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RESEARCH ARTICLE

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## PREPAREDNESS FOR FIRE OUTBREAK IN BOARDING SECONDARY SCHOOLS IN NYAMIRA COUNTY, KENYA

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### ABSTRACT

**Background:** Fire disasters in secondary schools lead to deaths and destruction of property. Consequently, there is a need to identify the causes and also evaluate the preparedness for fire outbreaks. **Methods:** A descriptive cross-sectional study design was used to investigate the causes of fire outbreak and evaluated the level of preparedness for fire outbreak in boarding secondary schools in Nyamira County, Kenya. Purposive sampling method was used to select 50 principals and 5 Sub-county educational officers from the schools. Both quantitative and qualitative data was collected using semi-structured questionnaire and key informant interview guide respectively. **Results:** The findings show that the main causes of fire outbreak are; arsonists (90%, n=45), electrical faults (88%, n=44), short or overloaded circuits (64%, n=32), flammable liquids (50%, n=25) and combustible materials (60%, n=30). Other causes are lighting (4%, n=8), open flames (5%, n=10) and welding extension codes (6%, n=12). As regards to the preparedness, most of the schools had dry chemical extinguishers (76%, n=38) and foam cylinders (54%, n=27) for firefighting, however over fifty percent of the respondents are unable to operate them. Majority (78%, n=39) of schools had emergency communication system, regular inspection and maintenance of firefighting equipment, existence of fire assembly plan (72%, n=36) and fire safety policy (63%, n=31). Other mitigation measure like fire insurance policy, evacuation plans and sanctions were not fully entrenched in most of the schools. **Conclusion:** The causes of fire outbreak can be controlled with precaution and schools are inadequately prepared for fire outbreak. We therefore recommend that the school administration to investigate on the underlying reasons for the arson attacks. In addition, the security officers to regularly unplug electrical appliances when not in use, more firefighting equipment to be installed, and schools to have a fire insurance policy and build the capacity of the teachers and education stakeholders on the evacuation plan.

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### INTRODUCTION

Globally, fire disasters are a major public health threat in the management of learning institutions especially secondary schools (Kihila, 2017). Fire disasters have been reported to lead to destruction of properties, psychological torture, injuries and loss of student lives (Leistikow et al., 2000). According to World Health Organization data, approximately 300,000 deaths are caused by fire related burns with 95% of them occurring in developing countries ((CDC). 1998). In Kenya, fire occurrences have been reported in dormitories, laboratories and administration blocks (Shibutse et al., 2014). The Bombolulu and Kyanguli Mixed Secondary schools fire disasters of 1998 and 2003 respectively were reported to be due to poor preparedness on fire disasters

(Mutugi & Maingi, 2011). Research studies report on various causes of fires in Kenyan secondary schools including arson, lack of training among teachers, electrical faults, poor electrical installation and appliances (Kukali & Kabuka, 2009; Shibutse et al., 2014). The Bombolulu fire disaster was reported to have been caused by electrical fault (Nyangawa, 2018). Firefighting equipment include sand bucket, fire blankets and fire extinguishers used for small fires and hose reels and sprinklers used for putting off large fires (Gichuru, 2013). Fire extinguishers must be of approved standards, inspected regularly, periodically serviced, available and easily accessible in the event of fire outbreak (Stowell, 2013).

Research studies report that fire extinguishers are effective in putting off 80% of the fire thus controlling fire. A research study in secondary schools in Kilimanjaro in Tanzania found out that 53% had fire extinguishers, 41% sand buckets and 6% fire blankets (Nestory, 2017). A study done in public secondary boarding schools in Kenya reported the prevalence of the firefighting equipment to be 92.4% fire extinguishers, 21.2% sand buckets and 12.1% fire blankets (Chemeli & Mwangeli, 2015). Another study done in Kenya reported that 23.5% of schools were installed with fire extinguishers in various places such as the dormitories, kitchen and offices although yearly servicing was not adhered to. Lack of firefighting equipment and emergency exit contributes to death and destruction of properties (Kihila, 2017).

Empirical evidence show that most doors do not open outwardly while some buildings in the schools have grilled windows (Chemeli & Mwangeli, 2015). Further, some schools lack exit routes while in others the dormitories are closed from the outside. A study carried out in Tanzania reported that the schools lacked the fire emergency plans (policy) (Nestory, 2017). In addition, a research study carried in Nyeri County reported that the school possessed an evacuation plan which was not in practice (Gichuru, 2013). On the contrary, other research studies report that most schools possess a disaster preparedness policy on health and safety (Japheth, 2019).

Research studies report that most secondary schools lack fire departments and disaster committees, an indication of ill preparedness for a fire disaster (Japheth, 2019; Makhanu, 2009). Further, the school community lack training on fire disaster management. Poor knowledge and awareness among staff and students on the causes, prevention and management of fire outbreaks have been reported to lower the levels of fire preparedness in organizations (Omuterema, 2009). Further, the prevalence of fire drills in most secondary schools is reported to be low due to the high cost of hiring a fire expert to conduct them (Japheth, 2019). There is therefore a need to perform regular fire drills to equip the staff and students with knowledge on handling emergencies (Kelly, 2010; Mwangi, 2014). Therefore, the purpose of this study was to identify potential causes of fire outbreak, preparedness for fire outbreaks and fire safety and prevention measures for fire outbreak in boarding secondary schools in Nyamira County

## MATERIALS AND METHODS

**Study area:** The study was carried out in 50 boarding secondary schools in Nyamira County in Kenya. The County has five sub-counties namely Nyamira South, Nyamira North, Borabu, Masaba North and Manga. The County has 173 secondary schools.

**Study design:** This study employed cross-sectional study design and mixed approach comprising of both qualitative and quantitative methods. This study design was appropriate for identification of potential causes of fire outbreak, level of preparedness for fire outbreak and to assess fire safety and prevention measures for fire outbreak in boarding secondary schools in Nyamira County.

**Target population:** The target population for this study comprised of secondary boarding schools in Nyamira County with history of fire outbreaks in the past 5 years. It also included Sub-County educational officers and Principal who

have been in the office for more than 6 months. However, all day secondary schools were excluded in the study.

**Sample size and sampling procedure:** Purposive sampling was used to select 50 schools with reported history of fire outbreaks in the last five years in Nyamira County. The study participants included 50 principals and deputy principals or senior teachers in cases where the principal was unavailable. In addition, five county educational officers in charge of the 5 sub-counties in Nyamira County

**Data collection:** Quantitative data was collected by administering semi structured questionnaires to the senior teachers and sub county education officers. The questionnaire contained four sections namely: demographic data; causes of fires in schools; fire preparedness and mitigation measures. Qualitative data was collected by conducting interviews using the interview guide. The information collected was used to describe the level of fire tragedy preparedness in Kenyan schools. Reliability was achieved by pretesting the data collection instrument on principals of 5 (10%) boarding secondary schools. This enabled the researcher to improve the data collection tools by redesigning the questions and simplifying the language used. Validity was achieved by ensuring that the question got the appropriate responses thus enabling the data collection instrument to measure what it was intended.

**Data analysis:** The questionnaires were checked for completeness and consistency prior to data coding and entry in SPSS 21 version. Data analysis was performed by descriptive statistics where data was presented in tables using frequency, percentages and proportions.

**Ethical Consideration:** The study participant voluntarily accepted to take part in the study after an informed consent process. They were assured of anonymity and confidentiality of the data collected from them. Permission to carry out the study was sought from the county government and education officers. Further, permission was obtained from the ethics committee of Jaramagi Oginga Odinga University of Science and Technology and the from National Commission of Science, Technology and Innovation (NACOSTI).

## RESULTS

**Demographic Information:** A total of 50 senior teachers of various boarding secondary schools in Nyamira County took part in this study. On the gender, 70% (35) were male and 30% (15) were female. Majority (53%) of the respondents had been in teaching practice for less than 10 years, 20% and 16% of them for 11-15 years and 16-20 years respectively and the rest have been in school for more 20 years. Of those interviewed 59% (16) had worked in the present school for less than 10 years, 22% (6) for 11 to 15 years, 15% (4) for 16 to 20 years and 4% for more than 20 years. On academic qualification, 66% (33) had bachelor degree, 28% (14) master's degree and 6% (3) had diploma certificate.

**Potential Causes of Fire in Schools:** Majority (90%, n=45) of the respondents strongly agree or agree that most fire in schools are caused by arsonists. Other causes (agree or strongly agree) are electrical fault 88% (n=44), short or overloaded circuits 64% (n=32), flammable liquids 50%

**Table 4.1: Potential Causes of fires in schools**

Causes of Fire in School	Strongly Agree N(%)	Agree N(%)	Disagree N(%)	Strongly Disagree N(%)
Arsonists.	25(51)	20(39)	2(4)	3(6)
Electrical fault.	16(32)	28(56)	4(8)	2(4)
Welding Extension Codes.	6(12)	11(22.5)	22(43)	11(22.5)
Short or overloaded circuits.	9(18)	23(46)	9(18)	9(18)
Lighting.	4(8)	20(41)	15(29)	11(22)
Open Flames.	5(10)	18(35)	15(31)	12(24)
Flammable liquids.	7(14)	18(36)	9(18)	16(32)
Combustible materials.	7(15)	23(45)	10(21)	10(21)

**Table 4.2: Firefighting Equipment**

Fire Equipment	Exist N(%)	Do not exist N(%)	Do not know N(%)
Dry chemical extinguishers.	38(76)	10(20)	2(4)
Halon extinguishers	19(38)	29(58)	2(4)
Foam cylinders.	27(54)	22(44)	1(2)
Lightening arresters.	15(31)	34(67)	1(2)
Fire Hydrants	8(15)	37(74)	5(11)
Fire hose and nozzles	12(23)	35(70)	3(7)
Fire sand Buckets	22(45)	26(51)	2(4)

**Table 4.3: Firefighting Equipment operational in School**

Fire Equipment	Able to operate N(%)	Not able to operate N(%)	Do not know N(%)
Dry chemical extinguishers.	36(72)	11(22)	3(6)
Halon extinguishers	19(38)	27(53)	4(9)
Foam cylinders.	31(62)	17(34)	2(4)
Lightening arresters.	12(25)	31(61)	7(14)
Fire Hydrants	7(14)	34(67)	9(19)
Fire hose and nozzles	19(37)	24(48)	7(15)
Fire sand Buckets	32(64)	16(32)	2(4)

**Table 4. 4: Fire preparedness measures**

Preparedness Measures	Aware N(%)	Not aware N(%)	Do not know N(%)
Emergency communication system	39(78)	11(22)	-
Regular inspection and maintenance of firefighting equipment	41(82)	9(18)	-
Trained on emergency services in case of fire outbreak.	25(49)	22(45)	3(6)
Existence of fire assembly point.	36(72)	11(22)	3(6)
Availability of an emergency fire disaster kit	22(43)	25(51)	3(6)
Accessibility to Fire hydrants	17(35)	27(53)	6(12)
Existence of Emergency population warning methods	21(43)	28(55)	1(2)
Regular Fire Drills	23(47)	23(45)	4(8)

**Table 4.5: Fire safety and mitigation measures**

Mitigation Measures	Exist N(%)	Do not exist N(%)	Do not know N(%)
Fire Insurance Policy	16(32)	31(62)	3(6)
Fire Safety Policy	31(63)	18(35)	1(2)
Evacuation Plans	18(37)	27(53)	5(10)
Sanctions e.g. mandatory evacuation	7(15)	39(77)	4(8)

(n=25) and combustible materials 60% (n=30). Less than 50% of the respondents also mentioned welding extension codes (6%, n=12), lighting (4%, n=8) and open flames (5%, n=10) as other likely causes (Table 4.1). Also, the KII-5, pointed out that arsonist and electrical faults as the major causes of the fire outbreaks.

**Fire Preparedness:** The firefighting equipment's available in the schools included dry chemical extinguishers (76%, n=38) and foam cylinders (54%, n=27). Other equipment observed are halon extinguishers (38%, n=19), lightening arresters (31%, n=15), fire hydrants (15%, n=8), fire hose & nozzles (23%, n=12) and fire sand buckets (45%, 22) (Table 4.2).

Only one KII-5 noted that the preparedness for fire break is good, others noted not good because they lacked firefighting equipment.

**Firefighting equipment operational in school:** Majority (50%, n=29) of the respondents said they were not able to operate the firefighting equipment whereas (41%, n=20) were able to operate them. Of those who were able to operate the equipment, nearly 80% mentioned that they are able to operate dry chemical extinguishers, 62% (n=31) foam cylinders and 64% (n=32) fire sand buckets. Other equipment which were operational in few schools include halon extinguishers 38%

(19), lightning arresters 25% (n=12), fire hydrants 14% (n=7) and fire hose & nozzles 37% (n=19) (Table 4.2).

**Fire preparedness measures:** Majority (82%, n=41) mentioned regular inspection & maintenance of firefighting equipment as the primary fire preparedness measures. In addition, 78% (n=39) mentioned emergency communication system, and 72% (n=36) pointed to the existence of fire assembly point. Others mentioned were training on emergency services in case of fire outbreak (49%, n=25), availability of an emergency fire disaster kit (43%, n=22), accessibility to fire hydrants (35%, n=17), existence of emergency population warning methods (43%, n=21) and regular fire drills 47% (n=23).

**Fire Safety and Mitigation Measures:** Most (63%, n=31) of the institutions had fire safety policy, 32% had fire insurance policy, 37% had evacuation plans while 15% had sanctions. However, 72% (n=36) were not satisfied with fire safety and mitigation measures at school with only 28% (n=14) being satisfied with the safety measures. All the informants recommended the need to have the fire insurance, fire safety policy, evacuation plans and mandatory evacuation regulations in learning institutions.

## DISCUSSION

The most common causes of fire as reported in this study are arsonist, electrical faults and flammable liquids. The findings from this study are in agreement with other research studies. A research study carried out on the causes of fires in secondary schools in Vihiga County reported electrical faults and arson as the culprit (Shibutse *et al.*, 2014). Further, electrical faults due to poor workmanship contribute to fires in secondary schools. This is supported by a research study carried out among 40 boarding schools in Siaya County in 2008, which reported poor electrical installation and improper use of electrical appliances as the main causes of fires in these schools (Kukali & Kabuka, 2009). Firefighting equipment play a pivot role in fire disaster preparedness. The results from this study show that a larger proportion of the respondents mentioning that they had regularly serviced fire extinguishers in their schools including dry chemical extinguishers and foam cylinders. This finding is similar to a study carried out in secondary schools in Nairobi County which reported fire extinguishers as the main firefighting equipment although they were not regularly serviced (Janice, 2011; Kikuvu, 2011). In addition, a research study in Kiambu County reported that 86.7% of the schools had fire extinguishers (Janice, 2011). Further, study carried out among secondary schools in Tanzania found out that 53% had fire extinguishers (Nestory, 2017). A study done in public secondary boarding schools in Kenya reported the prevalence of the fire extinguishers to be 92.4% (Chemeli & Mwongeli, 2015). In contrast, study done in Kenya reported that 23.5% of the schools were installed with fire extinguishers in various places such as the dormitories, kitchen and offices although yearly servicing was not adhered to (Mutugi & Maingi, 2011). A research study carried out in secondary schools in Githunguri reported that the firefighting equipment in most schools were inadequate putting to question their ability to deal with fire tragedy or arson (Gichuru, 2013). Lack of firefighting equipment and emergency exit were reported to have contributed to death of sixty-eight students at the fire outbreak experienced at the Kyanguli Secondary school.

Firefighting equipment such as fire extinguishers are effective in putting off 80% of the fire this preventing them from getting out of control.

In this study, although most teachers reported to have firefighting equipment in their schools but only 41% of them were able to operate them. In addition, 49% of the teachers were trained on emergency fire outbreaks. These findings are similar to those from secondary schools in Vihiga County in which majority of the school administrators were not trained on firefighting (Shibutse *et al.*, 2014). Further, majority of the sub County Educational Officers who took part in this study reported low level of fire preparedness among secondary schools in Nyamira County. This is in line with empirical data that suggest that most secondary schools in Kenya are ill prepared for fire disasters despite fires being common and frequent in schools. In this study, only 47% of the schools performed regular fire drills. This finding is in line with that reported in a study carried out among secondary schools in Vihiga County in which majority of the schools did not carry out fire drills and lacked safety committees (Shibutse *et al.*, 2014). On the other hand, a study on the level of preparedness of secondary schools in Nairobi County reported that most schools performed regular fire drills as stipulated by the Ministry of Education (Kikuvu, 2011). Lack of fire drills in secondary schools has been reported to be responsible for the loss of lives and destruction of school properties. Lack of regular fire drills and training in schools in this study is because of non-adherence to safety standards and guidelines as recommended by the Ministry of Education. Fire drills enhances the awareness of teachers and students on fire tragedy thus saving time during evacuation (Kelly, 2010; Mwangi, 2014).

Preparedness to fire disasters minimizes loss of lives, destruction of properties and provides quality learning times. This study further assesses the fire safety and mitigation measures in secondary schools in Nyamira County. This study reports that 63% of the teachers confirmed that their schools possessed fire safety policy. This finding is in agreement with study carried out to access fire preparedness in secondary schools in Uasin Gishu County in which most of the schools had a disaster preparedness policy on health and safety obtained from the MoE in Kenya (Japheth, 2019). However, among the schools that took part in this study, 62% lacked fire insurance policy, 53% lacked evacuation plans and 77% lacked sanctions. The findings from this study are consistent with that of a study carried out in Tanzania which found out that schools lacked the fire emergency plans (policy) (Nestory, 2017). Further, a research study carried out in secondary schools in Githunguri reported that most schools lacked an evacuation plan. The results from this study contrasts with those reported in other studies. A research study on fire disasters preparedness strategies at schools in Nyeri County reported that 78.6% of the teachers confirmed that the school possessed an evacuation plan not in use (Gichuru, 2013). Results from this study and other comparable studies indicate that the level of fire preparedness in most schools in Kenya is low. There is need for the education stakeholders to ensure that the school administrators have implemented the guidelines on fire safety as stipulated by the ministry of education. The key informants recommended a need to have the fire insurance, fire safety policy, evacuation plans and mandatory evacuation regulations in schools

## Conclusion

This study reports the major causes of fire in secondary schools to be arsonist and electrical faults. Further, fire extinguishers were the most common firefighting equipment in this study. Other firefighting equipment were available in small proportions thus insufficient. In addition, most of the teachers were not trained on how to operate them thus lack of fire disaster preparedness. This means that in case of a fire disaster most teachers would not know how to put off fire using the fire extinguishers thus leading to loss of lives and destruction to property. Most schools had the fire safety policy in place although they lacked the evacuation plan and sanctions for the schools which did not adhere to the fire safety and mitigation measures. This study recommends proper storage of flammable liquids in secured cabinets and school administration should investigate on the arson as a cause of fire in the school. There is need to add other firefighting equipment other than fire extinguishers. Further, school community should be trained on how to operate the firefighting equipment available in the school. The schools should improve on their safety and mitigation measures. There is need for the education stakeholders to ensure that the school administrators have implemented the guidelines on fire safety as stipulated by the ministry of education.

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