EVALUATION OF FIRE SAFETY MEASURES AT LOCAL UNIVERSITIES IN KENYA WITH REFERENCE TO FIRE RISK REDUCTION RULES LN.59, 2007

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Abstract
Fire-related accidents often result in injuries and sometimes death, which can be prevented through compliance to legislation and public awareness on fire safety. This study establishes fire safety measures in place in local universities in Kenya, and compared the compliance status between private and public universities on essential fire safety measures based on the stipulations of the fire risk reduction Rules, LN 59 of 2007. Data was collected using questionnaires from seven universities (three public and four private) targeting a sample size of 481 respondents. Site inspections were also conducted. The average duration worked by the respondents was significantly different with 53% of staff in the public universities having worked over 8 years at the universities as compared to 30% in the private universities. This had no significant effect on the levels of fire safety awareness amongst the staff as none of the institutions had formal policies and programmes on fire safety. More than 74% (n=481) of employees were not aware on any fire training programmes in place with no significant difference in both categories (χ^2 = 3.72; p> 0.05, df = 2). Failure to conduct regular fire evacuation drills was common to both categories (χ^2 = 3.16; p> 0.05, df = 2). The study found that the workplaces were adequately equipped with Fire exits signs (98%), fire extinguishers (99%), hose reels (82%) and had fire action procedures posted (88%). Despite the selected public and private universities having a mean existence of 47 years and 14.25 years respectively, there is equally low compliance with the requirement to provide emergency lighting, automatic fire suppression systems, fire detection and alarm systems and fire Hydrants. Private universities however complied marginally better than public universities on the installation of these essential equipment as they have relatively newer premises that have been constructed in compliance with current building codes. The study recommends the development of comprehensive fire safety policies and programs that will cover prevention, protection and emergency response backed by university management endorsement and support. The Directorate of occupational safety and health services should also make the public aware of these rules through regular training, outreach programs and enforcement.

Key words: Fire safety, legislation, awareness, compliance, policies, universities

1.0   Introduction

A fire can result in extensive damage and destruction of property as well as injuries to occupants of a given premises. Even when fires don't injure workers, they can disrupt activities quite significantly and bring most operations to a standstill. Fires can lead to the destruction of property and loss of important records and information hence the need for clear fire safety rules and fire safety compliance to minimize outbreaks and the loss that can result from such hazards (Maine Municipal association, 2004).

According to Satyen, Lata, Barnet, M (2004) the causes of many fires especially in the workplace may be accidental or as a result of a deliberate act on the part of employees. Several fires have been brought about by the acts or omissions of staffers in organizations. Being careless at work or failure to comply with regulations as laid down has been a cause of catastrophic fires that have led to destruction of property and loss of life (Satyen, Lata, Barnet,M 2004). The failure to take concrete remedial actions when hazardous situations are identified has been a cause of infernos in the work places hence the need for fast action to prevent fires when hazardous situations are discovered. Regardless of how a fire might start, it could lead to destruction of property and loss of life making it imperative for compliance with safety guidelines. It is vital for fire cause to be pointed out in order to avoid future recurrence of the same. These conditions include: the device or equipment involved, the presence of an ignition source, the type of the material initially ignited, and the circumstances or actions that brought all the factors together (Satyen, Lata, Barnet, M 2004).

The human and financial effects make fire at the work place a hazard that needs to be paid close attention. Fires at the work place can be started severally by: chemicals, electricity, flammable liquids, combustible materials, compressed gases, smoking, as well as poor housekeeping. Protective measures against these hazards should be taken to avoid of work place fires according to a report by Maine Municipal Association (2004).

In 2009, two fire catastrophes exposed the weakness of the nation in the face of fire disasters (Red Cross Society DREF operation report, 2009). The first disaster was the fire outbreak at Nakumatt supermarket in downtown Nairobi on 28th January 2009. The second catastrophe was in Sachangwan on 31st January 2009 when a petroleum tanker with about ten thousand liters of petroleum products overturned. In the supermarket fire, it took a joint team of fire men and other emergency services providers twenty four hours to extinguish the fire. The risk of the fire spreading to nearby buildings led to the evacuation of quite a number of them. At the end, twenty nine individuals lost their lives in the fire. In the same week, a petroleum tanker spilled its contents and in the resultant commotion, one hundred and forty Kenyans were burnt to death.

The government of Kenya published the fire risk reduction rules in 2007 under legal notice No. 59 of the Kenya Gazette. These rules are a subsidiary legislation made under the Occupational safety and health Act, 2007. The main objective of the rules is to create fire safe workplaces in Kenya by stipulating mandatory compliance fire safety standards to cover; fire prevention, fire protection and fire emergency response.

The main objective of fire safety efforts is to protect occupants from injury and to prevent loss of life or injuries. The second goal in fire safety efforts is to prevent property damage. By preventing fires and limiting damage we can assure that work operations will continue uninterrupted. The Health and safety executive (HSE, 2006) states that Fire risk assessment is a critical activity that helps in the protection of workers as well as bringing an institution to be in compliance with the law of the land. It helps draw attention to risks that could materialize.

2.0   Materials and Methods

Data for this study was collected from the targeted population, organized, collated, analyzed and interpreted. The study applied a descriptive research design. Both Qualitative and quantitative data was collected and used. Both primary and secondary information was used to collect data on the implementation of the provisions of the fire safety regulations in private and public universities in Kenya. Main campuses of public and private universities in Kenya that are recognized by the Commission for Higher Education by March 2010 were targeted. This study employed questionnaires (Annex 1), interviews and structured participatory observations using a prepared checklist in the collection of information. The study sample covered 3 public and 4 private universities as shown in Fig.1. This was a representative sample out of a total of 7 public and 20 private universities in Kenya. This study was undertaken to establish the implementation of the fire safety provisions in public and private Universities in Kenya with reference to the Fire risk reduction rules, 2007. The select sample was determined using stratified random sampling technique to distinguish private and public universities as separate strata. The study undertook 26% of the total targeted institutions.

3.0   Results and Discussion

3.1   Duration of Service of Respondents

A total of 481 respondents participated in this study. The duration of the years worked characteristics were significantly different for the public verses the private universities. 53% of staff in the public universities had worked over 8 years as compared to 30% in the private universities. This is expected outcome considering that average time in existence of the Private universities as presented in the tables 1 and 2.

Table 1: Public universities

University	Year established	Year of attaining university status	Total years of existence
Egerton	1939	1988	72
Jomo Kenyatta (JKUAT)	1981	1994	30
Masinde Muliro	1972	2009	39

The mean of the years of existence (up to 2011) of the selected public universities is 47 years.

Table 2: Private universities

University	Year established	Year of attaining university status	Total years of existence
Mt. Kenya	1996	2006	15
Gretsa	2006	2006	5
Daystar	1984	1992	27
Kabarak	2001	2001	10

The mean number of the years of existence (up to2011) of the selected private universities is 14.25 years. The various age categories and their percentage response is shown in Fig. 2 and 3.

3.2   Fire Safety Measures in Place in Local Universities in Kenya
The responses by sampled members of staff are represented in a frequency analysis table using a Likert scale for comparison in Table 3.

Table 3: Essential fire safety measures in private and public universities

		Frequency				
		1 (no)	2 (not sure)	3 (yes)	Mean index	Category of rating scale
1.	Automatic fire suppression (sprinklers)	465	9	7	1.05	1
2.	Fire hose reels	68	17	396	2.68	3
3.	Fire hydrants	347	88	46	1.37	1
4.	Automatic fire detection and alarm systems	209	63	209	2.00	2
5.	Fire doors	159	251	71	1.82	2
6.	Fire extinguishers	3	0	478	2.99	3

7.	Fire Exit signs	8	0	473	2.97	3
8.	Emergency lighting	354	90	37	1.34	1
9.	Conduct of Fire Drills	386	76	19	1.24	1
10	Fire safety Training programmes	356	79	46	1.36	1
11	Fire safety procedures posted	44	12	425	2.79	3

The results show that the facilities were adequately equipped with fire exits signs (98%, Average index 2.97), fire extinguishers (99% Average index 2.99, n=481), Hose reels (82%, Average index 2.68, n =481) and had fire action procedures posted (88%, average index 2.79, n=481) within the workplace. It was clear that the campuses did not conduct regular fire drills (average index 1.24). In addition there is low compliance with the requirement to provide emergency lighting, automatic fire suppression systems and fire Hydrants as well as formal training programs on fire safety (all having an average index of below 1.50). Respondents were not sure of the presence of fire doors within their premises.

3.3 Comparison between Private and Public Universities on Essential Fire Safety Measures in Place

The study compared the essential fire safety measures in place between private and public universities to determine a correlation between a specific provision and category of university.

3.3.1 Presence of Automatic Fire Suppression (e.g., Water Sprinklers)

This study showed that the presence of automatic fire suppression for both categories of universities was very poor. However private universities had few areas equipped with automatic suppression systems (3%) as compared to the public universities where respondents indicated that none of their workstations had automatic fire suppressions systems installed (χ^2 = 9.377, p < 0.05, df = 2). The results are represented in Fig.4. According to Kennet [6], automatic fire suppression systems control can extinguish fires without human intervention. To do so it must possess a means of detection, actuation and delivery. In many systems, detection is accomplished by mechanical or electrical means. Mechanical detection uses fusible-link or thermo-bulb detectors. These detectors are designed to separate at a specific temperature and release tension on a release mechanism. Electrical detection uses heat detectors equipped with self-restoring, normally-open contacts which close when a predetermined temperature is reached. Remote and local manual operation is also possible [6]. These findings are consistent with the fact that the Private

universities have newer buildings that are likely to comply with current building codes.

3.3.2   Presence of Fire Hose Reels

The presence of fire Hose reels is dependent on university category (χ^2 = 46.94, p < 0.05, df = 2)**.** Although both categories of universities are well equipped with Hose reels, it is clear that the prevalence is significantly higher in private universities as shown in Fig. 5. The study has found that fire hose reels were within the premises of 89% of private universities and 76% of Public universities. The relatively good compliance status to this requirement is attributed to the fact that the use of hose reels as means of Fire protection has been in existence since the 19th century it is thus old technology. According to Fornell (1991) it was not until the late 1860s that hoses became available to convey water more easily from the hand pumps, and later steam pumpers, to the fire. The rules stipulate that where hose reels are used there is need to have adequate water storage of at least 10,000 cubic metres with enough pressure to raise water to the highest point of workplace. The hose reels should be inspected at least once in 12 months by competent persons.

3.3.3   Installation of Fire Hydrants

A fire hydrant is an active fire protection measure connected to a source of water provided to enable firefighters to tap into the water supply system to assist in extinguishing a fire. Majority of the premises in both categories of universities lacked installation of fire hydrant systems (Likert scale rating 1.37 as shown in Table 3). The lack of dedicated water stored for fire protection purposes in the universities contributed to this low compliance score. Further analysis also show that presence of fire hydrants though low is dependent on university category (χ^2 = 11.74, p < 0.05, df = 2)**.** There is a significant difference between the category of university and installation of fire hydrants. The public universities have significantly more areas installed with fire Hydrants at 14% as compared to 5% of the private universities (Fig. 6). It was however noted that where the Hydrants were installed they lacked pressurized water. Similar to Fire Hose reels modern fire Hydrants were invented in the 19th Century (Fornell, 1991) thus can be classified as old technology however lack of reliable supply of water from the mains in recent times in Kenya and the high cost of installation and maintenance of Hydrant systems may be the reason why private universities to not incorporate this when constructing new premises.

3.3.4   Installation of Fire Detection and Alarm Systems

The fire risk reduction rules require every occupier to provide and maintain fire detection and alarm systems [3]. In this study respondents were asked whether their workstations had fire detection and alarm systems. The findings are represented in Fig 7. 48% of staff in the private universities responded in the affirmative as compared to 39% in the public universities. The difference between the two categories of universities is however not significant. (χ^2 = 4.78, p >0.05, df = 2)**.** Thus

it is concluded that the presence of automatic fire detection and Alarm systems is statistically not significantly dependent on the university category. These findings are consistent with the fact that the private universities have newer buildings that are likely to comply with current building codes.

3.3.5   Presence of Emergency Lighting

University staff members were asked whether emergency lighting is installed in their work areas and the findings are represented in Fig. 8. Only 10 % of the private university workstations had these installed. The compliance level was even worse for public universities which recorded 5% in the affirmative. Further analysis also show that presence of emergency lighting is dependent on university category (χ^2 = 7.79, p < 0.05, df = 2)**.** There is significant difference between the category of university and installation of emergency lighting. The private universities have more premises installed with emergency lighting albeit the percentage is still small. The presence of relatively more modern buildings within the private universities influenced this marginally better compliance score as compared to the public universities. The rules also require that stair cases used as means of fire exit be well lit and ventilated.

3.3.6   Conduction of Fire Drills

The study sort to establish whether the institutions conducted fire evacuation drills. The results for both categories of universities are represented in Fig. 9. Fire drills are carried out to check that staff understands the emergency fire action plan, to ensure that staff are familiar with operation of the emergency fire action plan, to evaluate effectiveness of the plan and to identify any weakness in the evacuation strategy (Jackman and Morgan, 2004). The rules require fire drills to be conducted at least once a year and this should be part of the duties where we have trained Fire teams.

The respondents in both categories of universities stated overwhelmingly that drills were not practiced regularly. 78% (n=240) of the Public university respondents indicated that these were not done relative to 82.6% (n=241) of the Private counterparts**.** The average index of 1.37 on the Likert scale presented in Table 3 confirms that these drills are not conducted across all the universities. There was no significant statistical difference between the university categories as regards the regular practice of Fire drills (χ^2 = 3.16, p> 0.05, df = 2). This poor compliance level can be attributed to the fact that the institutions lacked comprehensive Fire policies with programs that would include regular conduct of evacuation drills.

3.3.7   Fire Training Programs

The study shows clearly that there is lack of fire training programs targeting staff members of the local universities (average index in Table 3 of 1.36 on Likert scale). In both categories 74% (n=481) of respondents were not aware of any fire safety training programs in their institutions and have not attended any as shown in Fig.

10. Provision of fire safety training variable is independent of university category (χ^2 = 3.72, p> 0.05, df = 2) as there is no significant difference among the categories of universities. It is stipulated under section 21 (1) of the fire risk reduction rules, 2007 that 'every occupier shall ensure that all workers are instructed in the safe use of firefighting appliances (Maine Municipal Association, 2004) This poor compliance level can be attributed to the fact that the institutions lacked comprehensive Fire policies with programs that would include training of all staff on fire safety.

3.3.8   Provision of Basic Fire safety Requirements
A total of 49 locations representing 7 locations per university campus were inspected. The locations were diverse and comprised of office blocks, laboratories, workshops, lecture halls, clinics, and kitchens. Fig. 11 illustrates the findings.
It is clear from the results that there is no significant difference between both categories of universities. Compliance to these basic requirements is generally high across all universities. This can be attributed to the fact that having portable fire extinguishers is a requirement to have a building insured against fire and the other two items i.e. posting fire exit signs and Fire action procedures are low cost easy to implement.

3.3.9   Establishment of In-House Fire Fighting Teams
Respondents from both categories answered in the affirmative at a lowly 4% (n=481). 96% said that they were either not aware or unsure of the existence of such a team in their workplaces for both categories of universities as shown in Fig. 12 and 13 respectively. Section 21(2) of the fire risk reduction rules prescribes basic training course on fire safety to be undertaken by every member of the fire fighting team. This training must be done within three months of appointment to the team and a refresher taken at least once in every two years [3]. Though currently there is no DOSHS prescribed course or harmonized fire training curricula, 47 DOSHS approved Fire training institutions exist and offer this course using own curricula.

Structured observation survey confirmed that none of the sampled locations had trained active in-house firefighting teams comprising of regular staff.   There is also marginal difference between the two categories of universities (χ^2 = 8.606, p> 0.05, df = 2) with public university staff having a significantly greater number of staff not sure of the presence of these teams. The low levels of compliance to this requirement can be attributed to lack of comprehensive fire policies within the institutions. The policies would have procedures to appoint and terms of reference for in-house fire fighting teams.

4.0   Conclusion and Recommendations
The study has established that lack of knowledge and enforcement of the fire risk reduction rules, 2007 compounded with the absence of comprehensive fire safety policies and procedures in local universities in Kenya has had a direct effect on the

level of prevention measures to minimize the risk of fire outbreaks and its spread as well as capacity to respond effectively in the event of an outbreak. Presence of firefighting equipment in the facilities was influenced more by the need to comply with building codes and insurance requirements rather than compliance to the fire risk reduction rules. Overall, the present findings also suggest that provision of fire safety awareness training would be beneficial in improving safe behaviors and response techniques, factors affecting the implementation of fire reduction rules and compliance with the fire reduction rules of 2007. Exposure to fire safety training would enable individuals to accurately evaluate a fire situation and choose an appropriate course of action to take. It is also concluded that overall there is no significant difference in fire safety risk status between local and private universities.

The study recommends the following;
The local universities should develop comprehensive fire safety policies in conformity with section 34 of the rules. These policies must be backed by specific programs to address the existing gaps found by this study.

Fire safety training should be incorporated as part of health and safety improvement programs targeting all staff and students.

To determine the types and layout of the essential fire safety equipment, a formal Fire safety audit as stipulated in the rules should be conducted for all institutions. This will be conducted by a DOSHS approved Fire safety auditor.

The Government has a significant role to play as the study confirmed the overwhelming lack of awareness of the Fire Risk reduction rules, 2007. Awareness campaigns are recommended that would include publishing essential elements of the rules, issue and approve codes of practice. DOSHS should create awareness through enforcement, training and other outreach programs. DOSHS should also develop standard curriculum and approve a training course on basic fire safety for the firefighting teams to be used by all approved training institutions.

General safety compliance starts with the individual. This calls for a safety culture transformation in the society and it starts with each person. Higher learning Institutions can transform the safety culture through demonstrated and visible leadership commitment toward the safety improvement efforts among other culture change initiatives.

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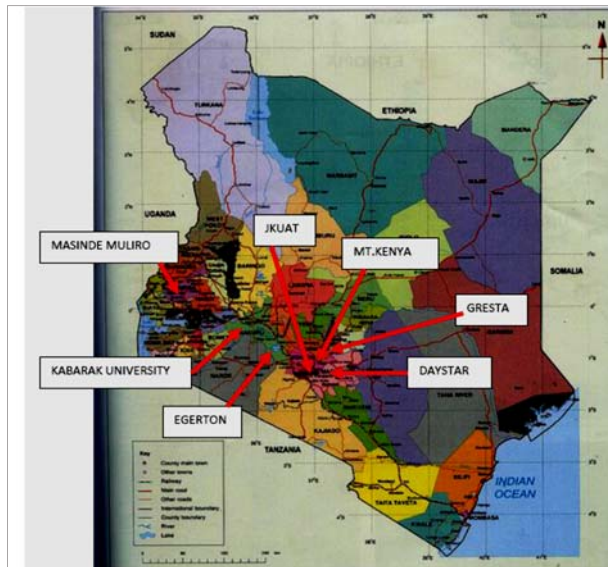
Fig. 7: Map of Kenya showing location of sampled university main campuses
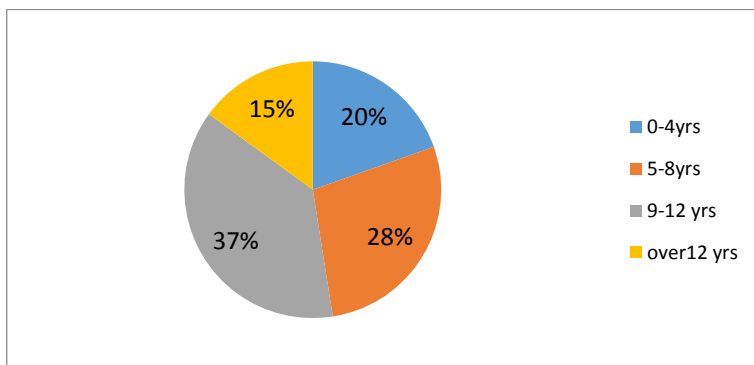

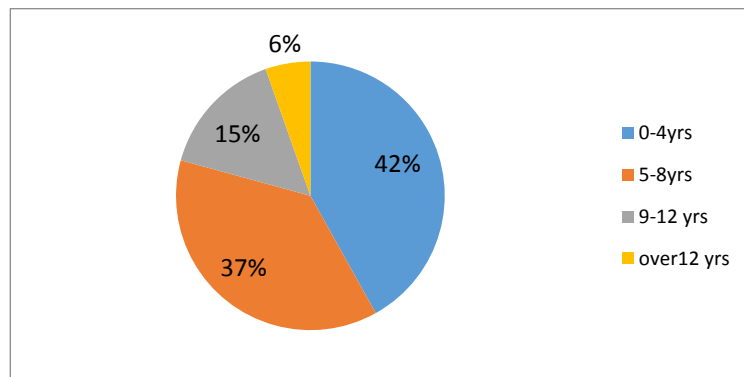*Fig. 8: Public universities staff duration of service proportions*

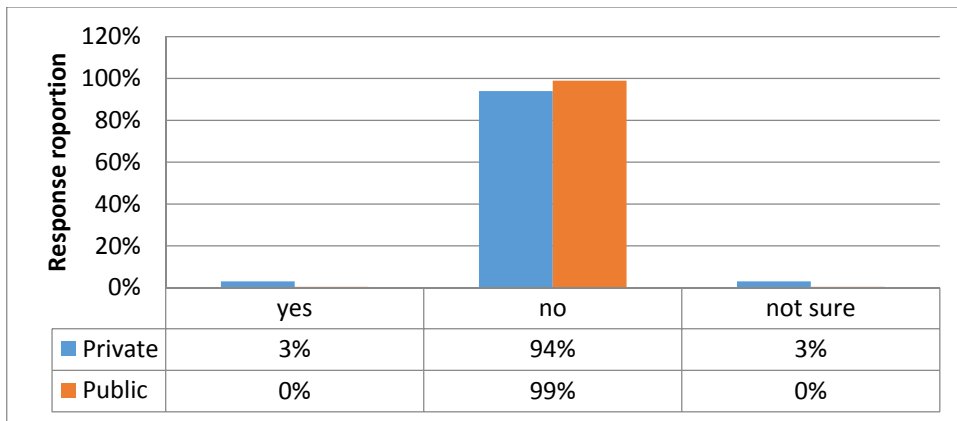*Fig. 9: Private universities staff duration of service proportions*

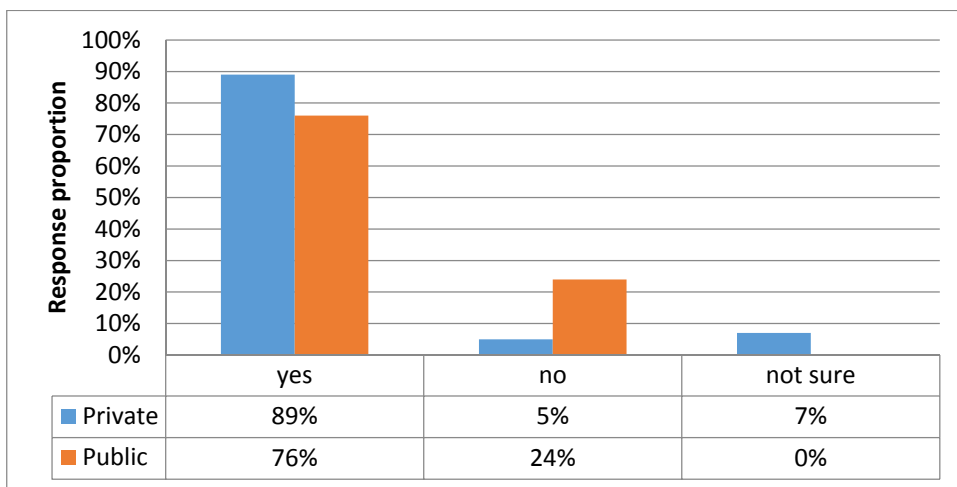*Fig. 10: Presence of Automatic fire suppression across sites*

	yes	no	not sure
Private	3%	94%	3%
Public	0%	99%	0%

Fig. 11 : Presence of fire hose reels across sites

	yes	no	not sure
Private	89%	5%	7%
Public	76%	24%	0%
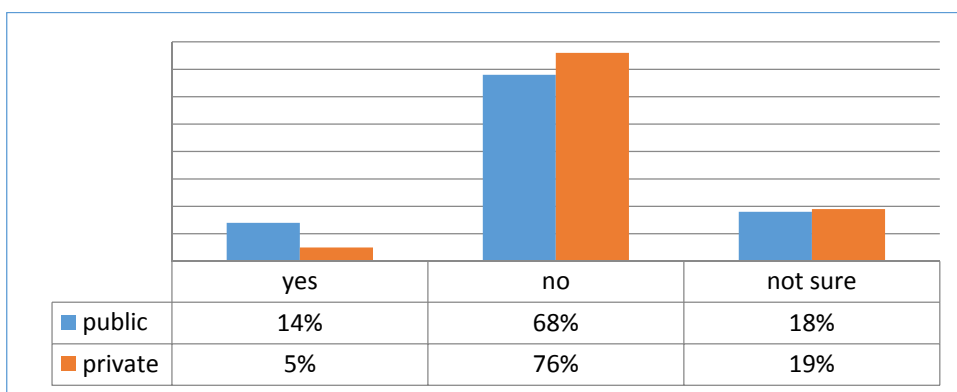
Fig. 12: Presence of fire hydrants on sites per university category

	yes	no	not sure
public	14%	68%	18%
private	5%	76%	19%

Presence of Fire detection and alarm systems

	yes	no	not sure
■ Private	48%	38%	14%
■ public	39%	51%	10%
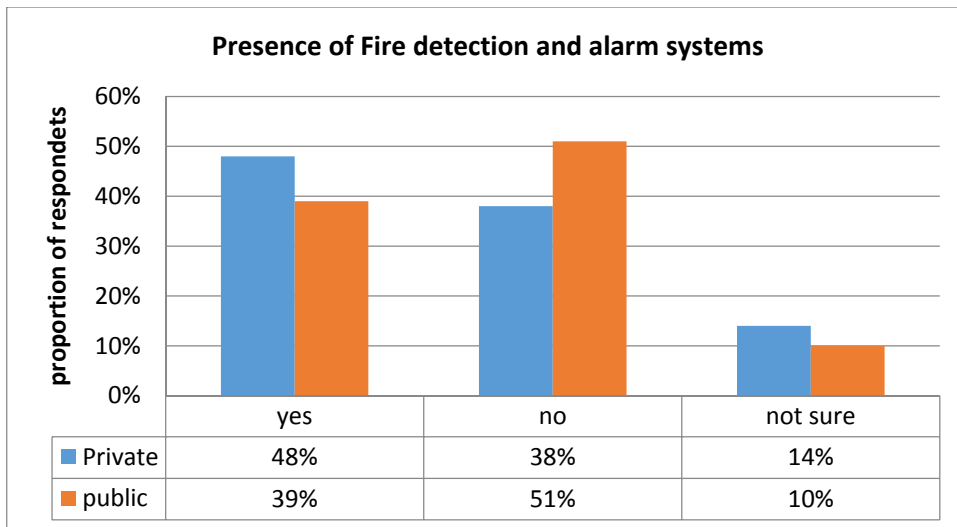
Fig. 13: Presence of fire detection and alarm systems per university category

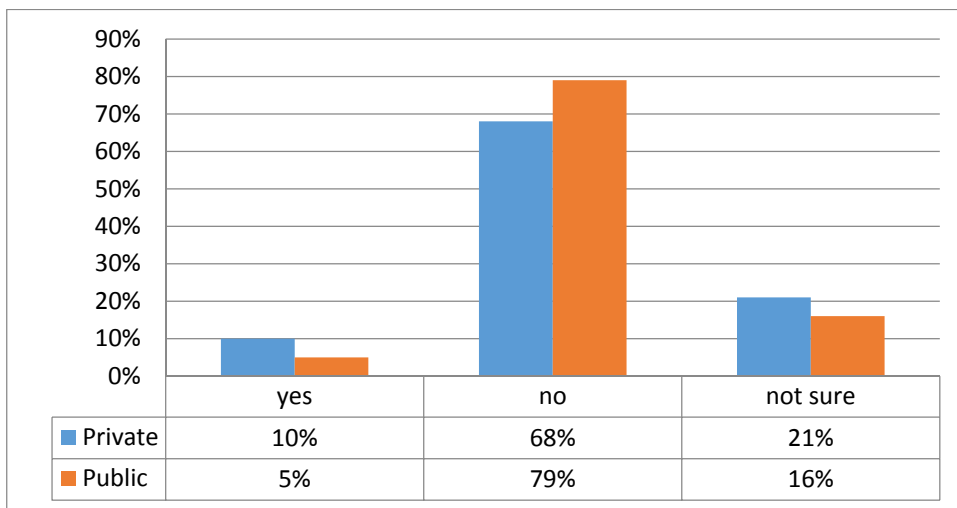|	yes	no	not sure
■ Private	10%	68%	21%
■ Public	5%	79%	16%

Fig. 14: Presence of emergency lighting
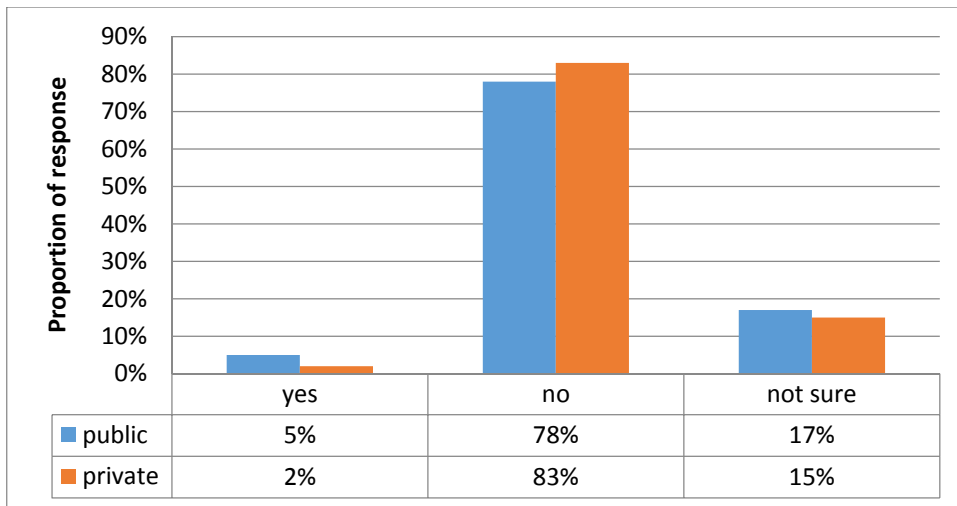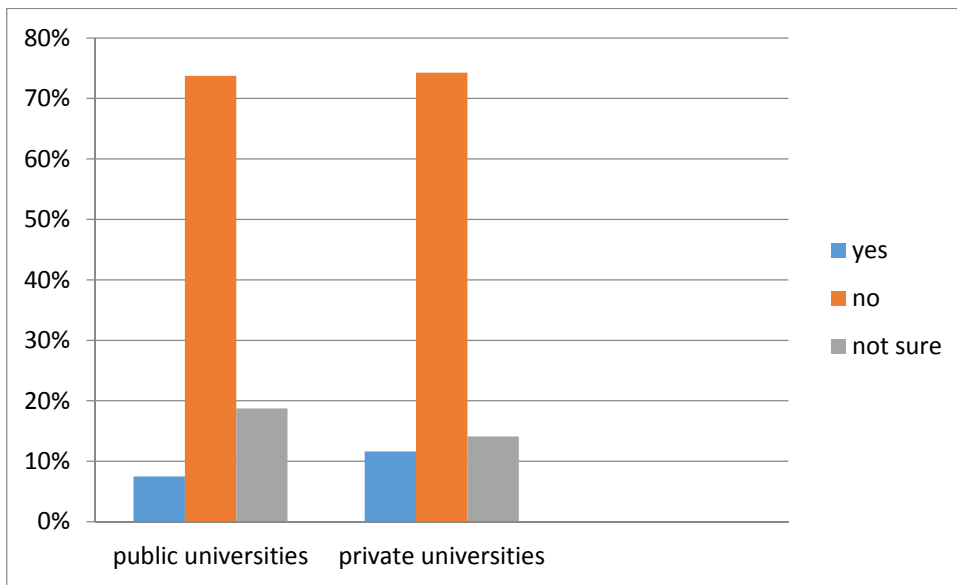
Fig. 15: Conduct of Fire drills within the institutions

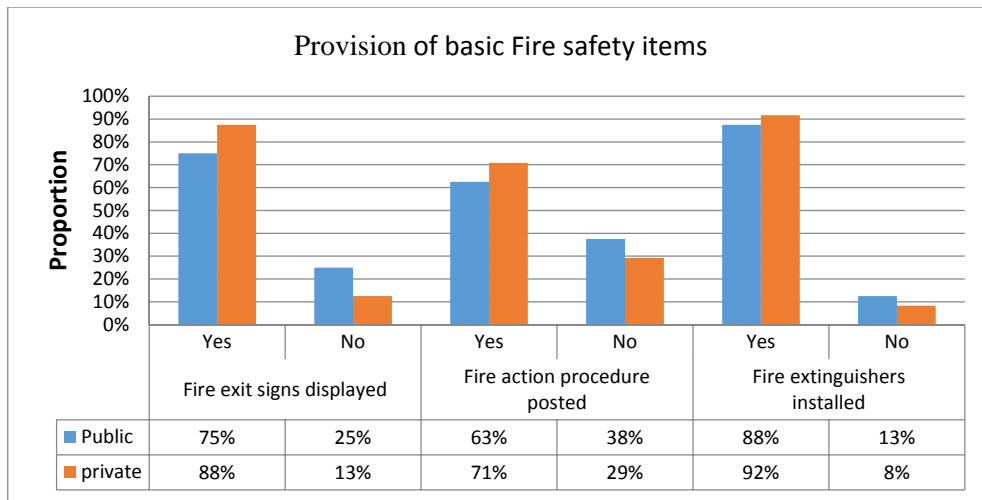*Fig. 16: Proportion of staff aware of Fire training programs in institutions*

Provision of basic Fire safety items

	Fire exit signs displayed		Fire action procedure posted		Fire extinguishers installed	
	Yes	No	Yes	No	Yes	No
Public	75%	25%	63%	38%	88%	13%
private	88%	13%	71%	29%	92%	8%

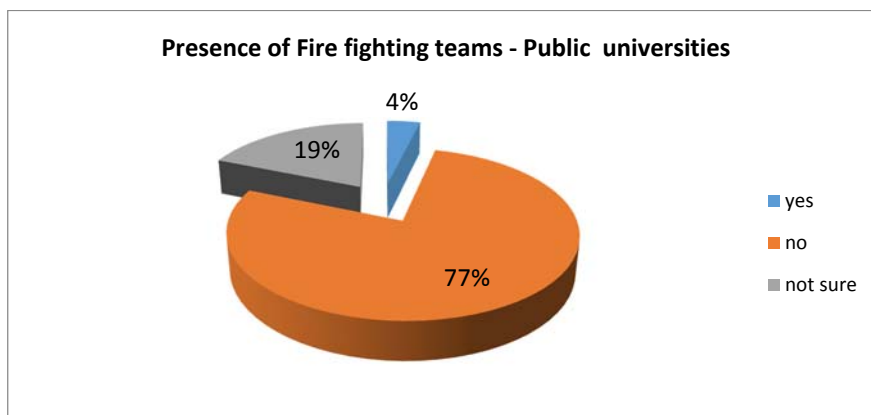*Fig. 17: Provision of basic Fire safety items across sites*

Fig. 18: Establishment of in-house fire fighting teams in public universities
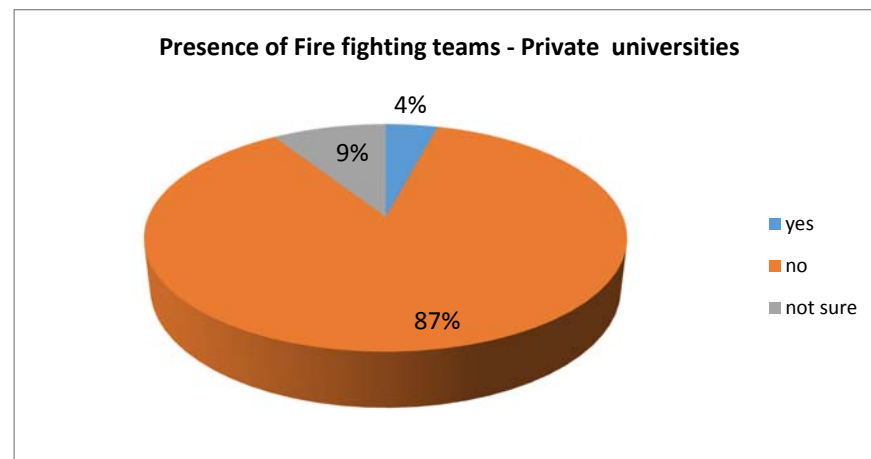

Fig. 19: Establishment of in-house fire fighting teams in private universities