23] list of deadly campus fires, off-campus housing accounts for 81 percent of fatal fires. Fire safety, as defined by Hassanain [18], is the decrease in the risk of death or injury because of a fire in a structure [18]. As a result, fire dangers that result in a large number of deaths raise concerns about the safety standards in buildings with the types of occupancy levels seen in the property where the deadly fire occurred [24]. Furthermore, claimed that to obtain the best degree of fire safety in a structure, a larger dependence on active fire safety systems such as automated systems for controlling smoke, detecting smoke, and sprinklers are required. The goals of fire safety, according to, are "life safety," "protection of a structure's contents," "protection of the building fabric," and "minimization of harm to the environment."

Fire safety management

The Fire Safety Management (FSM) model described here is a systematic strategy aimed at keeping "re-risk" in an organization's activities within an acceptable range. Derek (1999) defined fire safety management as the use of guidelines, data, and the duty of studying, evaluating, and regulating fire safety by policy managers. Building fire-safety management entails a variety of ways and aspects, including policy knowledge, fire-safety training knowledge, practically maintaining fire-safety equipment, organizing fire safety effectively, and communicating fire safety, to name a few. Fire safety management is a continuing process throughout the life cycle of a structure, Baker, Bouchlaghem, and [20]. Fire safety education, fire safety guidelines, fire safety procedures, fire safety reporting, fire safety audits, fire risk assessments, and emergency plans are some of the responsibilities that are involved in fire disaster prevention. However, to attain the necessary level of occupant safety in buildings, management is required. Buildings

should have a robust fire safety management program implemented throughout the stages of building and after construction (Samuel 2019). As a result, studies show that the appropriate putting-in-place fire safety management programs at the phases are critical to accomplishing fire safety goals. The need for a safe, healthy, and pleasant working and living environment has skyrocketed. According to [20], the implementation of fire safety measures is known as fire safety management to the assignment of assessing and monitoring a policy, standard, tool, knowledge, and practice officer in charge of fire safety. Fire is not always put out because of safety management. Hostels and hall facilities that meet the required rules and standards, but it does mean that fire will be reduced. Fire management for residential structures may improve the right selection of materials to be used in the structures, allowing them to withstand a particular level of fire resistance and preventing the facilities from being destroyed [12]. When a fire safety management system is established correctly and responsibly, according to Della-Giustina [12], the end outcomes may include lower property insurance rates, fewer company disruptions, improved customer service, and a better public image, among other things.

MATERIAL AND METHODS

Methods

Study sites

This research used the approach integrating both deduction and induction since it described the perception of fire safety provisions at student accommodation by a deductive approach using quantitative analysis and by inductive approach through qualitative analysis in the form of interviews and questionnaires to derive solutions to challenges that occur during the incidence of fire. The study took a mixed-methods approach. Secondary data was gathered by studying existing literature such as archive documents, books, and publications on the Internet. The primary data for this analysis was derived from a questionnaire survey for the participants of the survey, interviews, and case studies on fire safety provisions.

The halls that were under study were the traditional halls. Independence Hall, Queen's Hall, Republic Hall, and University Hall were grouped as one to be examined. The reason has been that they all have the same building typology. Unity Hall and Africa Hall were also grouped into one because of the same building typology. The typologies were categorized based on the design, orientation, and building forms. When it comes to the hostels, three (3) hostels were selected, these hostels were ones the school authority has approved. These hostels were West End Hostels, Victory Towers, and Golden Paradise Hostels. All of these hostels were located at Ayeduase. The hostels were selected based on the number of occupants inside and the complexity of the building.

Sampling

A 95% confidence level is typically regarded as acceptable in studies. Consequently, a sample size of 95 people for a population of 100 people will be very close to a realistic representation of the opinions of the entire population [29]. Saunders, Lewis, and Thornhill make the supposition that every one of the 95 participants took part in the data collection process. Because of the limited resources (in terms of time, and effort), a correct and fair picture of the population characteristics was obtained using the snowball sampling approach from a population of 500 undergraduate architectural students from their 1st year to their final year in the department. A sample size of 142 student participants was determined using a sample

size estimator from [30] using a Confidence Level of 95 percent and a Confidence Interval of 7.

The standard formula for calculating the sample size is:

Sample Size Formula = $[z^2 * p(1-p)] / e^2 / 1 + [z^2 * p(1-p)] / e^2 * N]$.

Where N is the population size. z is the z-score.

Interviews

Focus group interviews were not used in this research, but rather few people were examined. The managers and workers of the allocated hostels and halls were interviewed to give their responses on the subject under study. It also took eight (8) working days to interview the workers and managers of the hostels and hall. Many of the workers were finding it difficult to give their response but later after showing the letter of introduction, the relevant information on the study was given.

Design of data collection instruments

The questionnaire was divided into five (5) sections, each of which addressed a different area of the study. A prologue or introduction was delivered to the participant first. This offered the respondent a good idea of what the survey was trying to accomplish. The participant's context knowledge was addressed in the second portion of the questionnaire, which was concerned with their expertise in this area. In Section 3, participants were questioned about their broad understanding of the research field. Section 4 dealt with issues relating to fire safety provisions. Segment 5 summarized the questionnaire with any additional information that participants contributed, which was not referred to as the feedback element in the previous parts. To gather the necessary data for the study, an online questionnaire survey was used. Google documents were used to create this instrument.

Data analysis

The data for this study were analyzed using the Statistical Package for the Social Sciences (SPSS) software. It was measured using ordinal and nominal measurements. For the interpretation of results, descriptive statistics such as frequency distribution, percentages, and mean scores were used. These were best suited to the interpretation of the results as the study followed quantitative research techniques and approaches. The background data were mostly analyzed using frequency distributions and percentages whilst the main findings were analyzed using the mean score analysis.

RESULTS AND DISCUSSION

Halls and Hostels

A number of 142 questionnaires were administered to architecture students, from the first year to the postgraduate to access the fire safety provisions in students' accommodations. Of these, 142 people answered the questionnaires. This demonstrates the respondents' high response rate and underlines their overall interest in the study under consideration. The additional eight people filled it because the respondents sent it to their friends in the architecture department. Using the information gleaned from the respondents, 4.7% were residents at Golden Paradise, 50.7% were affiliated with Independence, queens, republic, and University Hall, 6.7% were currently residing at SRC Hostel, 18% were also in Africa and Unity Hall, 6% were residing in Wagyingo hostel and 14% were at West end hostels. This showed that 24.7% of the total respondents were residing off campus, while 75.3% were also affiliated with halls on campus. This provided

a slightly fair distribution among the students in the mentioned halls/hostels.

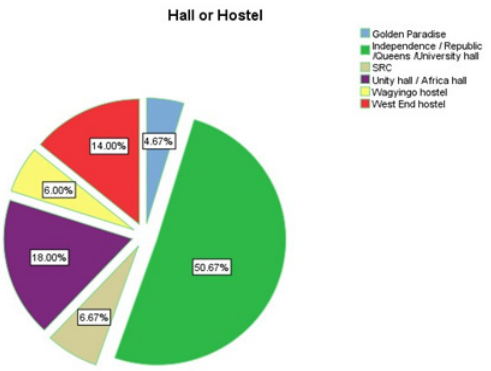


Figure 2: Percentage for respondent's residence, Author's construct, 2022

Level of education

Further evaluation of the respondents' background data proved that a fair number of the respondents had higher education to validate the research. Those with a higher number of respondents were in the 4th year at about 48%, followed by the first year with 28%, and about 16% for third-year students. Fewer respondents were from the postgraduate class.

The various fire safety provisions in student accommodation buildings. Based on the reviewed literature, the availability of fire safety provisions would help reduce the spread of fire from one property to another, ten (10) fire safety provisions were investigated, and the respondents together with the analysis from the case study were well elaborated and analyzed. Respondents were presented with the various fire safety provisions. They were to identify whether or not there were fire safety provisions in their halls/hostels of residence. The findings gathered were ranked based on the availability and quantity of the fire safety provisions. The most available fire safety provision in both halls/hostels was a portable fire extinguisher, which also had the highest quantity. Aside from fire extinguishers, fire safety signage, and escape stairs were also present in all the halls and hostels examined. Fire alarms were also identified in only the halls and a campus hostel, SRC. This showed that off-campus hostels lacked fire alarms in their hostels. Smoke detectors, heat detectors, sprinkler systems, fire doors, fire hydrants, and fire exits were not present in the halls and hostels.

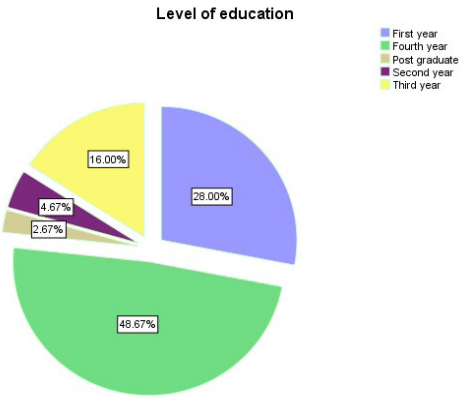


Figure 3: Percentage showing the level of education, Author's construct, 2022

Availability of fire safety provisions in students' accommodation.

A comparative study was done between on-campus halls and off-campus hostels. It was deduced that 53 portable fire extinguishers were available in these three halls and 21 extinguishers for off-campus hostels were selected. The difference between halls and hostels with regards to the fire extinguishers can be because of the floor levels (height of the building). From the literature reviewed, the higher the building goes, the higher the fire safety measures are been put in place. Fire safety signage for both halls and hostels

was counted and the results were 27 and 24 respectively. Moreover, there were more escape stairs in the halls compared to the hostels. It was observed that the West End hostel had no escape stairs. From the survey, it was concluded that the stairs at the West end hostels were not escaped stairs, which can help occupants escape if, in case there is a fire outbreak where the main stair is located. In addition, fire alarms were present in only the Wagyingo hostel whereas the other hostels under study had none. All on-campus halls had fire alarms fixed at the various residences under study.

Figure 4: Availability of fire safety provisions, Author's construct, 2022

The functionality of the various fire safety provisions in student accommodation.

Information was gathered from the respondents and residents, which says, "Because there has not been any fire outbreak incidence or occurrence, they cannot tell as to which of the fire safety provisions were working". Though some fire safety measures were put in place, it was difficult to tell if the provisions were working. However, investigation and interviews with the hall masters and workers of the halls and hostels showed that they were working just that there had not been any fire outbreak so people see it not to be working. They also reported that the fire extinguishers were working and were often checked if there were problems with them.

The awareness level of the various fire safety provisions in student accommodation by respondents.

Based on the reviewed literature, it was well stated that the lack of awareness level of fire safety provisions by occupants could also harm the occupants. Respondents were presented with the various fire safety provisions to access if they were aware of those provisions. Table 1 and figure 6, show that some respondents were aware of portable fire extinguishers and others were not aware of them.

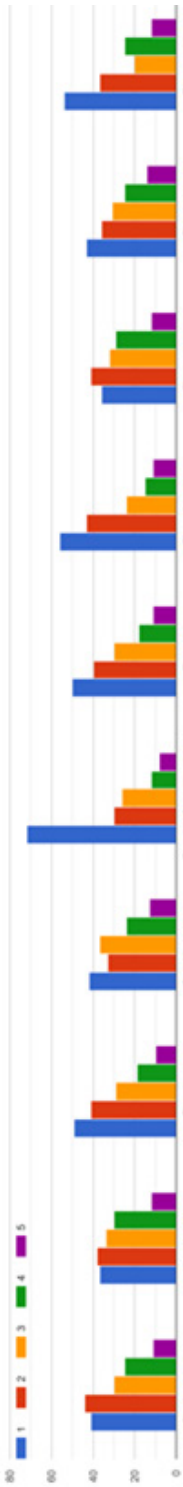


Figure 5: Functionality of fire safety provisions, Author's construct, 2022

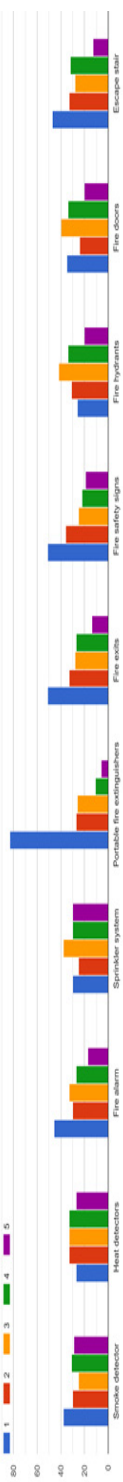


Figure 6: Awareness level of fire safety provisions by respondents, Author's construct, 2022

Table 1: Mean score analysis of the fire safety provisions in students' accommodation

Fire safety provisions	N	Mean	Standard Deviation	Standard Error Deviation	Rank
Portable fire extinguisher	1	1.8	1.15	0.9	1st
Fire safety signage	1	2.4	1.40	0.11	2nd
Fire exit	1	2.4	1.34	0.1	3rd
Escape stair	1	2.5	1.33	0.10	4th
Fire alarms	1	2.5	1.36	0.11	5th
Fire doors	1	2.8	1.35	0.1	6th
Smoke detectors	1	2.8	1.46	0.1	7th
Fire hydrants	1	2.9	1.28	0.10	8th
Heat detectors	1	2.9	1.36	0.11	9th
Sprinkler systems	1	3.0	1.39	0.11	10th

Assessment of current fire protection measures

The halls and hostels were assessed based on the availability of both passive and active fire safety provisions.

Reliability of fire protection systems

Active-fire prevention systems are not 100 percent reliable, which makes it difficult to detect a fire in its early stages, endangers residents' safety, and reduces the possibility of extinguishing or controlling a fire in its early stages. On the other side, malfunctioning active-fire protection systems, such as false alarms, can lead to mistrust of the fire alarm, undue fear, and significant property loss (e.g. water damage to sensitive furniture and paintings due to sprinklers). The major reliability constraint in the example of passive-fire safety measures is the structure's overall fire performance. Individual aspects of passive fire protection are frequently the focus of passive fire protection, with the assumption that if individual elements meet needed fire resistance standards, the entire system will be safe, these elements will also meet fire safety requirements in the construction of the structure.

Poor compliance with fire safety regulations

Despite the fact that developed countries experience fires more frequently than developing countries, the fatality rate in developed countries is significantly lower than that in developing countries with fewer fires [31]. The variance in compliance effectiveness or the degree to which fire safety requirements are applied, in the established building codes and standards of each nation is one of the main causes of this anomaly. This is crucial in terms of fire safety because if codes and regulations are not followed and properly implemented in the structures, the level of fire safety that is specified in them will be meaningless [31].

Lack of consumer education and awareness

The leading causes of fire in residential and non-residential buildings in the United States were examined to identify the major source

of structure fires [31], as the United States has the highest number of fires in the world and reliable global statistical data are scarce on fire hazards. Cooking is more common in residential structures, and the number of fires caused by cooking is higher in residential buildings than in non-residential buildings. Heating, electrical fault, negligence, open flame, and arson are some of the other primary causes of fire. However, it is obvious that, in comparison to cooking, this is the major cause, accounting for a significantly lesser fraction of the fire hazard in student housing. Increased consumer understanding of fire dangers can help to address these primary causes of fires. However, the current situation demonstrates a lack of the same. It should be emphasized that the primary causes of fire on KNUST may not necessarily reflect the fire situation in Ghana, but they do demonstrate the need for consumer knowledge when it comes to fire dangers [31].

CONCLUSION

Fire safety provisions in student accommodation buildings.

The first objective targeted the availability of fire safety provisions in students' accommodations. From the findings, there were some fire safety provisions in both the halls and hostel under study. Portable fire extinguishers were in abundance as compared to the other fire provisions. The information gathered from the literature showed that there were ten (10) fire safety provisions. However, it was observed that upon the information gathered from the literature relating to the provision of fire measures, there were many fire safety measures that were not provided in the halls and hostels under study. This could be a lack of knowledge on fire safety awareness by the hostel managers and the workers. Moreover, it was observed that some of the fire safety provisions at the halls and hostels were not functional. However, as for the portable fire extinguishers, it was told by the workers and the managers that the fire extinguishers were serviced more often.

Awareness level of fire safety provisions of these buildings.

The second objective focused on the awareness level of fire safety provisions by the occupants. The main challenges faced by the respondents were that many of them were not sure if they were aware of the fire safety provisions. In addition, other respondents showed that they were aware of fire safety provisions. This can be concluded that most people are not aware of fire safety provisions, that is, there is a low awareness level among the occupants. This could be a result of low insight into fire safety.

The following recommendations were brought to light from the research.

Education on fire and fire safety in various faculties.

The people must be well educated on fire and fire safety. From the data collected, many people were not aware of the fire safety provisions. During public gatherings like seminars, people should be trained and educated on fire safety provisions, also faculties and colleges should encourage it by inviting fire safety experts to educate students.

Public campaigns on fire safety by the management of the university.

The university should organize campaigns on fire safety through the student representative council. Social media can also be a means of public campaigns to broadcast and spread warnings to the people. Encouraging the use of fire safety signage at both students' accommodations and faculty areas.

DECLARATION OF COMPETING INTEREST

The authors declare no conflict of interest and that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

LIMITATION

The limitations that came with this study were the ability to reach many workers and the time spent with each participant. The hostels did not have guests moving around to have contact with them. The hostel managers who were able to participate made me wait for an hour before attending to me. Therefore, it was difficult to have an in-depth interview with them. On the other hand, the questionnaires sent to students online took time. Many of the respondents delayed in the questionnaires sent to their email. The limitation did not affect the credibility of the research. The respondents gave their full concern on the questions they were asked.

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