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Statistical Analysis of Electrical Fire Outbreaks in Buildings: Case Study of Lagos State, Nigeria

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Abstract:

Electrical fires are not always noted despite their prevalence. When fire is severe, it can be difficult to discern whether an electrical appliance started the fire or if a poorly wired plug was the case. Electrical fires are pervasive throughout Lagos state, causing injury, claiming lives, and resulting in large losses of property. Data for this paper covering 2012 to2014 were obtained from various fire services in the country namely: This paper adopted statistical approach using SPSS tool to determine the possible factors causing electrical fires in buildings thereby providing remedial measures afterwards. Some of the areas covered are: amount lost, number of fire injuries, number of fire deaths, fire origin, items first ignited, month of occurrence, equipment involved in ignition and area covered by fire. It was discovered from analysis that the amount lost per fire for residential building electrical fires in Lagos state for the period considered is more than double that for nonelectrical residential building fires. The functional and structural areas of the building were found to be the most likely to experience electrical fires. Structural components of a building are by far the largest category of items first ignited in residential building electrical fires. Electrical wiring with its various components was by far the major cause of residential building electrical fires. Remedial measures were provided.

Keywords: Electrical fire, buildings, statistics, deaths.

1.0 INTRODUCTION

Electrical fires are fires involving potentially energized electrical equipment. This sort of fire may be caused by short-circuiting machinery or overloaded electrical cables (Matt Fair, 2014). These fires can be a severe hazard to firefighters using water or other conductive agents, as electricity may be conducted from the fire, through water, to the firefighter's body, and then earth. Electrical shocks have caused many firefighter deaths. The most inclusive and direct interpretation of "electrical fire" is a fire involving some type of electrical failure or malfunction (Jeffcase, 2010). Any equipment powered by electricity can have such a failure. Electrical fire may be fought in the same way as an ordinary combustible fire, but water, foam, and other conductive agents are not to be used (Jeffcase, 2010). While the fire is or possibly could be electrically energized, it can be fought with any extinguishing agent rated for electrical fire. Once electricity is shut off to the equipment involved, it will generally become an ordinary combustible fire. Electricity is a basic part of residential life in the Nigeria. It provides the energy for most powered items in a contemporary home, from lights to heating systems to televisions. Today it is hard to imagine a residence without electricity. It is a part of our homes and our activities that most of us take for granted. We rarely think how powerful electricity is.

Electrical fires can be particularly complicated to put out. Since they involve electricity, and water conducts electricity, using water to put out the fire can cause electrocution. Chemical powders can cause the fire to smolder rather than extinguish, setting the stage to reignite Doug Leihbacher, 2010). Turning power off to the residence is an important step, if it is possible to do so. Residents demand higher levels of electrical energy to power their homes and appliances than they did in the past, and new homes are built to meet this demand for multiple televisions, phones, hairdryers, microwaves, washers and dryers, etc. As the consumers' electrical demands increase, so does their expectation that their homes will supply adequate power to meet these. They meet their

needs by adding more circuitry (and circuit breakers in blank spots on the breaker panel, or even another circuit breaker box) and outlets to accommodate their purchases. If an outlet is added to an existing circuit, then the load easily can be more than the wiring originally was designed to conduct—perhaps decades ago. What these consumers really do is create unseen hazards in their homes. Inside the walls, wiring is heating and damaging its own insulation, wood frames are being charred by high-wattage light bulbs too close to ceilings, and fixture wattage ratings are being exceeded. But as long as the lights come on and the appliances start, the consumer remains unaware of the danger—until a fire starts.

Most electrical fires are caused by faulty electrical outlets and old, outdated appliances. Other fires are started by faults in appliance cords, receptacles and switches (Dan Atknson, 2010). Never use an appliance with a worn or frayed cord which can send heat onto combustible surfaces like floors, curtains, and rugs that can start a fire (Statesman journal, 2000). Portable space heaters that use coils are potentially dangerous when they are positioned carelessly near curtains and rugs and adjacent to beds and cloth covered furniture. The chances of inflammable material coming into contact with the red hot coils increase the risk of fire. Unrestricted use of extension cords is a major fire hazard. The risk of fire increases when the TV, home theatre, computer and other appliances are all plugged into a single extension cord. This creates excessive power load on a single socket which may not be designed to handle that load. Running cords under rugs is another cause of electrical fires. Removing the grounding plug from a cord so it can be used in a two-prong electrical outlet can also cause a fire. The reason appliances have the extra prong is so they can be only used in outlets that can handle the extra amount of electricity that these appliances draw (Kansas.com, 2013).

Plate1: a photograph showing electrical fire involving multiple appliances

Light fixtures, lamps and light bulbs are another common reason for electrical fires. Installing a bulb with a wattage that is too high for the lamps and light fixtures is a leading cause of electrical fires (crystal Brown, 2010). Always check the maximum recommended bulb wattage on any lighting fixture or lamp and never go over the recommended amount. A very common cause of fires is plugging lights, lighting appliances and bulbs into electrical sockets that cannot handle higher wattage levels (Yusuf Olagbade, 2012). Antique lighting appliances may have defective wiring that makes the appliance unstable by overheating. Decorating lights with colored paper and cloth shades can increase the risk of fire when the material or fabric heats up (Charles Jennings, 2000). Another cause of fire is placing materials like cloth or paper over a lampshade. The material heats up and ignites, causing a fire. Faulty lamps and light fixtures also frequently result in fires. Misuse of extension cords is another electrical fire cause. Appliances should be plugged directly into outlet and not plugged into an extension cord for any length of time. Only use extension cords as a temporary measure. If you do not have the appropriate type of outlets for your appliances, hire an electrician to install new ones.

Plate2: a photograph having multiple plugs in a socket

Space heaters are a major cause of electrical fires. Because these types of heaters are portable, many times people put them too close to combustible surfaces such as curtains, beds, clothing, chairs, couches and rugs (Havre daily news, 2013). Coil space heaters are especially dangerous in this regard because the coils become so hot they will almost instantaneously ignite any nearby flammable surface. Outdated wiring often causes electrical fires. If a home is over twenty years old, it may not have the wiring capacity to handle the increased amounts of electrical appliances in today's average home, such as computers, wide screen televisions, DVD players, microwaves and air conditioners. Appliances that are old and overused and those that fall short of modern safety standards are the worst culprits. Frayed electrical cords, self-jointed wires, and worn out sockets that are not properly grounded are major causes of fires (Kelvin Adeoti, 2014). They become ready outlets for directing heat and fire to carpets, rugs, curtains and combustible plastic. Older appliances draw more power than the wall sockets can handle. Breakers should be triggered when circuits get overloaded by too much electricity, but outdated breaker boxes often have worn connectors that do not work,

causing the system to overload and start an electrical fire. Faulty wiring is one of the main causes of electrical fires. If you find anything that's frayed, tattered, or worn out, replace it with new wiring. Cords in poor condition can overheat or cause sparks and start a fire. For appliances, you can usually buy replacement cords. If you have an older home, hire a highly rated electrician to inspect the wiring. Electrical wiring is not meant to last forever, so if your home is a century old; it's overdue to be rewired. This is especially true if your home has aluminum wiring, which is more fire-prone than copper wiring.

Electrical fires may involve combustible metals - especially alkali metals like lithium and potassium, alkaline earth metals such as magnesium, and group 4 elements such as titanium and zirconium (WFSR, 2001). With the exception of the metals that burn in contact with air or water (for example, sodium), masses of combustible metals do not represent unusual fire risks because they have the ability to conduct heat away from hot spots so efficiently that the heat of combustion cannot be maintained—this means that it will require a lot of heat to ignite a mass of combustible metal. Generally, metal fire risks exist when sawdust, machine shavings and other metal "fines" are present. Generally, these fires can be ignited by the same types of ignition sources that would start other common fires (Olaoye Ahmed, 2014). Water and other common firefighting materials can excite metal fires and make them worse. Fire fighters recommend that metal fires be fought with dry powder extinguishing agents. Dry powder agents work by smothering and heat absorption. The most common of these agents are sodium chloride granules and graphite powder. In recent years powdered copper has also come into use.

Some extinguishers are labeled as containing dry chemical extinguishing agents. This may be confused with dry powder. The two are not the same. Using a dry chemical extinguisher in error, in place of dry powder, can be ineffective or actually increase the intensity of a metal fire. Metal fires represent a unique hazard because people are often

not aware of the characteristics of these fires and are not properly prepared to fight them. Therefore, even a small metal fire can spread and become a larger fire in the surrounding ordinary combustible materials (Paul Isaac, 2001). Only dry powder should ever be used to extinguish a metal fire.

Fires that involve cooking oils or fats are technically a subclass of the flammable liquid/gas class, the special characteristics of these types of fires, namely the higher flash point, are considered important enough to recognize separately (Olusegun et al 2014);. Water mist can be used to extinguish such fires. Appropriate fire extinguishers may also have hoods over them that help extinguish the fire. Sometimes fire blankets are used to stop a fire in a kitchen or on a stove. Over a period of time you add more electrical appliances such as wide screen televisions, home theatre, microwave oven, refrigerator and air conditioners. The outdated home wiring cannot handle the increased power load (Patrick Oscar, 2014). Older wiring tends to heat up quickly and catches fire. If the breaker boxes are themselves defective, they cannot prevent overheated electrical panels from catching fire.

Plate2: A photograph showing burnt electrical outlet

2.0 RESIDENTIAL BUILDING ELECTRICAL FIRE SCENARIOS IN LAGOS

May 2012, Mushin, Lagos: A family lost all of their personal belongings in an electrical fire. The fire, which officials said originated in one of the wall outlets, consumed a three-bedroom flat and its contents. Fire or smoke was not seen although a family member smelled something burning. Bedrooms were checked and, in the corner of one, was a fire. "At first it started small but it went up fast," the young woman observed.

October 2013, Isolo, Lagos: A fault in the electric distribution system was determined to be the cause of an apartment complex fire that sent three people to the hospital. The fire originated in an electric box on the outside of the building near the stairwell.

November, 2013, Ikorodu, Lagos: Fire blamed on a worn extension cord extensively damaged a house in Ikorodu. Fire investigators noted the fire was caused by an extension cord that had been strained under the corner of a couch. The investigators affirmed that the house became a total loss.

3.0 AIMS AND OBJECTIVES

The aim of this paper is to use statistical approach to determine the causes of electrical fires in homes and subsequently providing workable remedial measures.

Objectives are to:

- Provide data on loss measures for residential building electrical fires from 2012-2014.
- Provide data on area of fire origin in residential building electrical fires from 2012-2014.
- Provide data on items first ignited in residential building electrical fires from 2012-2014.
- Provide data on month of occurrence and alarm time in residential building electrical fires from 2012-2014.

- Provide data on equipment involved and fire spread level in residential building electrical fires from 2012-2014.

4.0 METHODOLOGY

- ❖ Visiting some locations of electrical fire outbreak in Lagos state.
- ❖ Visiting relevant agencies in Lagos state to obtain data on electrical fire outbreaks in the state from 2012 to 2014.
- ❖ Administering questionnaires and interviews on incidences of electrical fire outbreaks within Lagos metropolis.
- ❖ Performing statistical analysis using the information obtained.
- ❖ Providing recommendations to curb the menace of fire outbreak in the state.

5.0 DATA PRESENTATION AND ANALYSIS

Table 1: **Loss Measures for Residential Building Electrical Fires (2012-2014).**

Loss Measure	**Residential Building Electrical Fires**	**All Nonelectrical Residential Building Fire Causes**
Amount lost per fire	₦10,504, 672	₦4,331, 276
Injuries per 500 fires	120	98
Deaths per 500 fires	128	73

Source: ***Lagos State Fire and Safety services, Ikeja (Olaoye Ahmed, 2014)***

Table 1 reveals that electrical fires in residential buildings result in more damage and higher death rates per 500 fires on average than nonelectrical residential fires. Amount lost per fire for residential building electrical fires is more than double that for nonelectrical residential building fires. Deaths per 500 fires are about 75% higher for residential building electrical fires. The injury resulting from residential building electrical is about twice that of nonelectrical fires, The analysis above is an indication that electrical fires in residential buildings are more destructive than nonelectrical fires.

Figure1: Area of fire origin (2012-2014)

Source: Lagos State Fire and Safety services, Mushin (Olaoye Ahmed, 2012- 2014)

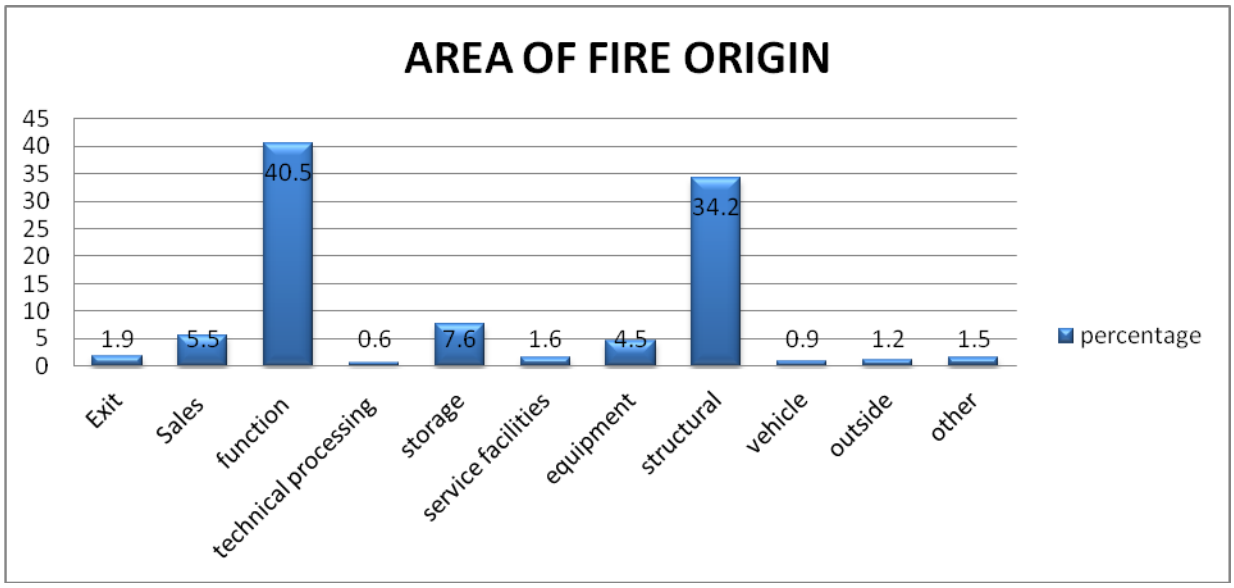

Figure 1 shows that the functional and structural areas of the building are the most likely to experience electrical fires. The functional categories are bedrooms, dining rooms, kitchens, bathrooms, laundry areas, and the likes.

Figure2: Items First Ignited in Residential Building Electrical Fires, 2012–2014. ***Source: Lagos State Fire and Safety services,ojoo (Olaoye Ahmed, 2014)***

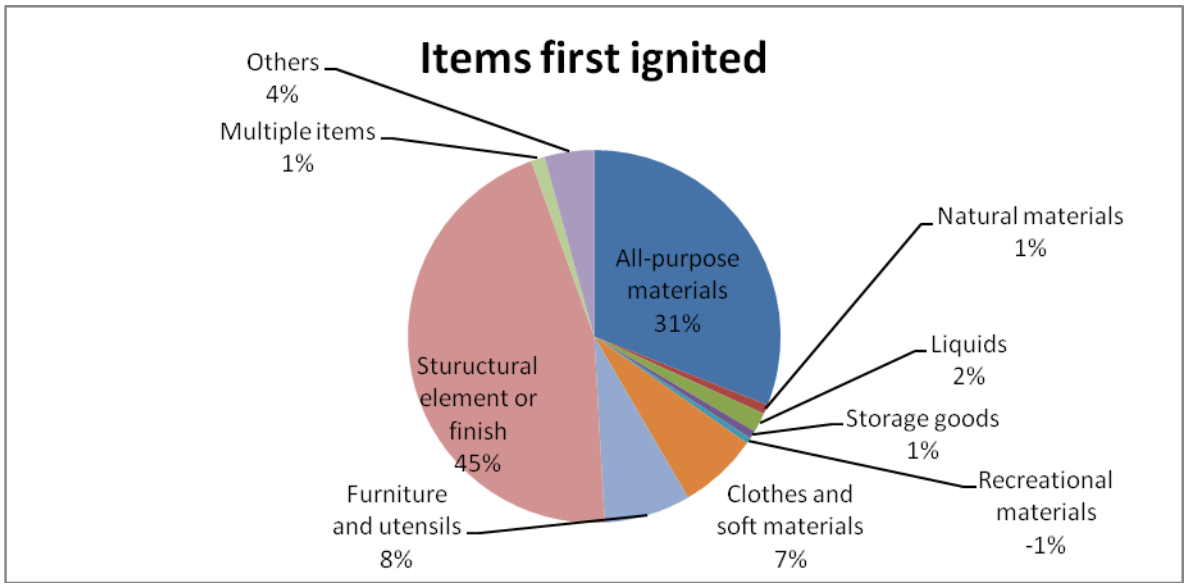

Figure 2 shows that structural components of a building is by far the largest category of items first ignited in residential building electrical fires with a percentage of 45.

Figure 3: Month of occurrence of residential electrical fires

Source: Lagos State Fire and Safety services, Ikorodu (Olaoye Ahmed, 2012-2014)

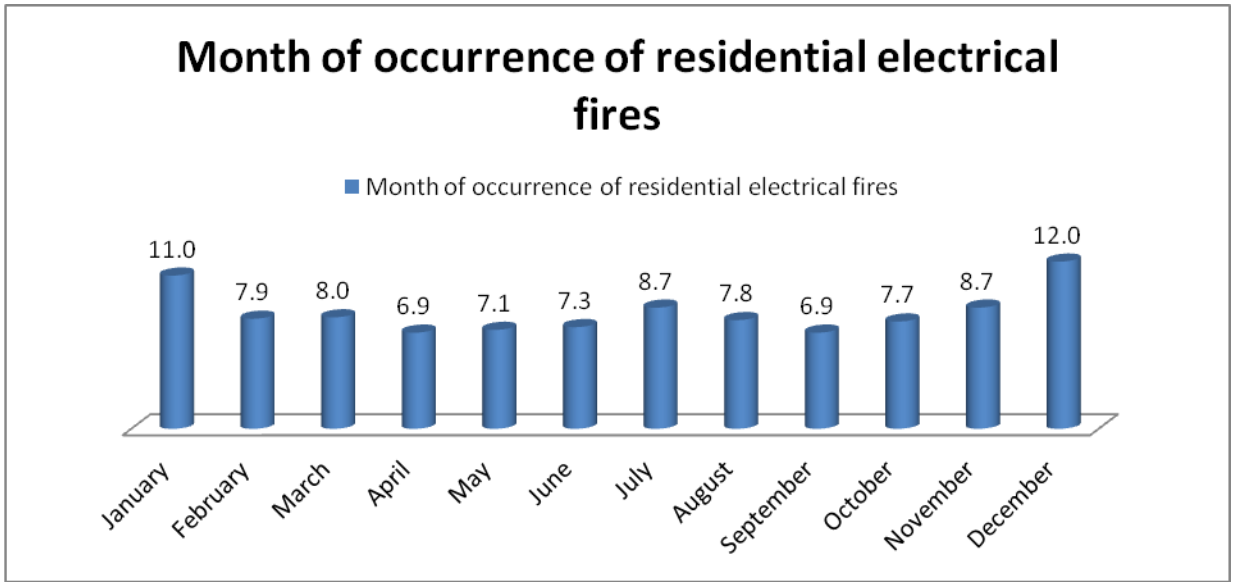

Figure 3 shows that electrical fires in residential buildings occur most in November, December and January being dry season while only July in the rainy season has a significant high occurrence.

Figure 4: Month of fire deaths

Source: Lagos State Fire and Safety services, Surulere (Olaoye Ahmed, 2012- 2014)

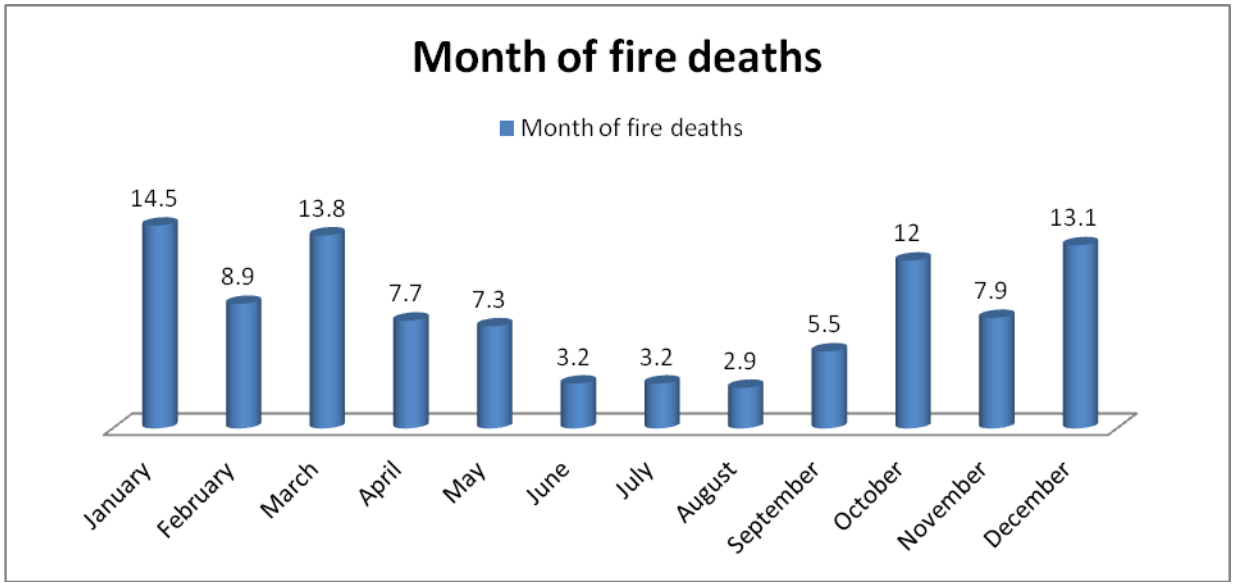

Figure 4 reveals that fire deaths also are high in January, March and December, but April and May, both have similar peaks. Wet season has the lowest incidence of deaths resulting from electrical fires in the home.

Figure 5: Equipment involved in ignition

Source: Nigerian institute of safety professionals, NISP (Olaoye Ahmed, 2012- 2014)

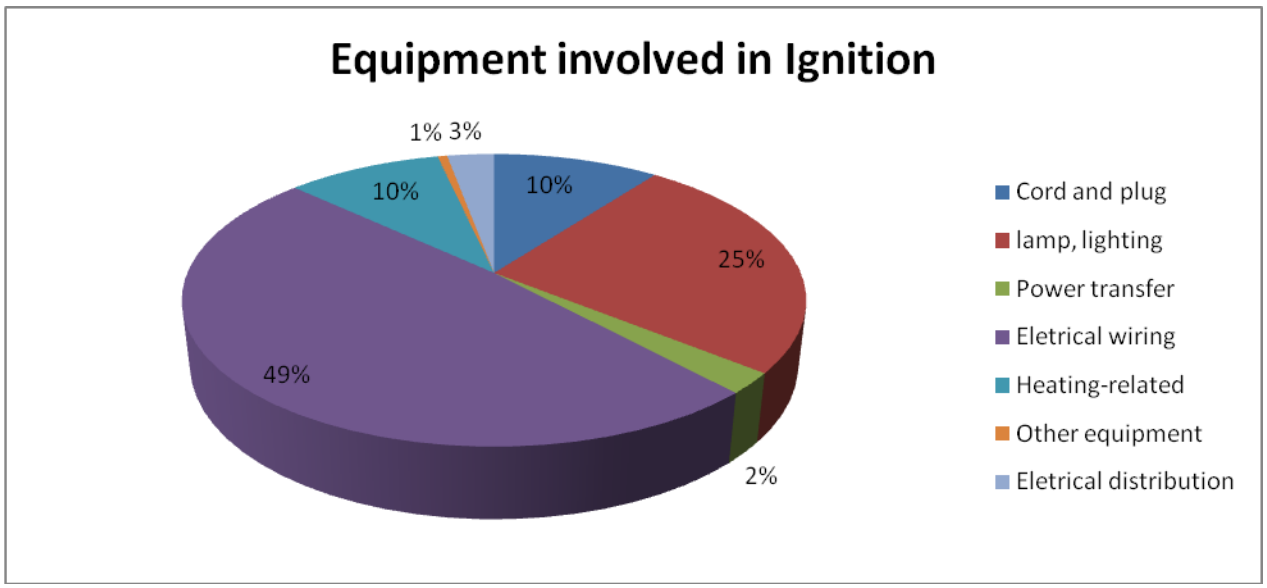

Figure 5 shows that electrical wiring with its various components is by far the major culprit in residential building electrical fires. This could be because temperature is one of the factors affecting the resistance of wires. When those wires get heated they easily melted and consequently catch fire. Lamps and other lighting and cords and plugs also present severe problems.

Figure 6: AREA COVERED BY FIRE

Source: Nigerian institute of safety professionals (Olaoye Ahmed 2012- 2014)

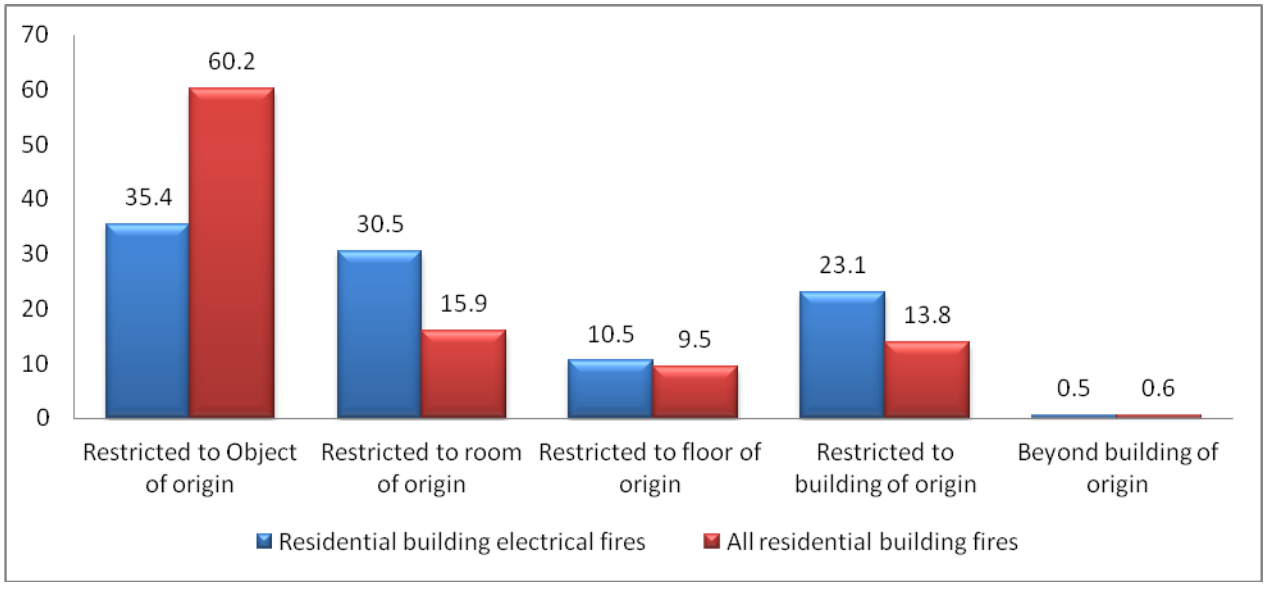

Figure 6 reveals that most residential building fires are confined to the object of origin (60%) with 35% of fires spreading through the residence and beyond. Fire spread from residential building electrical fires, however, has nearly the opposite.

Figure 7: Factors leading to ignition

Source: Lagos State Fire and Safety services, Agege (Olaoye Ahmed, 2012-2014)

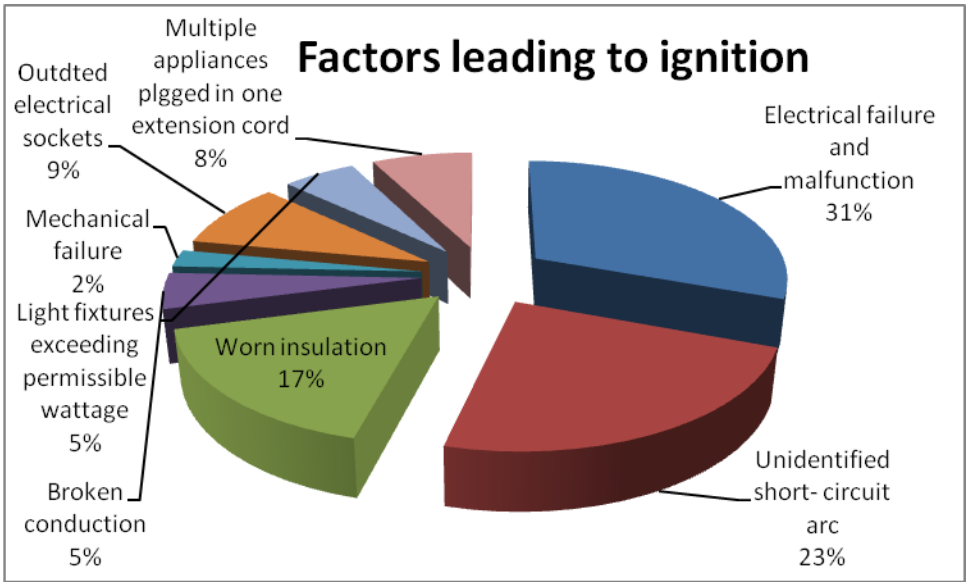

Figure 7 shows that the leading specific factors, all electrical issues, account for 98% of these electrical failures. Electric failure and malfunction are the highest factors leading to ignition.

CONCLUSION

The analysis from this study revealed that amount lost per fire for residential building electrical fires in Lagos state for the period considered is more than double that for nonelectrical residential building fires. Deaths per 500 fires are about 75% higher for residential building electrical fires. The injury resulting from residential building electrical is about twice that of nonelectrical fires. The functional and structural areas of the building were found to be the most likely to experience electrical fires. Structural components of a building are by far the largest category of items first ignited in

residential building electrical fires. Electrical fires in residential buildings occur most in November, December and January annually. Electrical wiring with its various components is by far the major culprit in residential building electrical fires. Most residential building fires are confined to the object of origin (60%) with 35% of fires spreading through the residence and beyond.

REMEDIAL MEASURES

- The frequency of checking of electrical appliances should be increased in addition to close inspection of cords and plugs.
- Defective electrical cords should be replaced as fast as they are detected, and never attempt to repair them yourself.
- Appliances that use quality materials should be bought, and approved safety standards should be followed.
- Install ground fault circuit interrupters and surge protectors that will guard all major appliances; use only protectors and power strips that are authorized by reputed testing laboratories.
- Ensure that all light bulbs and lighting devices are plugged into electrical sockets that match the prescribed wattage. Avoid using extension cords for lighting purposes.
- Ensure that inflammable materials are positioned well away from portable space heaters. Better still, use radiation heaters that do not catch fire on direct contact.
- Get the electrician to install power outlets matched to appliances that you frequently use. Avoid plugging appliances into multi-socket extension cords. The best course is to avoid using extension cords altogether.
- Call an expert electrician to look over your building. Detect and replace old wiring immediately, and you would be eliminating the biggest threat to electrical fires that your home could be exposed to.

- Beautifying your old home, landscaping your garden and redecorating the bedroom are important for enhancing the aesthetic beauty of your home but the safety and security of your home and your family are equally, if not more, important.
- Get an expert to conduct a thorough electrical safety audit of your wiring, external power panels and electrical wall outlets. Install good quality smoke detector alarms and fire extinguishers to strengthen your chances of surviving any electrical fire, saving lives and minimizing damage.
- Overloading is a common cause of electrical fires. This happens when you plug too many appliances into the same outlet, extension cord or power strip.
- Portable electric space heaters are especially dangerous, but don't overlook irons, hair dryers or irons, and even lamps. Any electrical appliance can start a fire if it makes contact with flammable materials, including blankets, towels and rugs. Don't hide cables, especially extension cords, under rugs or carpets. If overheated, they can easily start a fire.
- Fix shorts and faulty wiring as soon possible-Unless it's something as simple as replacing a cord, fixing shorts and faulty wiring requires the expertise of an electrician. Faulty wiring symptoms include flickering lamps, plugs that spark when you plug something in, breakers that constantly trip. All these can cause sparks, which can quickly cause a fire. While you're at it, make sure to replace or eliminate any wire, connection, extension cord or fuse box that feels warm; warmth in these cases usually indicates a faulty or unsafe wiring connection. It can also mean that too much current is running through the circuits, which could cause an overload and result in a fire.

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