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Basic school pupils' knowledge of fire safety in the Sunyani municipality of Ghana

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Abstract
The incidence of fires in schools represents a significant hazard to pupils' safety and constitutes a pressing public concern. This study therefore sought to investigate the state of fire safety awareness and preparedness among basic school students in the Sunyani Municipal area. A cross-sectional study was conducted involving 200 pupils within Sunyani Municipal. Respondents were selected using random sampling. All data were analyzed using descriptive statistics. The study further found that fire drills and evacuation exercises were absent in both public and private schools, making pupils vulnerable. It also indicated that pupils in public schools were more vulnerable than those in private schools due to a lack of government financing for life safety systems. To address these findings, the study recommends the implementation of fire safety education programs, regular fire drills, collaboration with the Ghana National Fire Service (GNFS), clear emergency response plans, continuous monitoring, adjustment of fire safety initiatives and making provision for life safety systems in public schools capitation grant. These recommendations are essential to enhance the safety and well-being of basic school students in the Sunyani Municipal area and serve as a crucial step towards comprehensive fire safety preparedness.

Keywords
Life safety systems, Fire drill, Sunyani Municipal, Evacuation, Fire education

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1. Introduction

The occurrence of fires in schools poses a significant threat to the safety of pupils and is a matter of great public concern (Aidoo et al., 2020). Globally, fire incidents have far-reaching consequences, including loss of life, physical injuries, damage to valuable properties and infrastructures, and negative effects on the mental well-being of pupils (Seyedin et al., 2020). To effectively prevent and handle fire incidents, it is crucial to have a comprehensive grasp of fire safety knowledge, especially among pupils who are more susceptible to fire hazards due to their age and limited exposure to fire safety procedures (Kendal and Nichola, 2022). Despite the importance of fire safety education, there is limited information on the knowledge of fire safety systems, measures and awareness among basic school pupils in Sunyani Municipality and Ghana as

a whole (GNFS, 2018). Therefore, studies into the importance of fire safety play a vital role in minimizing the risks associated with fire outbreaks in basic schools of Sunyani Municipal (Kendal and Nichola, 2022). The World Health Organization (WHO) reports that fires rank as the fourth leading cause of unintentional injury deaths globally, with the majority of fire-related fatalities occurring in low- and middle-income countries, with children under the age of 14 being particularly vulnerable. The limited access to fire safety information, insufficient incorporation of fire safety education within school curricula, and constrained resources for the management of fire safety measures in Sunyani Municipal necessitate the study (Nakitto and Lett, 2010). Therefore, prioritizing fire safety education in basic schools and other institutions that cater for young people is essential to mitigate the risks of fire incidents (Kendal and Nichola, 2022). The critical factors that contribute to the diminished level of fire safety awareness among basic school pupils in developing nations of which Sunyani municipal is no exception are combustible materials, fire safety knowledge, fire enforcement regulations, accident investigation, urbanization, and the fire culture of the society (Nakitto and Lett, 2010: Omar et al., 2023). For instance, Fire safety knowledge of basic school pupils in Uganda was shaped by their socioeconomic status and access to information. These factors encompass limited access to information on fire safety, insufficient incorporation of fire safety education within school curricula, and constrained resources for the management of fire safety measures (Nakitto and Lett, 2010). The escalating occurrence of fires in primary schools has become a major worry for those involved in the education sector. According to reports from the Ghana National Fire Service (GNFS), there have been numerous instances of fire incidents in basic schools over the years. These fires have led to the loss of lives, injuries, and property damage. A recent incident took place at Miracle Preparatory and Junior High School in Baakoniaba, Sunyani Municipality, Ghana, on October 27, 2022. The fire rapidly spread, causing significant damage to the school's administration block and other property, though no casualties were reported the study into the knowledge and awareness of fire safety systems will help minimize future occurrences (Ghana News Agency, 2022). Fire safety education plays a crucial role in improving the level of fire safety knowledge, serving as an integral component of the continuous process that involves planning, organizing, training, equipping, exercising, evaluating, and enhancing strategies for effective coordination and capability improvement in responding to fire disasters (Pooley et al., 2021). The majority of basic schools in Sunyani Municipal lack fire safety education programs and gadgets (GNFS, 2018). Against this backdrop, this study sought to assess the; Knowledge of Fire safety measures and awareness among pupils, life safety systems among basic schools and the type of school (public or private) and its fire emergency preparedness, in the Sunyani municipality. This study therefore provides scientific documentary evidence to serve as a good foundation for churning out policy initiatives in this regard.

2. Materials and Methods

2.1 Study Design and Site

The study area of this research is the Sunyani Municipality, which is located in the Bono Region of Ghana (Figure 1). The municipality is situated between Latitudes 7^o19'N and 7^o140'N and Longitudes 2^o115'W and 2^o130'W and covers an area of approximately 110 square kilometres and has 136,022 inhabitants, with a significant proportion being children of school-going age.

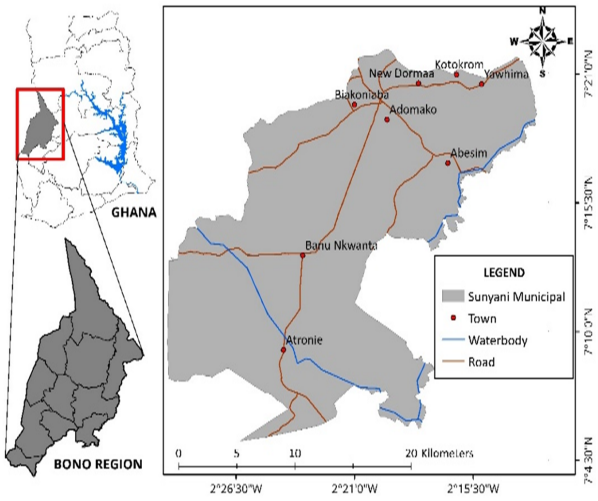

Figure 1. Study area map of Sunyani Municipal

2.2 SCriteria for selecting the study area

The Sunyani Municipal was purposively selected due to the high incidence of fire within the area. Some schools and communities have been affected by these fire incidences. An interview with an expert at the Bono Regional Public Relations office revealed that 254 fire cases were recorded in the year 2023 (GNA, 2024). These fires (Modern Ghana, 2022, GNA 2022) affected some Basic Schools. Although threats of fire pose several risks to the basic schools in the Municipality, important information concerning why, where, when, and how fire safety awareness and safety systems have not been thoroughly examined. These scenarios therefore informed the choice of the study area.

2.3 Research Design

This study adopted a cross-sectional research design to compare the fire safety knowledge and practices of pupils from different basic schools and look at the adequacy of

life safety systems in basic schools. This design ensured the identification of gaps in fire safety knowledge and practices of basic school pupils and made recommendations for improving fire safety measures and infrastructure in basic schools.

2.4 Target Population and Sampling Procedure

The target population is defined as the complete set of subjects or the entire environment of interest to the researcher (Willie, 2022). For this study, the target population consisted of pupils from both private and public schools located within the Sunyani Municipal boundaries, ranging from Primary 4 to Junior High School 3. The sampling procedure for this study was a multistage process designed to ensure a comprehensive and representative sample of basic school pupils in the Sunyani Municipal area. First, a comprehensive list of all basic schools, including both public and private schools within the municipality was compiled. These schools were then categorized into two distinct strata: private schools and public schools. Following the process, within each stratum four (4) schools were from each stratum using simply random sampling, yielding a total of eight (8) schools that were included in the study (Table 1).

Table 1. List of selected schools

Public school	Private school
St. Patricks R/C Basic School	Sunyani Ebenezer Pressby Preparatory
Methodist Primary and JHS School	JohnChris Preparatory School
SDA Basic School	Solomon Bennet Memorial School
Presbyterian Basic School	Divine Montessori

Within each of the selected schools, simple random sampling technique was applied to select eligible pupils. With Upper Primary 4-6 and Junior High School (JHS) 1-3 being the sampling frame. The total pupils'population for the upper primary and JHS for the 8 schools was 1200.The determination of the sample size was set at 200 pupils (25 each in a school), was calculated based on Cochran, W. G. (1963) formula (Equ. (1))

$$n = \frac{Z^2 \times \sigma^2}{E^2} \tag{1}$$

where: n = sample size, Z = Z-score (confidence level), σ = population standard deviation and E = margin of error.

Confidence level (Z-score) of 95% (Z = 1.96), Population standard deviation (σ) of 0.5 (or 50% of the population) and Margin of error (E) of 0.05 (5% of the population)

$$n = \frac{1.96^2 \times 0.5^2}{0.05^2} \qquad n = 200 \tag{2}$$

By way of ethical considerations, informed consent was sought from the headteachers and the teacher as the various schools. The study was conducted in such a way not to put any pupil in harm's way, they were also informed of their liberty to truncate the process of interview at any time.

2.5 Data Collection Procedure and Analysis

Data was collected through questionnaires. The questionnaires were distributed to the selected pupils to gather information on their fire safety knowledge, measures and practices. Quantitative data were collected employing a closed-ended questionnaire. The questionnaire encompassed a Likert scale and multiple-choice questions designed as a benchmark for assessing fire safety knowledge among basic school pupils. The questionnaire was divided into three sections. The first section gathered information on the demographics of the pupils, the second section assessed the fire safety knowledge of the pupils and the third section focused on pupils' knowledge of life safety systems. The headmasters' approval was obtained during the researchers' visit to the school, and the appropriate days for data collection were arranged. The data were analysed descriptively and inferentially using IBM Statistical Packages for Social Sciences (SPSS) version 26.0. All continuous variables were analysed using descriptive statistics and presented as frequency (percentages) for categorical variables. The relationship between the degree of awareness and knowledge regarding fire safety among students in government and private schools was examined using the chi-square test. Additionally, the Pearson correlation test was used to assess the relationship between student's class level (grades) and their fire safety awareness as well as the kind of school whether private or government and the adequacy of life safety systems.

3. Results

3.1 Demographic Characteristics of participants of the study

Table 2 presents key demographic findings from the survey. It reveals an equal split between public and private schools, with (100) 50% each. In terms of gender, there is a slight majority of male respondents (106) (53%) compared to female respondents (95) (47%). Notably, no participants were under 10 years old, and the majority (194) (97%) fell within the 10-15-year age range. Only a small proportion (6) (3%) are aged 16 and above. Regarding grade levels, an equal distribution is observed with (100) 50% in Primary 4-6 and (100) 50% in JHS 1-3.

Table 2. Demographic characteristics of participants

		Frequency (N)	Percentage (%)
Type of school	Public	100	50
	Private	100	50
Gender	Male	106	53
	Female	94	47
Age	Under 10yrs	0	0
	10-12yrs	102	51
	13-15yrs	92	46
	16yrs and above	6	3
Grade	Primary 4-6	100	50
	JHS 1-3	100	50

3.2 Pupils' familiarity with fire safety measures and procedures

The study revealed that respondents from private schools assert a greater degree of familiarity, with 9% claiming to be "very familiar," in contrast to the 2% from public schools. On the other hand, a larger proportion of respondents from public schools, at 27%, indicate being "somewhat familiar" with fire safety measures, compared to 21% from private schools. Notably, both public and private schools exhibit higher percentages of respondents expressing "not familiar at all" with fire safety measures, that is 71% and 70% respectively. The p-value of 0.074 in this Chi-square test depicts that there is no strong evidence to suggest a significant difference in students' familiarity with fire safety measures and procedures between Public and Private schools (Table 3). In private schools, a significant majority of respondents (70%) indicated being aware of the emergency number, while only 34% of respondents from public schools claim awareness. The p-value of 0.001 in the Chi-square test indicates that there is an extremely strong and statistically significant association between the type of school and students' awareness of the fire service emergency number (Table 3).

Table 3. Pupils' familiarity with safety measures and procedures

	Type of school		
	Public	Private	Chi-square tests
Very familiar with safety measures	2	9	$X^2 = 5.212$
familiar with safety measures	27	21	df = 2
Not familiar with safety measures	71	70	p-value = 0.074
Aware of Emergency Number	34	70	$X^2 = 46.721$
			df = 4
Not aware of Emergency Number	66	30	p-value = 0.001*

Where * means Significance of 5%

3.3 Initial action to be undertaken upon spotting a fire

The majority of respondents, constituting 63.0%, revealed that they would run and inform a teacher as their initial reaction to a fire. Meanwhile, 21.0% of participants stated that they would call the Ghana National Fire Service (GNFS) for assistance, while a smaller proportion of 7.0% expressed the intention to try extinguishing the fire themselves. Only 1.0% of respondents mentioned staying calm and shouting for help as their immediate response. Furthermore, 8.0% admitted that they did not know what to do in such a situation.

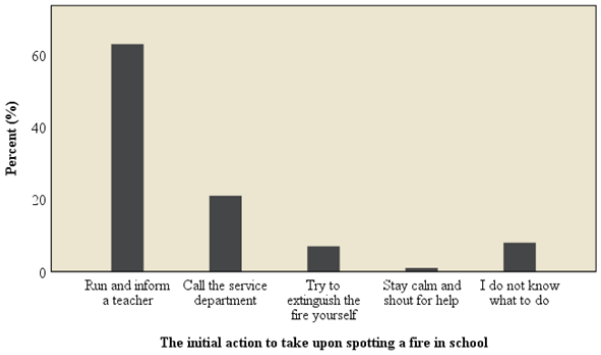

Figure 2. Initial action to be taken upon spotting a fire in schoolInitial action to be taken upon spotting a fire in school

3.4 School Management' knowledge of life safety systems in basic schools

The researchers held in-depth discussions with school administrators to assess their knowledge of life safety systems and awareness safety measures. The findings revealed that the mangement in public schools generally have limited knowledge about life safety systems and demonstrated a lack of awareness regarding the availability of life safety systems in their schools. The researchers also observed that essential life safety equipment, including fire hydrants, automatic sprinkler systems, fire hoses and hose reels, fire sand buckets, and heat/smoke detectors, were not available in their school public school. However private school had some of the life safety systems such as portable fire extinguishers which was inadequate. Similarly, a significant majority the school management believed fire blankets were unavailable, with a notable proportion unsure about their availability. Regarding fire alarm or warning systems, an overwhelming majority of schools believed they were not available, with only a small minority indicating any knowledge of their adequacy.

3.5 Availability of evacuation systems and plan

The findings revealed a striking 84.0% of respondents stated that an emergency assembly point did not exist in their school. An even higher percentage, 91.5%, expressed doubt about the existence of an evacuation plan and procedure (table 5). This information provided by the pupils were triangulated through interviews with the management and field observations. The triangulation confirmed that the information provided by the pupils were accurate.

Table 4. Level of evacuation systems and plan

	Exist (%)	Not Exist (%)	I do not know (%)
Emergency assembly point	0	84	16
Evacuation plan & procedure	0	91.5	8.5
General fire notice	0	100	0
Fire emergency signs & exit	0	100	0

3.6 The perspective of school management on fire safety in basic schools

The researchers also conducted interviews with school management to evaluate their understanding of fire safety protocols. The findings revealed that administrators in public schools generally have limited knowledge about fire safety, whereas their counterparts in private schools demonstrated a commendable level of understanding in this regard. Public school management disclosed that there has not been adequate education on safety measures and the appropriate actions for pupils and staff in the event of fire emergencies. In contrast, private schools have received education on the safety measures and the actions to be taken during a fire emergency, primarily provided by the Ghana National Fire Service. The school management stated that their premises lack life safety systems, except private schools that possess a limited number of portable extinguishers on their premises.

4. Discussion

4.1 Demographic characteristics of participants

The findings provided valuable insights into the demographic characteristics of the survey. One notable aspect is the balanced representation of public and private school students, with 50% in each category. This suggests that the survey effectively reached out to a diverse group of students from different types of educational institutions, ensuring a comprehensive view of the subject matter. In terms of gender distribution, the data shows a slight majority of male respondents at 53% and female respondents at 47%. This gender distribution may reflect underlying trends in the target population or the survey's outreach strategy. The absence of participants under the age of 10 in the survey data strongly suggests that the majority of students in the upper-level primary school category (Primary 4-6) are indeed above the age of 10. The overwhelming majority falling within the 10-15-year age range, at 97%, indicates that the survey predominantly captures the perspectives of early to mid-adolescents. It is crucial to consider the potential impact of age on responses, as younger and older individuals may have different viewpoints and experiences related to the survey topic.

4.2 Pupils' familiarity with fire safety measures and procedures

The findings presented in the assessment of the level of fire safety knowledge and practices underscore the need for improved fire safety awareness and education among basic school students. The data reveals that a significant majority of respondents, accounting for 70.5% of the total sample, indicated that they were not familiar at all with fire safety measures. Only a few of the pupils (5.5%) indicated their familiarity with fire safety measures and procedures (table 3). This lack of basic familiarity with fire safety measures is a concerning finding, as it suggests that a substantial portion of the surveyed population may be ill-prepared to respond effectively to fire emergencies. This lack of familiarity with fire safety measures is consistent with a study conducted by Ahiabor and Fobil in 2017 in Ghana found that a significant proportion of the population lacked knowledge of basic fire safety measures and procedures. This lack of awareness was attributed to a lack of education and public awareness campaigns on fire safety (Ahiabor and Fobil, 2017). Similarly, research conducted in other countries, such as Nigeria and Kenya, has also highlighted the need for improved fire safety education and awareness (Abah et al., 2018; Odumo et al., 2016). Concerning the awareness of the emergency number of the Ghana National Fire Service (GNFS). A substantial difference is evident between the two schools (public and private). In private schools, 70% of the respondents were aware of the emergency number, while only 34% of respondents from public schools claimed awareness. In the public schools 66% of the pupil report not being aware of the emergency number. This suggests that the type of school significantly influences whether pupils are aware of the emergency number for fire incidents in their school. Previous research has highlighted that students attending public schools often come from more diverse socioeconomic backgrounds compared to those in private schools. Socioeconomic factors can influence students' exposure to fire safety education and resources. This could explain the observed differences in awareness of the fire service emergency number between public and private school students (Smith et al., 2016). Additionally, research has shown that schools with well-structured and comprehensive fire safety programs tend to have better-prepared pupils, however, standardization can help bridge the gap in awareness and preparedness (Hassan et al., 2018; Pamidimukkala et.al, 2023)

4.3 Initial action to be undertaken upon spotting a fire

The study provided highlights on the initial responses of pupils upon noticing a fire within their school premises and assessed whether students' grades influence their actions during such emergencies. The majority of respondents (63.0%) indicated that their initial reaction to a fire would be to run and inform a teacher, which is a responsible action to take as it ensures that trained personnel can respond to the situation. Additionally, 21.0% of participants stated that they would call the Ghana National Fire Service (GNFS) for assistance, highlighting an awareness of external support in fire emergencies.

However, a concerning finding is that only a small proportion of respondents (7.0%) expressed the intention to try extinguishing the fire themselves, which may pose risks if not done properly. Furthermore, a negligible percentage (1.0%) mentioned staying calm and shouting for help, which is a crucial safety measure during fire emergencies. This finding aligns with the recommendations of fire safety experts who stress the importance of remaining calm and alert during a fire emergency (National Fire Protection Association, 2020). Additionally, 8.0% admitted that they did not know what to do in such a situation, indicating a lack of fire safety awareness among some students. The statistical analysis using Spearman correlation revealed a significant difference in students' level of education (grade) and their initial actions during a fire. With a p-value of 0.001, there is strong evidence to suggest that students' grades influence their responses to fire emergencies. This finding underscores the importance of providing fire safety education tailored to different age groups, as older students may demonstrate more informed and responsible actions compared to younger students. This lack of preparedness is a significant concern, as fire drills are essential for ensuring that individuals know how to safely evacuate a building during a fire emergency. Research has emphasized the importance of regular fire drills in educational institutions to enhance preparedness and response (Zahari et.al, 2014; Ahmed, 2024).

4.4 Pupils' knowledge of life safety systems in basic schools

The findings on the assessment of the adequacy of life safety systems in basic schools raise significant concerns about the state of fire safety preparedness in these educational institutions. The findings highlight significant deficiencies in crucial fire safety equipment, systems, and features within the surveyed schools. A majority of school management believe that essential fire safety resources, such as fire hydrants, automatic sprinkler systems, fire hose and reels, fire sand buckets, and heat/smoke detectors, are not available in their schools. Additionally, there is a concerning perception that portable fire extinguishers are either inadequately available or absent. The availability of essential fire safety resources in schools is a critical aspect of fire safety management. Research has consistently shown that the lack of these resources has hindered effective fire prevention and response (NFPA, 2015; USFA, 2017; NFIRSB, 2019).

4.5 Availability of evacuation systems and plan

Moreover, the data reveals a striking absence of key fire safety features and resources within the school environment, including emergency assembly points, evacuation plans and procedures, and general fire notices or emergency exit signs. These deficiencies raise serious concerns about the ability to respond effectively to fire emergencies, posing potential risks to the safety of students and staff. One of the most alarming findings is that all respondents (100%) perceived that critical fire safety practices, including the maintenance of electrical installations and safety equipment, regular inspection of firefighting equipment, prohibition of flammable substances, and the conduct of fire drills, are never implemented within their schools. This suggests a severe lack of adherence to essential fire safety protocols and highlights potential negligence of fire safety responsibilities within the school administration. These findings align with the broader literature on fire safety in educational institutions including research by (Cele, 2016; Chepkonga, 2017; Chinnarani, 2018) have revealed deficiencies in fire safety infrastructure and practices in schools. These studies emphasize the importance of robust fire safety measures in educational settings and the need for comprehensive fire safety education programs. The data revealed that there is no notable disparity in fire safety awareness among basic school students, particularly between public and private schools. A considerable number of pupils in the schools appear to lack sufficient knowledge about fire safety, as highlighted by the study. This raises concerns about the preparedness of these pupils to respond appropriately in the event of a fire emergency. This was consistent with a study done by Kendal & Nichola, 2022 which indicates that fire safety education is essential for promoting fire safety awareness and prevention of fire-related injuries and fatalities in basic schools and the lack of emphasis on fire safety education in public schools could contribute to the knowledge gap among pupils.

4.6 The perspective of school management on fire safety in basic schools

The researchers also delved into the perspectives of school management by conducting interviews to assess the availability of fire safety protocols. The findings indicate that administrators in public schools confirm the lack the knowledge of fire safety and systems in their schools. This knowledge gap among school management could have implications for the overall safety measures and preparedness within public schools. The management of these public schools relies entirely on government funding. Since fire safety education is not included in the capitation grant, obtaining logistics for the Ghana National Fire Service to conduct fire safety education becomes challenging. Similarly, Akomah and Kotey (2018) found that the lack of funds and the high cost of fire safety equipment are the key reasons for non-compliance with fire safety. Conversely, the data reflects a positive trend in private schools, where administrators demonstrate a commendable level of understanding in terms of fire safety. This suggests that private schools do sometimes implement some measures, training, or educational programs to enhance fire safety awareness among both pupils and staff. In contrast to public schools, the study found that private schools can afford to provide logistics for the Ghana

National Fire Service to carry out fire safety training and education for both pupils and staff. The revelation that the school management acknowledges a deficiency in fire safety and life safety systems on their premises raises concerns about the overall safety preparedness of these educational institutions. Without adequate life safety systems, schools may face challenges in responding promptly and effectively to fire emergencies, putting the safety of pupils, staff, and the school infrastructure at risk. The exception mentioned, where some private schools possess a limited number of portable extinguishers, highlights a positive step towards addressing this issue. Portable extinguishers are crucial components of fire safety, providing a means for immediate response in case of a small fire outbreak. However, the term "limited number" suggests that there may still be room for improvement in terms of the quantity and variety of life safety systems available.

5. Conclusion

The present research study has provided valuable insights into the state of fire safety awareness and preparedness among students in basic schools. The findings have highlighted critical areas of concern that warrant immediate attention to enhance the safety of students and staff in educational institutions. The research revealed that a substantial portion of basic school students in Sunyani Municipal lack basic fire safety awareness. Many respondents exhibited limited knowledge of essential fire safety measures and procedures. This underscores the pressing need for comprehensive fire safety education programs tailored to the unique needs of this demographic. It is imperative to equip pupils with the knowledge and skills necessary to respond effectively to fire emergencies. Furthermore, the study exposed disparities in fire safety awareness between public and private schools, highlighting the importance of standardized fire safety curricula and education initiatives across all school types. Equity in fire safety knowledge and preparedness is essential to ensure that every student, regardless of the school they attend, is adequately prepared to face fire emergencies. The examination of fire safety measures and infrastructure in basic schools revealed significant deficiencies in the availability of critical life safety systems. The absence of essential fire safety features within the school environment poses a grave risk to the safety of pupils and staff during fire incidents. Addressing these deficiencies must be a top priority, with a focus on improving the availability of firefighting equipment and developing comprehensive fire evacuation plans. Based on the findings, it is clear that there are significant gaps in fire safety knowledge, practices, and infrastructure in basic schools in the Sunyani Municipal area. Schools should implement comprehensive fire safety education programs that cover basic fire safety knowledge, emergency procedures, and preventive measures. These programs should be integrated into the curriculum and conducted regularly. All, schools through effective collaboration with the Ghana National Fire Service should develop and communicate clear emergency response plans and procedures to students and staff. These plans should include designated assembly points and escape routes.

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8. Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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