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ASSESSMENT OF ATTIC FIRES AND CASUALTIES IN RESIDENTIAL BUILDINGS: CASE STUDY OF LAGOS STATE

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ABSTRACT

Attics are not commonly used as occupied spaces and, as a result, they usually do not have smoke alarms or heat sensors. The moment a fire occurs in an attic, it is common that it will go unnoticed until smoke or flames, escaping from the roof, are observable from the exterior. The fire has often been described as the greatest servant but the worst master difficult to control when it turns into an inferno, burning and destroying everything in its path. In the rage of its fury, it has no respect for anyone. Buildings as infrastructure along with people's lives need protection against attic fire. Data on attic outbreaks in Lagos metropolis from2016 to 2021 were obtained from various rescue agencies in the state. Interviews were conducted alongside the structured questionnaires administered to a good number of citizens of the state. An estimated 1,000 residential building attic fires were reported each year and cause an estimated 300 deaths, 140 injuries, and ₦1.87 million in property loss. Residential building attic fires are considered part of the residential fire problem and comprise approximately 11 percent of all residential building fires.Almost all residential building attic fires are unrestricted fires (95 percent). One- and two-family residential buildings account for 90 percent of residential attic fires. Electrical malfunction is the leading cause of residential building attic fires (43 percent), followed by natural fires (16 percent). A third of all residential building attic fires spread to involve the entire building. Only 2 percent extend beyond the building to adjacent properties. Residential building attic fires are most prevalent in December (12 percent) and January (11 percent) and peak between the hours of 4 and 8 p.m. Electrical arcing is the most common heat source in residential building attic fires (37 percent). Prevention techniques were consequently highlighted.

Keywords: Attic fire, Residential building, losses, Prevention techniques

1.0 Introduction

Attics are not commonly used as occupied spaces and, as a result, they usually do not have smoke alarms or heat sensors (Aseeva et al. 2014). The moment a fire occurs in an attic, it is common that it will go unnoticed until smoke or flames, escaping from the roof, are observable from the exterior. Occasionally, however, enough smoke will reach the smoke alarms on the lower levels, setting them off.Because they can take longer to detect, attic fires are very dangerous for firefighters and residents alike (Berge, 2005). While some attics are converted into bedrooms, home offices, or attic apartments complete with windows and staircases, most remain difficult to access (and are usually entered using a loft hatch and ladder). Attics help control temperatures in a house by providing a large mass of slowly moving air, and are often used for storage. The hot air rising from the lower floors of a building is often retained in attics, further compounding their reputation as inhospitable environments. However, in recent years attics have been insulated to help decrease heating costs, since, on average, uninsulated attics account for 15 percent of the total energy loss in average houses.

The delayed detection allows the fire to become larger in size, ultimately causing more damage. The attic provides the fire with an array of fuel sources like open wood support beams and storage items (Dimova, 2015). In attic fires, multiple areas of the attic tend to be involved. The fire tends to spread amongst the wood fairly easily and can be concealed under the insulation (Gašpercová, 2015). This makes it very important that firefighters perform a thorough check ofthe attic to ensure that no hotspots, embers, or smoldering debris are still present (Calkins, 2009). The location of the attic provides many difficulties for firefighters when extinguishing the fire. Careful planning goes into deciding the best way to extinguish an attic fire. Firefighters must decide whether to fight the fire from above or below, both of which present many difficulties (Kelvin Adeoti, 2014). In both instances, firefighters have to consider that roofs or ceilings may collapse (Olaoye Ahmed, 2014). The large amounts of water used to extinguish the blaze causes the insulation and wood beams to become saturated. Firefighters have been known to fall through the roof into the attic or through the attic into the floor(s) below (Olusegun A, 2014). In addition, not all attics have flooring. If firefighters enter the attic, they must be careful not to step outside the flooring area since they risk falling through the ceiling (Patrick Oscar, 2014).

Plate 1: Typical Attic fire

In the present day of rapid advancement in all branches of arts and mechanics, it is quite natural that many improvements should take place not only in the appliances for, but also in the methods of handling fires. The improvement and perfection of our fire-fighting methods and apparatus have well kept pace with other branches of our city governments. So many circumstances enter into an "attic fire" that it is almost impossible to follow any set rule; and, in nearly every case, much depends on the judgment of the commanding officer and the means and men at his disposal. The average "attic fire" in the stereotyped two and a half story hip-roof house is best handled, in our judgment, by throwing streams from both or either end of the building, and as most houses of this class have a window in each end of the attic, the means of access are usually very easy, and unless such fire has gained considerable headway the extinguishment of it should occupy but a short time.

The construction of the attic is another area that presents difficulties to firefighters. Older and newer homes are constructed using different techniques. Older homes tend to have roofs that are framed with larger sized lumber, 3 by 7 inches. These attics usually provide a continuous attic space with a peak as high as 8 feet. Conventional atticsare not generally compartmentalized like many new home attics.10 Newer home attics typically employ a truss-framedconstruction that involves smaller wood boards placed in "A" (or triangular) shapes throughout the attic from the ceiling to the floor. This construction can be difficult for a firefighter to navigate. In addition, wood members in truss-framed construction can conceal fires and make extinguishing the fire more difficult (Paul Isaac, 2014).In large new homes and multifamily dwellings, many attics are constructed with fire stops, which can be as substantial as 2-hour, fire-resistance rated walls (Yusuf Olagbade, 2012). These help limit the spread of the fire from the attic to surrounding areas.Because attic fires pose unique challenges, this topical report addresses the characteristics of residential building attic fires as reported from 2016 to 2021. The NFIRS data analysis method was used for the analysis presented throughout the report (World Fire Statistics Report (WFSR), 2001). For the purpose of the report, the terms "residential fires" and "attic fires" are synonymous with "residential building fires" and "residential building attic fires," respectively. "Attic fires" is used throughout the body of this report; the findings, tables, charts, headings, and footnotes reflect the full category, "residential building attic fires."The objectives are: a) to investigate attic in residential buildings b) to investigate leading causes of fires in buildings. c)To provide information on factors contributing to ignition, area of origin, level of spread, and losses observed d) to provide prevention techniques.

2.0 Methodology

Stages of the Study

Some locations where attic fires occurred in Lagos State were visited. Relevant agencies were consulted to obtain necessary data on attic fires from 2016 to 2021. Questionnaires and interviews were conducted on incidences of attic fire outbreaks within Lagos metropolis.Statistical analysis were carried out using the information obtained from various attic fire sites. Recommendations were provided to curb the menace of attic fires in the state.

3.0 Data Presentation And Analysis

Table 1: Attic fires from residential buildings based on type of incident (2016 to 2021)

Incident Type		%
	Building Fires	79.4
Unrestricted Fires	Fires in other structures and not buildings	9.8
Sub total		89.2
Restricted Fires	Chimney Fire	5.5
	Boiler breakdown	2.7
	Trash contained	2.6
Sub total		10.8
Total		100

Building fires can be divided into two classes of severity namely restricted and non-restricted. The restricted fires are those fires restricted to certain types of equipment or objects while unrestricted fires are not. Restricted building fires are small fire incidents that are limited in extent, staying within fireplaces or certain other non-combustible containers.Restricted fires rarely result in serious injury or large content losses, and are expected to have no significant accompanying property losses due to flame damage. Unrestricted fires account for nearly all attic fires as shown in Table 1. The restricted fires carry majority of the proportion based on attic fire cases recorded. Restricted fires show just 10.8% compared to a high value of 89.2% for unrestricted fires.Since there are so few restricted attic fires (less than 15 percent), the following analyses in this study include all attic fires only.

Table 2: Attic and Non-attic Residential Building Fires based on Type of property (2016 to 2021)

Type of occupants	Residential building attic fires (%)	Non-attic fires residential building fires (%)
Family of one or two	79.5	75.4
Multi-family	12.3	20.2
Supplementary	8.2	4.4

Residential buildings can be divided into three major property types: Family of one or two, multi-family buildings, and supplementary. Family of one or tworesidential buildings include isolated single-family residences, manufactured homes, mobile homes not in transit, and duplexes. Multi-family residential buildings include apartments, condos, and town houses. Other residential buildings include all other types of residential buildings, such as hotels or motels, long-term care facilities, dormitories, and sorority or fraternity housing. Family of

one or tworesidential buildings account for nearly all (80 percent) of residential attic fires reported as seen in Table 2. By comparison, Family of one or tworesidential buildings account for 75 percent of fires originating in other, non-attic areas of residential buildings, more in line with the occurrence of Family of one or tworesidential building fires overall (76 percent).

Table 3: Loss Measures for Attic and Non-attic Residential Building Fires(2016 to 2021)

Loss Measurement	Residential building attic fires	Non- attic residential building fires
Fatalities per thousand fires	3.5	5.4
Injuries per thousand fires	13.2	27.2
Equivalent amount lost per fire	₦270.3m	₦110.2m

Table 3 presents losses, averaged over this five year-period, of reported attic and non-attic residential fires.Attic fires cause less fatalities and injuries per thousand fires than non-attic residential building fires (Table 3). As attics tend to be unoccupied areas, the lower loss measures for fatalities and injuries may be a reflection of this occupancy status. Attic fires, however, do result in more money loss per fire than non-attic residential building fires. The increase in amount of money loss per fire may ultimately be due to challenges in the detection of attic fires and to the fire location. The fires are harder to detect, become larger in size, and cause more widespread flame damage. Water damage also affects the dollar loss, since the fire is attacked at the highest level, affecting all of the floors below, as opposed to a fire that is attacked on lower floors only. The table 3 also shows vividly that residential building attic fires experience the major loss to the tune of two hundred and seventy million naira compared to non-attic residential building fires which is one hundred and ten million naira

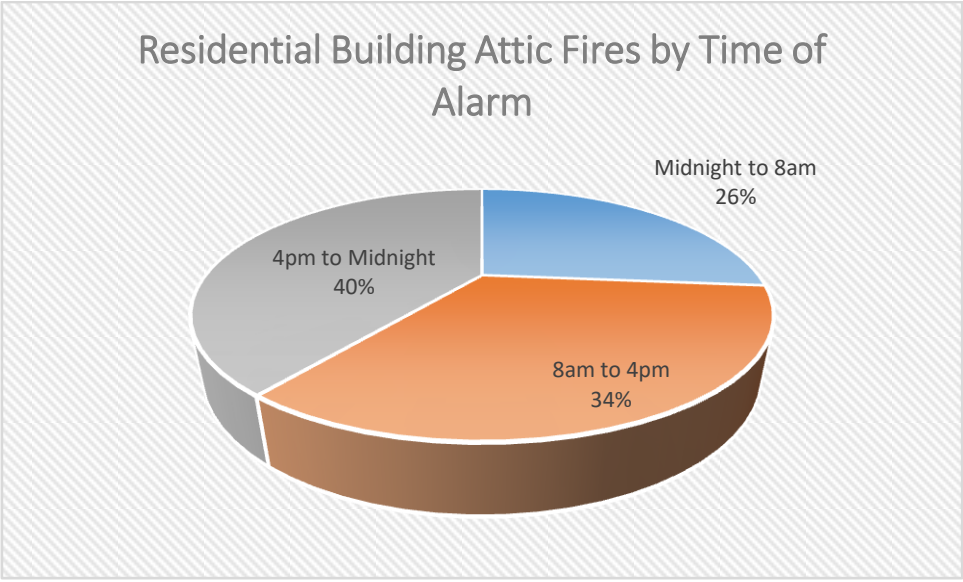

Figure 1:Residential Building Attic Fires by Time of Alarm (2016 to 2021)

As shown in Figure 1, attic fires occur most frequently in the late afternoon to early evening hours, peaking from 4 to 8 p.m. They gradually decline throughout the late evening and early morning hours. The lowest point is reached between 4 and 6 a.m. The fire incidences then begin to rise gradually until 7 a.m. where a small peak is observed. A small decrease is seen from 8 to 10 a.m. beginning at 10 a.m., the number of fire incidences start to increase until the peak hours are reached. The peak period (4 to 8 p.m.) accounts for 23 percent of attic fires.

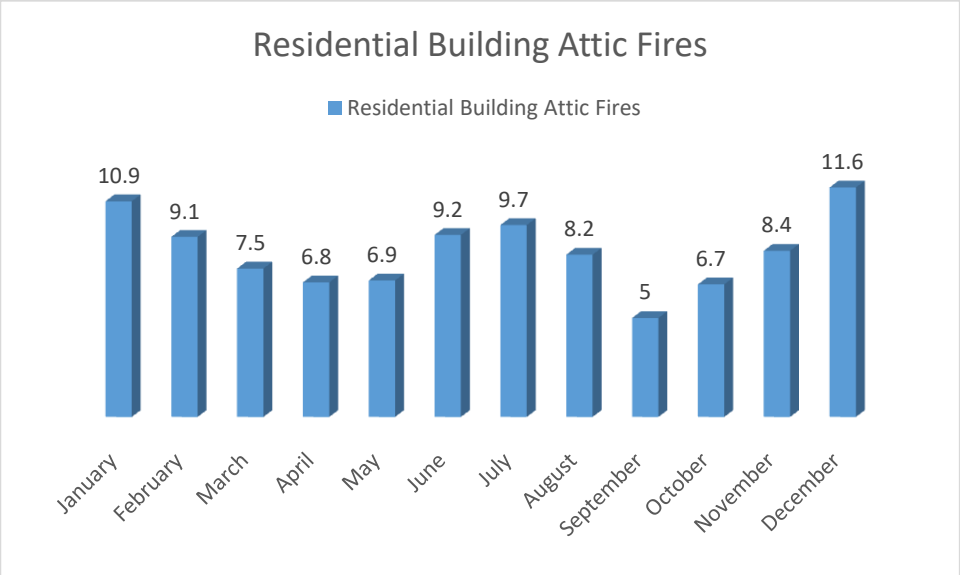

Figure 2: Residential Building Attic Fires by Time of Alarm (2016 to 2021)

Figure 2 demonstrates that attic fires peak twice during the year, once in the colder months and again in the summer. The cold weather peak, which is the highest peak, occurs during the months of December (12 percent) and January (11 percent). The increase in attic fires during these 2 months is partially a result of electrical malfunction fires. The second peak in attic fires is seen during the months of June (9 percent) and July (10 percent). This summer peak is primarily a result of natural fires, which are highest during these 2 months. The majority of these natural fires are the result of lightning discharge. The lowest number of fire incidents is seen in September which sees the least number of attic fires caused by electrical malfunctions.

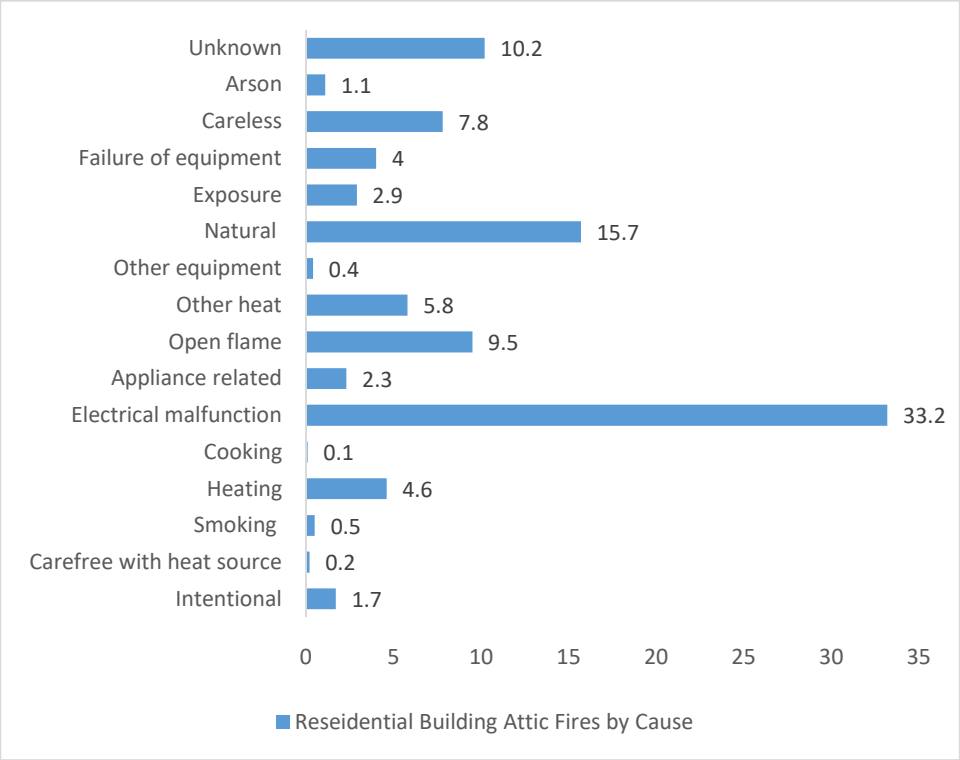

Figure 3: Residential Building Attic Fires by Cause (2016 to 2021)

Thirty-three percent of all attic fires are electrical malfunction fires as shown in Figure 3. This finding suggests that homeowners and residents should make it a priority to have electrical equipment and electrical wiring in the attic inspected and properly maintained.The next four leading causes combined account for 40 percent of attic fires: natural fires (16 percent), open flame fires (10 percent), other unintentional, careless fires (8 percent), and other heat fires (6 percent)

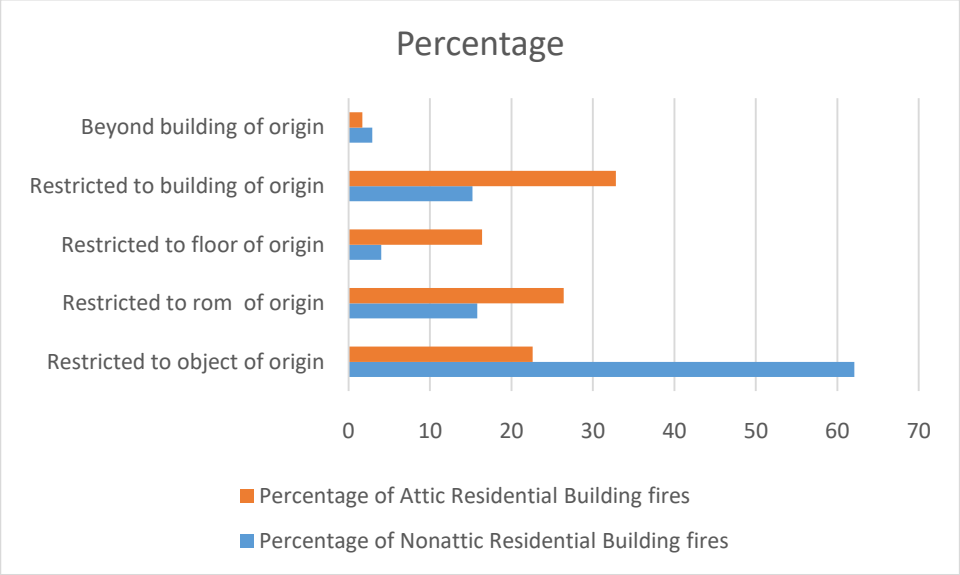

Figure 4: Extent of Fire Spread in Attic and Nonattic Residential Building Fires (2016 to 2021)

While 98 percent of attic fires never leave the building of origin (Figure 4), a third of the fires involve the entire building. An additional 2 percent extend beyond the building to adjacent

properties. The fire spread in attic fires is in contrast to nonattic residential building fires where most fires are confined to the object of origin (62 percent) and only 15 percent involve the entire building.

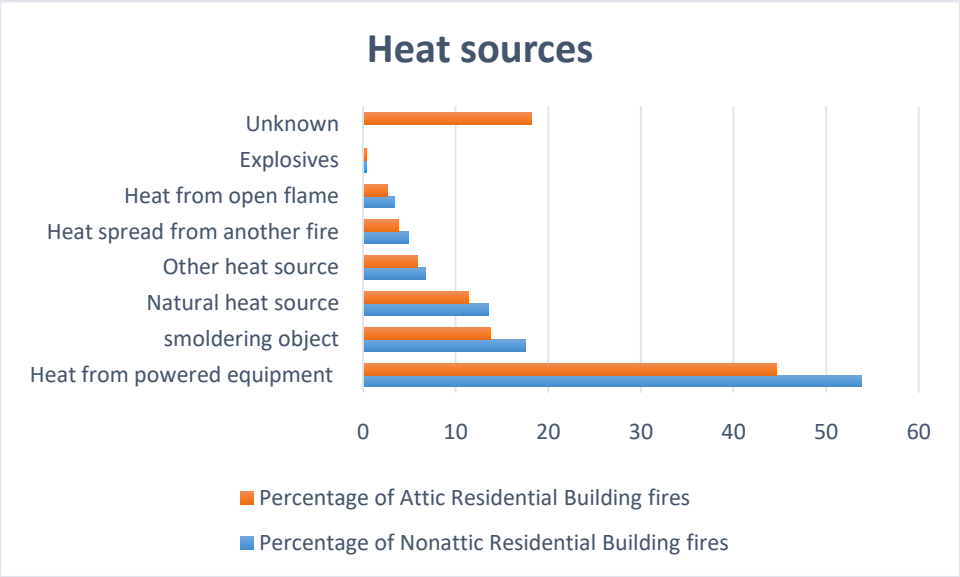

Figure 5: Sources of Heat Categories in Residential Building Attic Fires (2016 to 2021)

Figure 5 shows sources of heat categories in attic fires. The "heat from powered equipment" category, predominately electrical distribution-related equipment, accounts for 54 percent of all attic fires. Within this category, electrical arcing accounts for 37 percent, radiated or conducted heat from operating equipment accounts for 8 percent, heat from other powered equipment accounts for 6 percent, and sparks, embers, or flames from operating equipment account for 3 percent of all attic fires. The "hot or smoldering objects" category accounts for 18 percent of attic fires. This category includes fires started by miscellaneous hot or smoldering objects (8 percent) and hot embers or ashes (8 percent). The third largest category "chemical, natural heat sources" (14 percent) is primarily lightning discharge (13 percent).

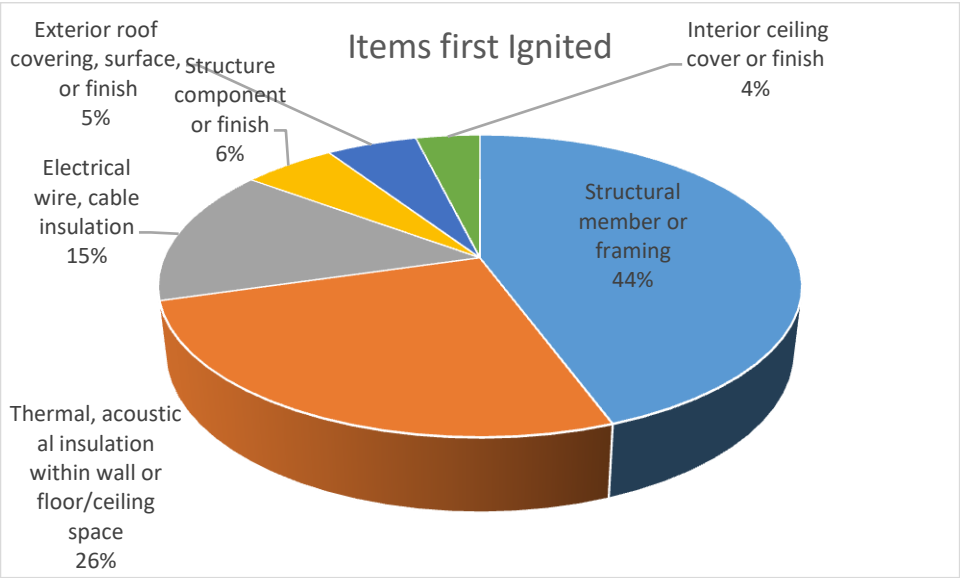

Figure 6: Leading Items First Ignited in Residential Building Attic Fires (2016 to 2021)

Structural member or framing (39 percent), thermal, acoustical insulation within wall, partition, or floor/ceiling space (23 percent), and electrical wire, cable insulation(13 percent) are the specific items most often first ignited in attic fires (Figure 6). Other structure component or finish accounts for 5 percent of the items first ignited. The exterior roof covering, surface, or finish accounts for an additional 5 percent.

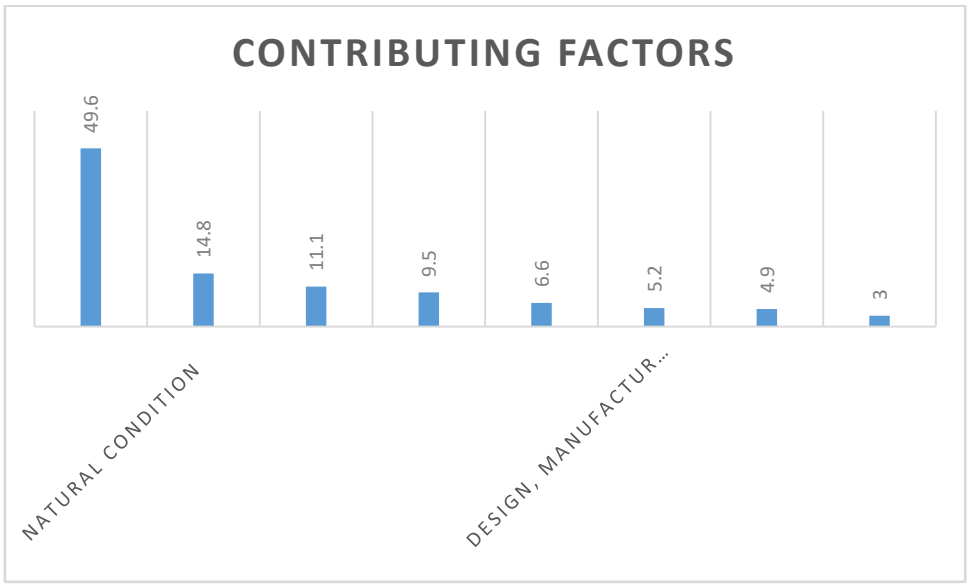

Figure 7: Contributing factors to Ignition for Residential Building Attic Fire (2016 to 2021)

Figure 7 shows the categories of factors contributing to ignition in attic fires. By far, the leading category is "electrical failure, malfunction" (50 percent). Unspecified electrical failure or malfunction (21 percent), unspecified short-circuit arc (14 percent), and short-circuit arc from defective, worn insulation (10 percent) account for the majority of the fires in this category.

The "natural condition" category is a contributing factor in 15 percent of attic fires. Storms (12 percent) are the leading specific factor contributing to ignition in this category.The categories "fire spread or control" and "misuse of material or product" are the third and fourth leading factors at 11 and 10 percent, respectively. The remaining categories are contributing factors in 20 percent of attic fires.

4.0 Few Cases of Attic Fires in Lagos State

- In August 2016 an attic fire in a building started around 3 a.m. and is believed to have been caused by an electrical problem. Five family members were home when the fire took place but no injuries or deaths occurred. The fire caused between ₦150, 000 to ₦200, 000 worth of damage. The firefighters were able to keep the fire contained to the attic
- In May 2018: A fire that started in the attic at a residential building in Lagos which was caused by faulty wiring in a second-story ceiling fan. The fire was brought under control in about 30 minutes and was contained to the attic and roof areas. The occupants and a contractor who was working on the back entrance were home when the fire started. Both were alerted to the fire by a smoke alarm and were able to escape safely.
- In April 2020: A four-alarm fire in a residential building started when a lighting strike hit a house, causing a fire to start in its attic. The fire ended up destroying the home despite firefighter's efforts to combat the blaze. The fact that the fire department had

no access to water at the home's location had a significant effect on the outcome. No deaths or injuries were reported as a result of the incident.

- In May2021: A neighbor called fire fighter's line shortly after 11 p.m. when he smelled smoke coming from a neighboring house. The fire is believed to have been caused by an electrical malfunction in the attic. No one was home when the fire started and no injuries were reported. It is estimated that the house sustained ₦300,000 worth of damage from the fire

5.0 Conclusion and Findings

An estimated 1,000 residential building attic fires were reported each year and cause an estimated 300 deaths, 140 injuries, and ₦1.87 million in property loss. Residential building attic fires are considered part of the residential fire problem and comprise approximately 11 percent of all residential building fires.Almost all residential building attic fires are unrestricted fires (95 percent). One- and two-family residential buildings account for 90 percent of residential attic fires. Electrical malfunction is the leading cause of residential building attic fires (43 percent), followed by natural fires (16 percent). A third of all residential building attic fires spread to involve the entire building. Only 2 percent extend beyond the building to adjacent properties. Residential building attic fires are most prevalent in December (12 percent) and January (11 percent) and peak between the hours of 4 and 8 p.m. Electrical arcing is the most common heat source in residential building attic fires (37 percent).

6.0 Attic Fire Prevention Techniques

- Limit the number of cords plugged into one outlet or power strip to avoid a blown circuit breaker.
- Remove any excess lint or debris in the attic.
- Consider removing any other items which can easily catch fire.
- Avoid storing flammable materials in the attic.
- Regularly clean vents of lint, dust and other materials.
- Check for a leaky roof, as water can cause electrical components to malfunction. If you notice a leak in your roof, contact a professional to seal it as soon as possible.
- Get a professional review of your electrical system to assess your property for possible vulnerabilities.
- Make sure all of your smoke detectors work. You'll want to have one in the kitchen, and one on every floor of your home, particularly in the bedrooms. Walk around your home and test all of them. Putting a smoke detector in your attic will also let you know if an attic fire starts. That way you can respond before it gets out of control.
- Next, be sure to inspect the wiring. Generally speaking, unless you need something, you probably won't venture up into the attic that often. During your spring cleaning a few months ago, the attic was probably one of the places you went through making sure there was nothing wrong. Still, things can change, especially if your entire house has old wiring that is in desperate need of updating.
- Dry season shouldn't be the only time you clean your house, and your attic is no exception. Getting rid of cardboard, paper, pieces of wood, and even loose bits of insulation can be tremendously helpful when it comes to reducing the risk of an attic fire starting.

- As important as it is to keep the inside of your home as fireproof as possible, you will need to do the same for the exterior parts of your house as well. For starters, make sure that there are no tree branches over your roof and attic. If the branches are too long, they can drop pieces of bark and leaves that can dry out and become fuel for a fire sparked by a lightning storm that passes through your neighborhood. An attic fire can spread to the rest of your house, so that means that proper tree care becomes even more important in the summer to keep your attic safe.

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