



## **Fire Disaster Preparedness and First Aid to Fire Burn Victims: A Case of Primary Schools in Morogoro Municipal and Mvomero District, Tanzania**

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### **ABSTRACT**

*The rising number of fire incidents, resulting in injuries and fatalities, has raised public concern regarding fire outbreaks in schools. This study aimed to evaluate the level of fire disaster preparedness among primary school students at Morogoro municipal and Mvomero district. The research methodology is based on an empirical quantitative approach, using surveys as data collection instruments. The survey employed structured questionnaires consisting of closed-ended questions to elicit responses from pupils and to gain insights into their awareness, knowledge and attitude. The data was analyzed using the Statistical Package for the Social Sciences (SPSS) software. The findings revealed that majority of respondents, 287(73.8%), were aware that fire accidents can occur within the school premises. Furthermore, 290(74.6%) acknowledged that fire outbreaks can cause damage to properties, including homes, schools, and marketplaces. Interestingly, a majority of participants, 322(82.5%), expressed a belief that they have limited ability to prevent fire incidents due to the absence of fire training in schools. The study concludes that while a majority of respondents, 316 individuals (81.2%), understand the adverse impact of wildfires on the environment, the local community remains a source of environmental destruction. The study findings emphasize the strong recommendation for prioritizing public education on fire prevention, emphasizing its significant importance. It is crucial to integrate fire prevention education into the school curriculum as a proactive measure. It is essential to provide training to the school community, including both students and parents, on the appropriate actions to take in the event of a fire outbreak. The training should cover specific steps tailored to different types of fires, ensuring preparedness and safety measures are in place.*

**Keywords:** Fire disaster, preparedness, safety measures, Mvomero, First Aid, Morogoro

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## INTRODUCTION

Fire can be defined as the occurrence resulting from the interaction between a combustible material and oxygen, emitting light, heat, and smoke. It involves a chemical reaction wherein the heat stored within a flammable substance is released along with the production of light and smoke (Obasa et al., 2020). Nevertheless, due to the rise in anthropogenic activities, fires are exerting a detrimental influence on the environment, society, and the economy. The probability of an incident qualifying as a disaster is escalating due to higher population densities and the expansion of settlements in high-risk zones. Fire disasters pose a significant concern in Africa, leading to the conclusion that these incidents are expected to escalate further (Arturson, 2000; Wade et al., 2007).

The African continent has long been referred to as 'the fire continent' due to the high incidence of fires it experiences (Archibald et al., 2010). Tanzania is no exception, as it has also faced numerous natural and human-induced disasters, resulting in loss of lives, property, and environmental destruction (Kachenje et al., 2010). Fire outbreaks that pose a potential for disasters have been a cause for concern in both urban and rural areas. In urban areas, fires have been observed in buildings used for various purposes, including residential, commercial, educational, and office spaces, as well as mixed-use establishments (URT, 2007). Consequently, the frequency of fire outbreaks in buildings and houses tends to be higher compared to other types of premises. In the city of Dar es Salaam, fire incidents in buildings have represented a significant portion, ranging from 38.3% to

55.8% of all fire outbreaks recorded during a four-year period from 2005 to 2008 (Kachenje et al., 2010). According to a report by the US Fire Administration, there were approximately 1,300,000 fire cases annually between 2008 and 2017, resulting in 3,400 fatalities and 15,000 injuries (USFA, 2018).

Fire outbreaks entail significant losses in terms of human lives, material assets, economic resources, and environmental impact. In many cases, the magnitude of these losses surpasses the resources and capabilities of the affected institutions to effectively address and manage on their own (Msowoya, 2019). A notable example is the tragic incident at Shauritanga Secondary School in the Kilimanjaro region, where a fire engulfed the school dormitories, leading to the loss of over 40 pupils' lives (Nestory, 2017). The casualties primarily occurred due to smoke inhalation, the toxic fumes produced by burning electrical materials, exposure to flames, injuries sustained during evacuation, and some unfortunate individuals perishing in their sleep within the scene of the fire disaster (Nestory, 2017).

According to study conducted in Nyeri Central District, Kenya, focusing on fire disaster preparedness among secondary schools, revealed that a majority of head teachers (77.8%) had not received training in this area (Gichuru, 2013). Additionally, 39.3% of participating teachers reported that the staff members had not received training. The study further indicated that 58.3% of the schools had personnel who were trained to handle fire emergencies, and over 60% of the teachers reported the

existence of fire alert procedures (Gichuru, 2013).

Fire outbreaks have significant environmental consequences as they release various gases and solid particles into the atmosphere, affecting the biosphere on local, regional, and global scales. These emissions include substances such as atmospheric particulate matter (PM) and various gaseous compounds, including carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), methane (CH<sub>4</sub>), non-methane hydrocarbons (NMHC), nitrogen oxides (NO<sub>x</sub>), and nitrous oxide (N<sub>2</sub>O) (Valente et al., 2007). The smoke pollution resulting from these fires poses a significant public health concern, particularly for individuals involved in firefighting activities (Brustet et al., 1991; Valente et al., 2007). Additionally, it should be noted that these emissions can result in increased levels of tropospheric ozone, extending beyond the immediate vicinity of the emission sources (Crutzen & Carmichael, 1993). The environmental consequences associated with these emissions are intricately linked to the processes of transport and deposition.

According to Gennarelli and Kotapa (1992), first aid refers to the initial care provided to accident victims before professional medical assistance is available. The primary goal of first aid is to prevent and, if possible, reverse further harm. It involves prompt and straightforward actions, such as ensuring clear airways, applying pressure to stop bleeding, or treating chemical burns on the skin or in the eyes. Given the urgent need to provide relief to burn victims within a limited timeframe and the significance of specific first-aid techniques, it is essential

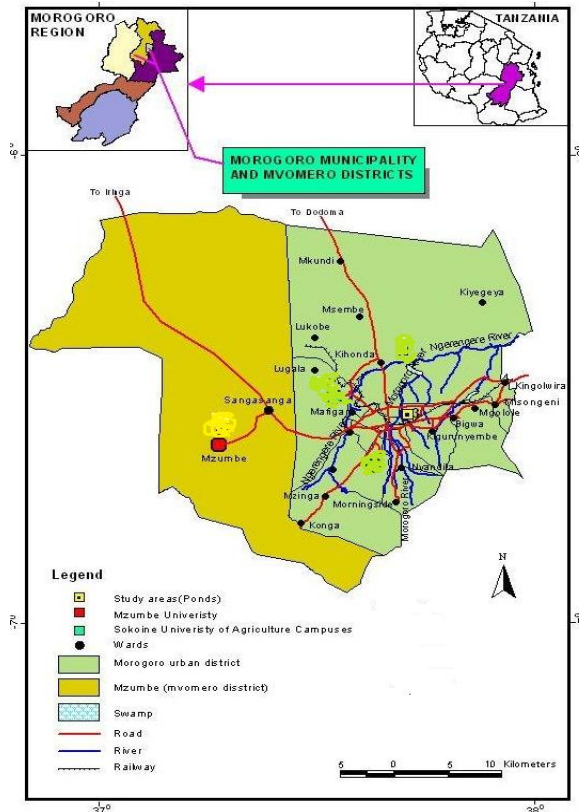
to consider three distinct phases of relief operations: immediate assistance, first aid, and organized relief even during the planning stage (Sorensen, 1979). The provision of appropriate first aid care is straightforward, making it feasible for even non-medical personnel to administer. However, despite the critical importance of this aspect of healthcare, there is limited available data on the initial care provided to burn patients in Tanzania. In an initial study conducted by Temu et al. (2008), it was discovered that a range of substances, including water, honey, dung, and kerosene, were applied to burn wounds. Ringo and Chilonga's (2014) study further revealed that insufficient management of burn wounds began immediately after the injury and continued throughout the hospitalization period.

This study aims to assess the awareness, knowledge, and attitudes of primary school children in Morogoro municipal council and Mvomero district regarding the impacts of fire outbreaks. By involving younger generations in the study, we can better understand the extent of community engagement in raising awareness about fire outbreaks. It is important to note that Africa experiences a wide range of wound types and causes, and while interventions for these injuries are readily available in urban hospitals, rural communities often rely on traditional medicine (TM) as their primary source of treatment. Hence, the primary objective of this study is to evaluate the knowledge and attitudes of students regarding fire outbreaks, with the aim of proposing appropriate strategies for improvement. By gaining a deeper understanding of children's awareness about the consequences of fire outbreaks, human risks, environmental degradation,

and sustainable habits, we can promote parental involvement in raising environmentally conscious children.

## METHODOLOGY

### Description of the Study Area



**Figure 1:** Map of Morogoro Region showing Study Area

This study was conducted in the municipality of Morogoro and Mvomero district at Morogoro region which is found in the middle of Tanzania (Figure 1). Morogoro region is located at 6°49' S and 37°40' E. Morogoro municipality among the regions with the highest level of urbanization in Tanzania and ranked fifth after Dar es Salaam, Mwanza, Mbeya and Arusha City Councils (Wenban-Smith, 2015). The Morogoro Region has a tropical savannah climate with regular rainfall. In lowlands, the annual average temperature ranges from 18°C to 30°C. Nearly the entire year, the region receives

moderate temperatures of about 25°C. Morogoro Municipal was chosen due to the tragic incident in August 2019 when a fuel tanker burst into flames, resulting in over one hundred deaths and numerous serious injuries at Msamvu-Morogoro (Msowoya, 2019). Mvomero District was selected because of the residents' frequent use of fire for land clearing or animal hunting

### Research Design

The sample was drawn from 20 primary schools, with 10 schools from Morogoro Municipal and 10 from Mvomero District. Each selected school contributed 20 standard seven pupils (10 boys and 10 girls), who were chosen through systematic sampling from the respective lists of standard seven boys and girls. The 20 primary schools were also selected through systematic sampling from the lists of schools in Morogoro Municipal and Mvomero District. The student sample was obtained using a combination of stratified sampling and convenience sampling methods, chosen for their accessibility to the researchers.

### Sample Population

The focus population for the study was standard seven primary school pupils in Morogoro Municipal and Mvomero District, Tanzania. The sample size was determined according to Yamane (1967:886).

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

Where  $n$  = sample size,  $N$  is the population size (15,935), From the formula above the sample size was drawn from a population

of 15,935 standard seven pupils (7,507 from Mvomero district and 8,428 from Morogoro Municipal) in the year 2020. The  $e$  is the level of precision at 95% confidence interval level the value of  $p = 0.05 = 0.05$  for single tail.

Therefore:

$$n = \frac{15,935}{1 + 15,935 (0.05)^2} = 389 \text{ pupils} \quad (2)$$

### Sample Tool

After questionnaires were designed were pre-tested at Kilosa district (Rudewa Primary School and Gongoni Primary School). A cross-sectional study was conducted using a pretested questionnaire among 389 standard seven primary school pupils. Data collected between 10<sup>th</sup> to 30<sup>th</sup> September 2020. Regarding the attitude towards fire knowledge on impact of fire outbreak, the respondents were asked to respond to 11 statements, on a five-point Likert scale ranging from 5-point Likert Scale with category of strongly agree, agree, strongly disagree, disagree and don't know. Regarding attitude towards the

impact of fire outbreak, respondents were asked to respond to 10 statements, on the same Likert rating scale. The data was analyzed using SPSS version 16.

## RESULTS AND DISCUSSION

In this study, the male respondents constituted 49.1% while female respondents constituted 50.9% of the sample. The male and female respondents were almost equal because the sample population from standard seven had equal number of male and female pupils. Therefore, the data collected were not biased against gender as gender balance was effectively covered.

### Attitude towards fire safety and control measures

The attitude of respondents towards the fire safety and control measures was evaluated using spellings survey based on ten items (Table 1). In the discussion we have combined responses of strongly agree and agree as well as disagree and strongly disagree.

**Table 1:** Responses towards attitude on fire safety and control measures

Questions	Strongly agree (%)	Agree (%)	Disagree (%)	Strongly disagree (%)	Don't Know (%)
Fire outbreak can occur in areas such as Home, Buildings, Schools or Markets	287 (73.8%)	99 (25.4%)	3(0.8%)	0	0
Fire Outbreak can cause damage to Home, School or Market properties.	290 (74.6%)	92 (23.7%)	6(1.5%)	1(0.3%)	0
Fire Outbreak can cause injuries and death to people and other living organisms.	336 (86.4%)	51 (13.0%)	1(0.3%)	1(0.3%)	0
People should not light cigarettes and smoke closer to petrol stations as it can cause fire outbreak.	322 (82.8%)	64 (16.4%)	2(0.5%)	1(0.3%)	0
Every Pupil should be trained in what to do and not to do in case of fire outbreak.	297 (76.3%)	81 (20.8%)	6 (1.5%)	4 (1.0%)	1(0.4%)
Fire sources such as ash trays, smoking materials, heaters, hot plates, tea pots etc. should be kept well and away from beds and bedding.	226 (58.6%)	107 (27.5%)	34(8.7%)	20 (5.1%)	2 (0.6%)
It is important for pupils to prepare for fire fighting in case of fire outbreak instead of escaping it.	180 (46.3%)	96 (24.7%)	70(18.0%)	42 (10.8%)	1(0.2%)
Every Pupil should be trained in using fire extinguishers.	284 (73.0%)	93 (23.9%)	11(2.8%)	1 (0.3%)	0
Teaching pupils about fire safety in schools is a waste	4(1.0%)	3 (0.8%)	97 (24.9%)	285	0



Questions	Strongly agree (%)	Agree (%)	Disagree (%)	Strongly disagree (%)	Don't Know (%)
of time.				(73.3%)	
There should be a Law requiring all schools to train staff and pupils about fire accident.	250 (64.3%)	117 (30.1%)	13 (3.3%)	8(2.1%)	1(0.2%)

Majority of pupils (99.2%) agreed that fire outbreak can occur in areas such as home buildings, schools, marketplaces and petrol stations. In addition to that, 98.3% of respondents agreed that fire outbreak can cause damage at home, school or market properties, while 382 (99.7%) they are aware of fire outbreak to cause injuries and death to people and other living organisms. This was in line with results reported (Kala, 2023), who indicated that fire outbreak has a potential impact on people, property and the environment all over the world. He went further indicating fire outbreak can result into losses as well as deaths, widespread damage to property and contents and significant impacts on the environment. Hwang et al., (2006) indicated one of the most significant factors in fire occurrence and the afterward casualties are the humans' unsafe actions, and this is deemed as the main factor of burn incidents.

Majority of respondents 333(86.1%), agreed that fire sources such as ash trays, smoking materials, heaters, hot plates and tea pots should be kept well and away from beds and bedrooms. According to Bhebhe, et al., (2019), there are several causes of fire ignition in schools. These include electrical, heating, smoking, and intentional causes. In addition, poor safety management and housekeeping practices are critical causes of fires in schools (DHS, 2007).

Majority of respondents 378 (97.1%) agreed every pupil should be trained on what to do and not to do in case of fire outbreak while 276 (71%) agreed that it is important for pupils to prepare for firefighting in case of fire outbreak instead of running away. Lambie et al., (2015) in his study indicated the gap of teachings in a society is considered as a risk factor of fire occurrence. The problem can be largely solved by teaching safety cautions regarding fire such as how to use fire extinguishers practically and exercise emergency evacuating for the target groups including the students and the school principals (Lovreglio et al., 2015).

The study also revealed that 94.4% students were aware with a by law requiring all schools to train staff and pupils about fire outbreak accident and only 21 (5.4%) think there is no need of having school by law or government law enforcement to schools for fire outbreak. Amuli (2019) indicated that fire outbreaks continued to occur in schools due to the existence of critical issues which were not resolved on time despite the government issued policy directives like accountability, sabotage, irresponsible school managements and unreliable sources of electrical power.

More than half of respondents (53.4%) don't know, or they do not have knowledge about fire triangle. This was not surprising because the majority of respondents (82.5%) had indicated that there was little they could do to prevent

fire in their homes. This shows that pupils do not have an idea on how to stop fire. That means one of the three elements of the fire triangle must be removed. According to Caplan *et al.*, (2008); if fire runs out of fuel, it will smolder out; if you can cool fire down, it will lose heat and go out; and if the oxygen is removed it will suffocate. Therefore, attempts at combating fire and also preventing fire are based upon these principles. The process can be done by using either fire blankets, for example, suppress a fire by blankets, removing the oxygen by applying carbon dioxide fire extinguishers and as a result, putting it out. Similarly, fire extinguishers are developed to eliminate one of the three

elements such as water fire extinguishers which cool the fire down and remove any heat (Caplan *et al.*, 2008).

There are three essential elements which cause fire, which are fuel source, sufficient heat to ignition and the presence of oxygen (Pentapati *et al.*, 2015). These three elements are commonly referred to as fire triangle, increasing the risk of fire accidents. Three basic techniques for fire extinguishing include starvation (removing the fuel from the fire), blanketing (by limiting the oxygen supply) and cooling (to remove heat). Table 2 indicated responses of students on knowledge about fire outbreak.

**Table 2:** Responses of Pupils for Questions Regarding Knowledge about Fire Outbreak

Question	Strongly agree N (%)	Agree N (%)	Disagree N (%)	Strongly disagree N (%)	Don't know or no answer N (%)
I know about fire triangle and its components.	80 (20.6%)	101(26.0%)	100(25.7%)	57 (14.7%)	51(13.0%)
I know about the different types of fire outbreak.	212 (54.5%)	149(38.3%)	12 (3.1%)	5(1.3%)	11(2.8%)
I know about different types of fire extinguishers	216 (55.5%)	139(35.7%)	14 (3.6%)	7(1.8%)	13(3.4%)
I know about dos and don'ts in case of fire outbreak.	226 (58.1%)	129(33.2%)	18 (4.6%)	10(2.6)	6(1.5%)
I know about the use of fire extinguishers.	207 (53.2%)	134(34.4%)	24 (6.2%)	12 (3.1%)	12 (3.1%)
There is little I can do to prevent fire in my home.	200 (51.4%)	121(31.1%)	46 (11.8%)	20 (5.1%)	2(0.6%)
When a fuel tanker gets an accident and crushed, people should avoid gathering at the accident site to loot the fuel.	246 (63.2%)	46 (11.8%)	35 (9.0%)	61 (15.7%)	1(0.3%)
Most people who die of fire are killed by smoke, gases or lack of oxygen and not by the flames.	121 (31.1%)	105(27.0%)	83 (21.3%)	76 (19.5%)	4(1.1%)
Educating the public about fire prevention will do much to reduce the number of fire out breaks.	320 (82.3%)	56 (14.4%)	6 (1.5%)	5(1.3%)	2(0.5%)

This was contrary to previous study in India (Kumar, et al., 2016), which found that only about 7% of the respondents were aware of the fire triangle and its components and 4.4% knew about different types of fire. Also only 15% of the participants were aware about different types of fire extinguishers 7% of the respondents were aware of the fire triangle and its components and 4.4% knew about different types of fire (Kumar, et al.,

2016). Knowing types of fire is crucial because there are different extinguishers to tackle different types of fire. The fire and its corresponding extinguishing agent combination must be adhered to, not only for efficient firefighting but also because

the incorrect combination might also turn lethal (Izadkhah and Hosseini, 2005).

Using a fire extinguisher during an emergency can be intimidating, especially

if you do not know the proper way to use one. Majority of respondents 332 (85.4%) indicated they know how to use fire extinguisher. However, approximately the same ration 321 (82.5%) indicated that indicated there is little they can do in case of fire at home.

The fire triangle, also referred to as the "combustion triangle," consists of the three essential components required to initiate and sustain a flame: fuel, heat, and oxygen. In the absence of any of these elements, fires cannot be ignited or maintained. Surprisingly, less than half of the respondents, specifically 181 individuals (46.6%), are aware of the concept of the fire triangle. However, most respondents, 361 individuals (92.8%), possess knowledge about various types of fire outbreaks. Additionally, 355 respondents (91.2%) are familiar with different types of fire extinguishers, and 341 respondents

(87.6%) have a basic understanding of how to use them.

These findings indicate that although the fire triangle is taught as part of the curriculum in classrooms, there is a lack of practical fire training or drills in schools. The need for training was expressed by a significant majority of respondents, with 376 individuals (96.7%) recognizing its importance. In a study conducted in Uganda schools by Nakitto et al. (2010), it was revealed that approximately 50% of the surveyed schools had received training on fire safety, including the usage of fire extinguishers, firefighting techniques, and causes of fires.

### First Aid Rendering to Victim from Different Types of Fire

A significant number of respondents, 101 (26%), expressed disagreement, while 143 (36.8%) strongly disagreed with the notion of advising someone to run away if their clothes catch on fire due to a petrol spill (Table 3).

**Table 3:** Responses of Pupils for Questions Regarding Awareness on First Aid Rendering on Different Types of Fire Victims

Question	Strongly agree N (%)	Agree N (%)	Disagree N (%)	Strongly disagree N (%)	Don't know or no answer N (%)
If my friend's clothes catch on petrol fire, I will ask him/her to run away	61(15.7%)	76 (19.5%)	101(26.0%)	143 (36.8%)	8(2.0%)
To extinguish my friend's clothing due to spill of petrol, I will use a jet of water directly to his/her body.	85(21.9%)	89 (22.9%)	111(28.5%)	93 (23.9%)	11(2.8%)
I can use water or wet clothes to cool the burned parts of my friend's body.	134(34.4%)	121 (31.1%)	74(19.0%)	52 (13.4%)	8(2.1%)
Washing the burned area with water at room temperature is the first correct step in case of burn injuries	32(8.2%)	81(20.8%)	245(63.0%)	4(1.0%)	26(6.7 %)
Burned part should not be medicated with ailments or other drugs as these would only mask the part.	74(19.0%)	92(23.7%)	126(32.4%)	86 (22.1%)	11(2.8%)

It is recommended to advise them to "Stop, Drop, and Roll technique (Lieberman, 1978). This means they should stop moving, drop to the ground, cover their

face with their hands, and roll back and forth to smother the flames. Running can actually fan the flames and spread the fire further, increasing the risk of injury.



Using a jet of water directly on a person's body to extinguish clothing that is on fire due to a petrol spill is not recommended. A significant portion of respondents, comprising 85 (21.9%) who strongly agree and 89 (22.9%) who agree, lack awareness regarding the potential consequences of using water to extinguish a petrol fire. Water can spread the fire and cause the petrol to splash, potentially making the situation more dangerous. It is recommended to follow the "Stop, Drop, and Roll" technique, where the person should stop moving, drop to the ground, and roll to smother the flames (Lieberman, 1978). Additionally, removing any burning clothing and using a fire blanket or non-flammable material to smother the fire is safer options. It's important to prioritize personal safety and seek immediate professional medical assistance in such situations (Seyedin, et al., 2020).

When asked about the initial action to take when a person has a burn on their body, a significant percentage of respondents (34.4% and 31.1%) expressed strong agreement and agreement, respectively, that the first step should involve using water or wet clothes to cool the affected area. Conversely, 19.0% and 13.4% disagreed and strongly disagreed, respectively, with the notion that using water or wet clothes to cool the burnt parts of the victim is the primary step.

Most students, specifically 245 individuals (63.0%), are unaware that the initial correct step in treating burn injuries involves washing the burned area with room temperature water. According to

Lawrence (1986), the primary objective in caring for burn wounds is to disperse the heat. Even after removing the heat source, the temperature beneath the skin continues to rise for a period. It takes approximately 3 minutes for the tissues to return to normal body temperature (King and Zimmerman, 1965). Promptly cooling burn wounds with cool tap water through techniques such as lavage, soaks, compresses, or immersion proves to be effective. Sustained cooling for the first 10 minutes dissipates heat, reduces pain, delays the onset of symptoms, and minimizes the extent of swelling caused by burns by decreasing the release of histamine from the skin's mast cells.

As stated by Arturson (1996), it is crucial to subject the burned area to a continuous flow of cool water for a minimum duration of five minutes to alleviate swelling. Other experts, such as Caison (1981) and Werner and Grose (2003), consider additional risks and the accident environment to ensure the safety of the burn victim. It is essential to move the individual away from the burn source, and in the case of an electrical burn, the power source must be switched off before coming into contact with the victim. Following that, any constrictive items like belts and jewelry in or near the burned areas should be removed. Subsequently, the burned area should be covered with a clean, moistened cloth or bandage, employing cool and clean water (Ronan et al., 2015).

Only a small number of respondents, specifically 74 individuals (19.0%), are aware that applying ointments or other medications to a burned area would simply conceal it. Shrivastava and Goel (2010)

emphasized the importance of not using ointments, creams, lotions, powders, grease, ghee, gentian violet, calamine lotion, toothpastes, butter, coloring agents, or other sticky substances on burn wounds. These products hinder the accurate assessment of the burn wound's nature, depth, and extent, making it challenging to provide appropriate treatment (Kramer, et al., 2004).

## CONCLUSION AND RECOMMENDATIONS

Fires outbreaks impose adverse consequences on human and the natural environment including contamination of the air via the fire plume and its subsequent diffusion. With deposition of particulate and other materials likely to contaminate soil, air and water. Although there was an appreciable level of positive attitude towards fire outbreak and control amongst the students, there were deficits in their knowledge about fire control measures in most areas. The knowledge of the students could be improved by emphasizing on fire control practices. A school must always understand the importance of fire prevention and be a fire-safe place for our children. School fire safety measures, fire devices, fire drills, fire exits, fire escapes fire alarms are just components of good school fire safety measures.

School fire tragedies and disasters can be prevented if proper fire safety measures are in place and religiously implemented, school authorities are well informed, right school personnel are suitably designated to implement such measures, all government fire safety policies are followed and of course proper training and cooperation by students and faculties. Students need to be

trained by firefighters on how to use some of the firefighting appliances like fire extinguishers. School authorities should make sure that they regularly inspect the electrical wiring of the premises.

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