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Original Research Article

SPATIO-TEMPORAL PATTERN OF MOTORCYCLE ACCIDENTS IN ANAMBRA STATE, NIGERIA

Abstract

This research work focuses on spatio-temporal pattern of motorcycle accidents in Anambra state, Nigeria. The study used mostly secondary data, accident records which were obtained from Federal Road Safety Commission Awka, Anambra state (RS 5.30). The data on motorcycle accidents was obtained for a period of ten (10) years (2007-2016). Analysis of variance (ANOVA) technique was employed in the examination of the statistical significance of the variation among the local government areas of the state. The result indicates that there is a significant variation in the number of motorcycle accidents among the local government areas of the state ($F_{29, 189} = 2.609$; $p<0.05$). Again analysis of variance was employed in the examination of the statistical significance of the variation of motorcycle accidents over time (2007-2016) in Anambra state. The result indicates that there is a significant difference in the number of motorcycle accidents from 2007-2016 ($F_{9, 200}= 13.210$; $p<0.05$). Multiple regression analysis was employed in the examination of some of the characteristics of the local government areas of the state. It was observed that, there is a joint prediction of motorcycle accidents by a combination of some of the characteristics of the LGA of the state ($p<0.05$), the result implies that other characteristics of the Local Government areas of the state played little influence on the number of motorcycle accidents that occurred in 2011. The need for re-orientation of the land use pattern in the study area, better road network characteristics, Government should set up more police patrols for the highways in order to enforce road traffic regulation including speed limits and the need to establish Federal Road Safety Corps archive where accident records will be kept, collated and processed are desirable.

Keywords: Spatio-temporal pattern; Motorcycles; Motorcycle Accidents; Variations; Anambra state.

1.0 INTRODUCTION

Generally, transport is the movement of persons and or things across space. It could thus be defined as the relocation and distribution process of persons, goods, information, ideas etc.

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It is about accessibility [1]. In recent years there has been an increase of road accidents. Worldwide, it is estimated that, 1.2 million people are killed in road crashes each year and as many as 50 million are injured [2]. With increasing modernization in many developing countries, road traffic deaths are increasing and traffic deaths are projected to become the third most important health problem by 2020 [3]. Injuries related to motorcycle contribute significantly to the number of road traffic injuries seen.

The reported prevalence of motorcycle accidents varies around the world, from 22.8% in China high as 62% in Vietnam [4]. [5] Identified factors influencing high rate of commercial motorcycle accidents in Nigeria. They found over speeding, wrong overtaking, bad roads, sudden mechanical defects and alcohol intake as major factors. They also discovered that commercial motorcycle riders do not comply with Road Safety Highway Codes.

In Nigeria, in a study done in Ondo State among motorcyclists, up to 30% of them engaged in drunk riding [6] while another study in Oyo State stated that 20.4% of motorcyclists reported current use of alcohol [7]. [8], have focused on causes and prevention of road traffic accidents. However, there is still paucity of information on spatial-temporal pattern of motorcycle accident in south eastern Nigeria. Hence, it was against the backdrop of these problems and others associated with the high rate of motorcycle accidents that the researcher sought to find out the spatial-temporal pattern of motorcycle accidents in Anambra State.

Epidemiological model were used to provide a conceptual framework for explaining types, cause and features of motorcycle accidents. The model helps to determine the relative contribution or influence of each of the three sub-systems, i.e. the vehicle as the agent, the road user as the Host, as well as the physical and social condition (the environment) at any point in time when as accident occurs. [9], using the epidemiological model as an analogy of the system theory, confirmed the inter relationships among the three component parts, viz: the road, the vehicles and the users. Recent studies [10] have demonstrate that the road as major constitute of the environment is a significant accident causative factor, for instance, [11] collected and analyzed “data on geometric design, information system, roadway surface and roadside conditions on seven two-lane rural road in the country”. He found that “rural roads in the country have low levels of stopping and overtaking; inadequate traffic control devices and uneven roadsides edges”. He argued that these deficiencies are due largely to inadequate road design specifications and maintenance. [12] while looking at the same subject matter, from the public health point of view noted that road traffic accidents have

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been recognized as an important health problems in both developed and developing countries. Motorcycles accident is believed to affect the quality of life and to have major social and economic consequences. It causes may be a combination of human errors and failures, poor road signs, adverse road conditions, and vehicle defects.

The major objective of this study is to analysis the spatial and temporal pattern of motorcycle accidents in Anambra state as well as their trends from 2007-2016. It is expected that the present study will help in making recommendations in order to improve road safety and reduce motorcycle accident in Anambra state.

2. MATERIAL AND METHODS

2.1. Study Area

Anambra State is located at the south- east of Nigeria. It lies between Latitude $6^0$21'N and Longitude $7^0$61'E of the Greenwich meridian. The state shares boundaries with Delta state to the west, Imo state to the south, Enugu state to the east and Kogi state to the north (Fig. 1). The land area is approximately 4,844km^2. It has an estimated population of 4,177,828 million people [13] which stretches over about 60 kilometres between surrounding communities. Anambra State has over 60% of its people living in urban areas making it one of the most urbanized places in Nigeria [14]. Since then, the state has being witnessing immense growth in the size of built-up areas increase, in number of immigrants, transportation and commercial activities. It experienced warm humid tropical climate with average rainfall between 1520-2020mm per annum. Minimum and Maximum temperature ranges between 25.4^{0}C and 30.6^{0}C and its vegetation is the tropical forest type (NIMET Seasonal Rainfall Prediction, 2014). The study was carried out across the 21 LG in Anambra state, Nigeria.

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Fig-1. Map of the study area (Anambra state)

2.2. Data Collection

Data for this study were obtained mainly from secondary source. The source includes Federal Road Safety Commission (FRSC), National Bureau of Statistics (NBS) and National Population Commission (NPC). Data on all recorded motorcycle accidents in each of the local government areas for 2007-2016 were obtained from Federal Road Safety Commission **RS 5.3** Anambra sector command with Headquarter at Awka, Anambra state. The Federal Road Safety Corp Anambra sector command comprise of seven unit commands in Anambra state, each unit command has designated service routes within the 21 Local Government Areas (LGAs). The unit command and the LGA they oversee are as follows: **RS 5.30** Awka unit command :Awka north, Awka south and Njikoka, **RS 5.31** Onitsha unit command:

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Onitsha north, Onitsha south and Ogbaru, **RS 5.32** Nnewi unit command: Nnewi north and Nnewi south, **RS 5.33** Nteje unit command: Anambra East, Anambra West, Idemili north, Oyi, Ayamelum, Dunukofia, **RS 5.34** Ihiala unit command: Ihiala**, RS 5.35** Igboukwu unit command: Aguata, Orumba north, Orumba south, Anaocha, **RS 5.36** Oraifite unite command: Ekusigo, Idemili south. Data on characteristics of the local government areas of the state were obtained from statistics and planning department in the state secretariat, Awka, Anambra state

2.3 Data Analysis

The method employed in the data analysis include; descriptive and inferential statistical tools. The descriptive tools used are; table, frequency, chart and percentage for description and comparative purposes to show the variation in the spatial pattern of motorcycle accidents among the Local government areas; and also used to show variation in the temporal pattern on monthly basis, while inferential data was analyzed using the (SPSS) package subjected to analysis of variance (ANOVA) and multiple regression.

The first hypothesis which states that there is no significant variation in the spatial pattern of motorcycle accidents across the Local Government Areas in Anambra state was tested using ANOVA. The mean difference between the sum of squares (WSS) and among the Sum of squares was determined by:

$$\underbrace{\sum I \sum j \, (x_{ij} - x_{)}^{2}}_{\text{TSS}} = \underbrace{\sum n1 \, (x-x)^{2}}_{\text{ASS}} + \underbrace{\sum \sum \, (x_{ij}-xj)^{2}}_{\text{WSS}}$$

The second hypothesis which states that there is no significant variation in the temporal pattern of motorcycle accidents was tested using ANOVA. The mean difference between the sum of squares (WSS) and among the Sum of squares was determined by:

$$\underbrace{\sum I \sum j \, (x_{ij} - x_{)}^{2}}_{\text{TSS}} = \underbrace{\sum n1 \, (x-x)^{2}}_{\text{ASS}} + \underbrace{\sum \sum \, (x_{ij}-xj)^{2}}_{\text{WSS}}$$

The third hypothesis which states motorcycle accidents in the various local government areas of Anambra state are not significantly explained by the characteristics of the LGAs. The hypothesis was tested using multiple regression analysis. Following this assertion, this study recognises the significance of times. For this study, times of motorcycle accidents include years and month in which the incidence had occurred. The least square model is presented as;

$$Y=a+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x5+b_6x_6+b_7x_7+b_8x_8+b_9x_{9+}e$$

Where Y is the number of accidents (2007-2016)

a is the intercept

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, b_1 is the Populations by LGAs

b_2 is the number of Police Station

b_3 is the number of Banks

b_4 is the number of Churches

b_5 is the number of Hotels

b_6 is the number of Market

b_7 is the number of Schools

b_8 is the number of industries

b_9 is the number of Health centres

Where X is the time in years

e is the error term.

The fourth hypothesis which state that there is no significant increase in the trend of motorcycle accident from 2007-2016 in Anambra state. For this study, the number of motorcycle accident in Anambra state from 2007-2016 is dependent variable (y), while time in years were considered as independent variable (x). The least square model is presented as; $Y = a + bx + \varepsilon$. Where Y = dependent variable (motorcycle accident).

x = independent variable (time in years).

a = intercept of regression line on y-axis

b = regression coefficient

ε = Error term

3. RESULTS AND DISCUSSION

3.1 Spatial variation of Motorcycle Accidents

The year 2007, Onitsha south and Idemili north local government recorded 6 cases respectively (figure 2). This was followed by Onitsha north 5 cases, Awka south and Nnewi north recorded 4 cases respectively. 2 cases were recorded in Awka north local government area. Njikoka,, Ogbaru, and Nnewi north, local government respectively recorded 1 case. Ihiala, Ekusigo, Idemili south Anambra East, Anambra West, Aguata, Anaocha, Orumba north, Orumba south, Oyi, Ayamelum, Dunukofia local government respectively recorded no motorcycle accident

The year 2008, 4 cases were recorded in Awka north local government. Awka south and Onitsha north local government respectively recorded 2 cases (figure 3). Njikoka, Anambra East and Nnewi south Local Government respectively recorded 1 victim. Ihiala , Onitsha

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south Ogbaru ,Nnewi north Anambra West, Idemili north, Oyi, Ayamelum, Dunukofia,Aguata, Orumba north, Orumba south, Anaocha Ekusigo, and Idemili south. Local government respectively recorded no motorcycle accident.

The year 2009, Awka south and Idemili south local government recorded 2 cases respectively. (This is followed by Ayamelum, Idemili north, Onitsha south, Awka north, and Aguata local government area respectively recorded 1 case. No accident was recorded in Njikoka ,Anambra East, Anambra West, Oyi, , Dunukofia ,Ekusigo, Onitsha north, Ogbaru, Ihiala , Orumba north, Orumba south, Anaocha, Nnewi north and Nnewi south local government area respectively (figure 4).

The year 2010, Awka south local government area recorded the largest number of motorcycle accident with 4 cases. This is followed by Awka north and Nnewi north with 2 cases respectively (figure 5). Njikoka, Nnewi south, Ekusigo Anaocha, Anambra West, Onitsha south and Ogbaru local government respectively recorded 1 case. Ihiala, Onitsha north, Idemili north, Anambra East, Idemili north, Oyi, Ayamelum, Dunukofia, Aguata, Orumba north, and Orumba south local government respectively recorded no accident.

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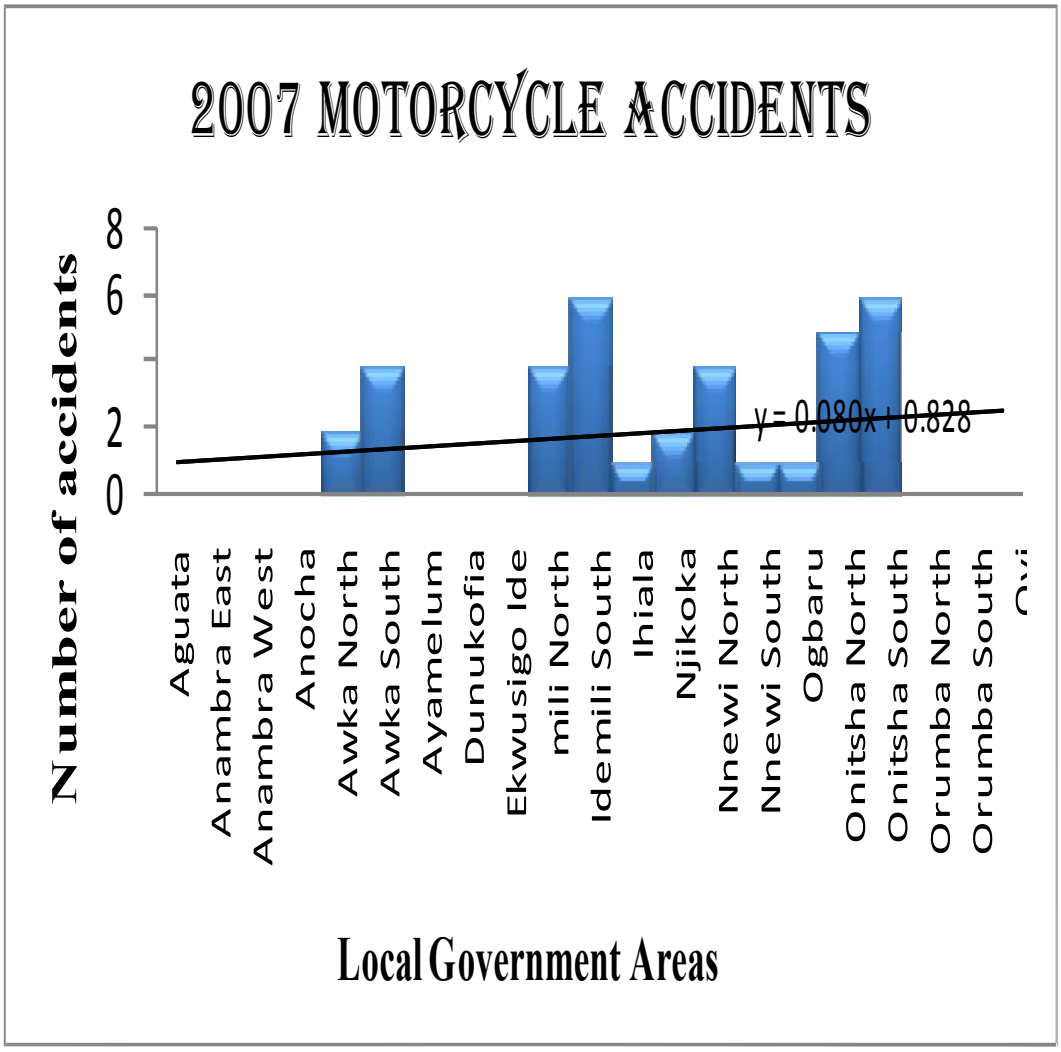

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188 Figure 2 Spatial Variation of Motorcycle Accidents in Anambra state by LGA, 2007

189 **Source:** Authors' fieldwork, May, 2017.

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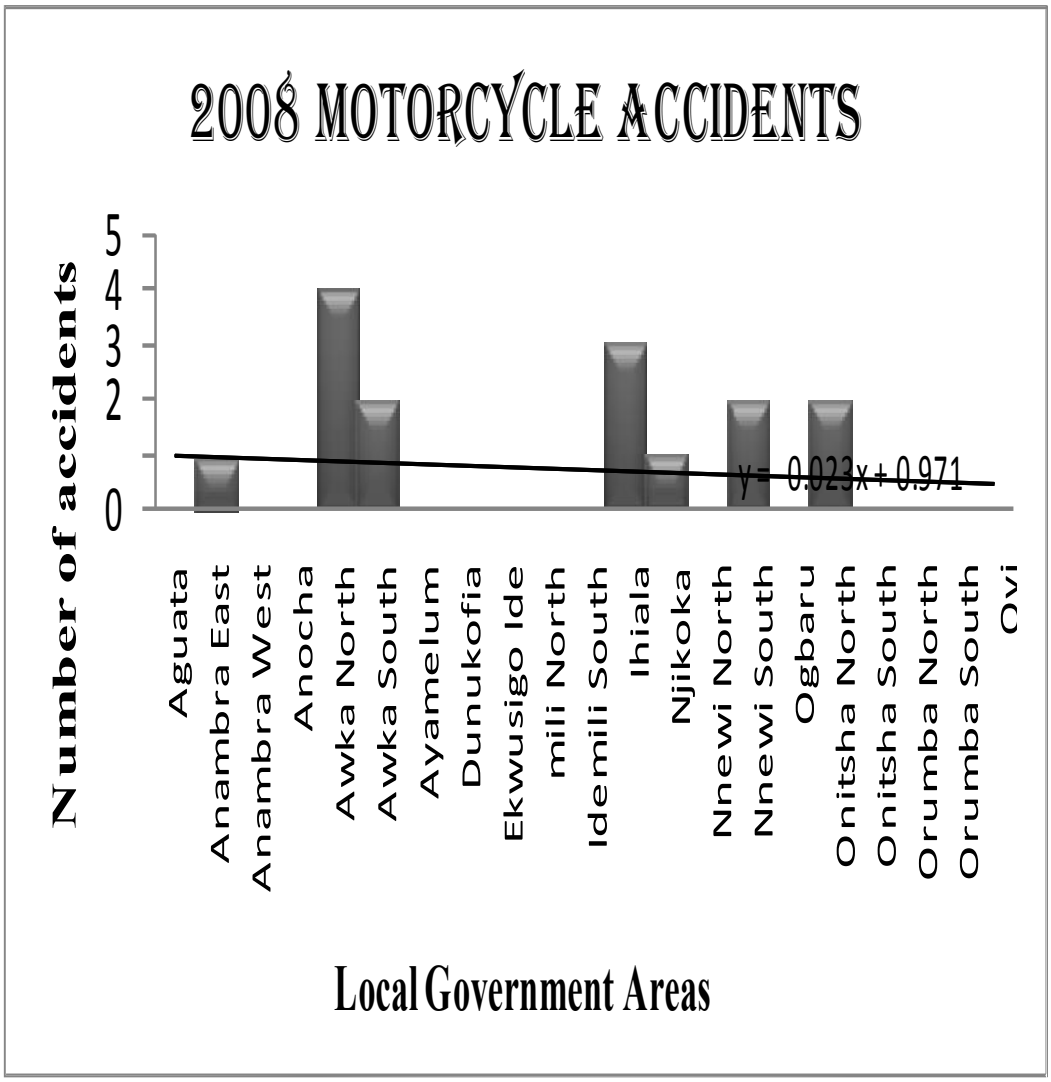

Figure 3: Spatial Variation of Motorcycle Accidents in Anambra state by LGA, 2008

Source: Authors' fieldwork, May, 2017

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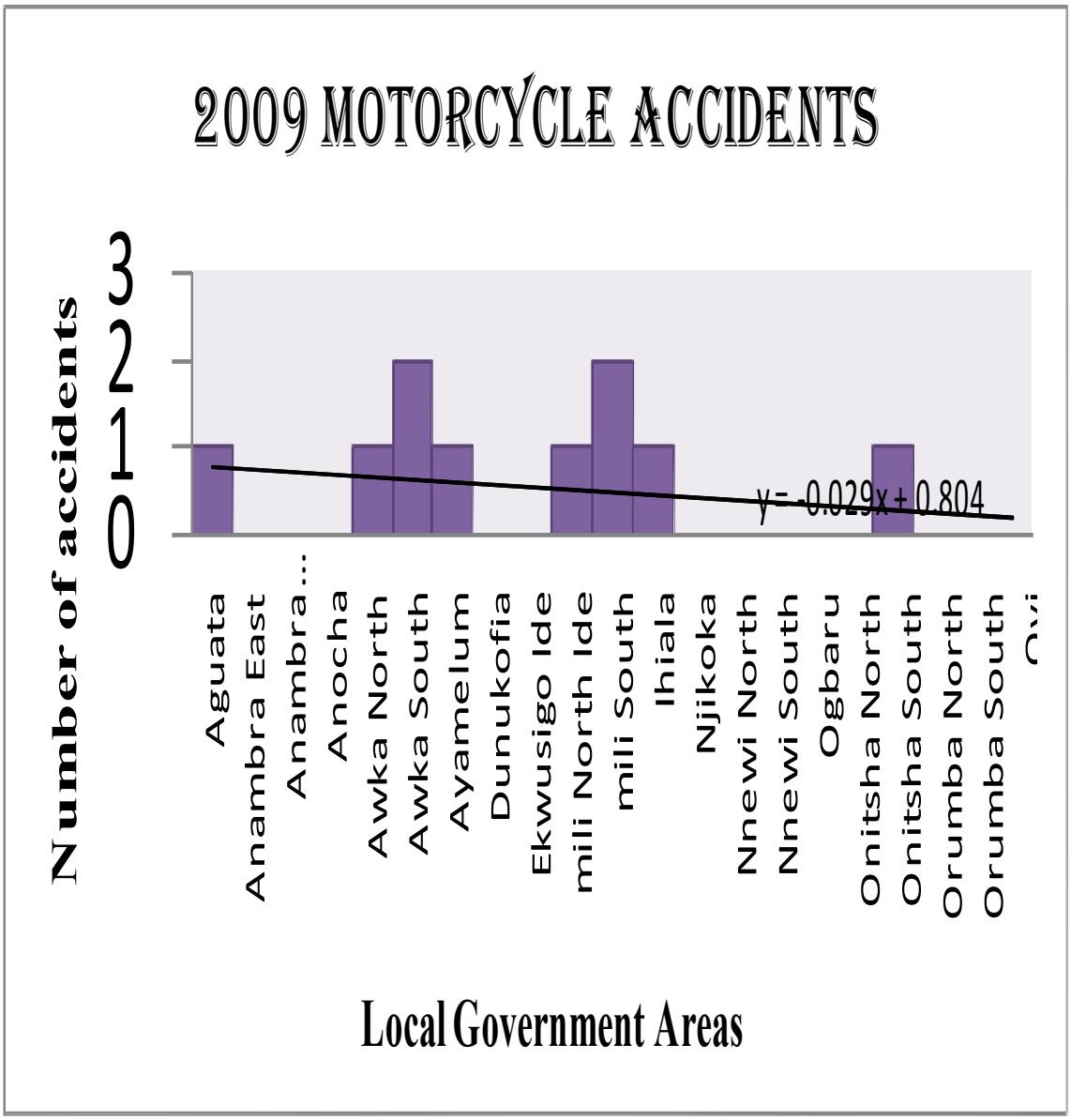

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196 Figure 4: Spatial Variation of Motorcycle Accidents in Anambra state by LGA, 2009

197 **Source:** Authors' fieldwork, May, 2017

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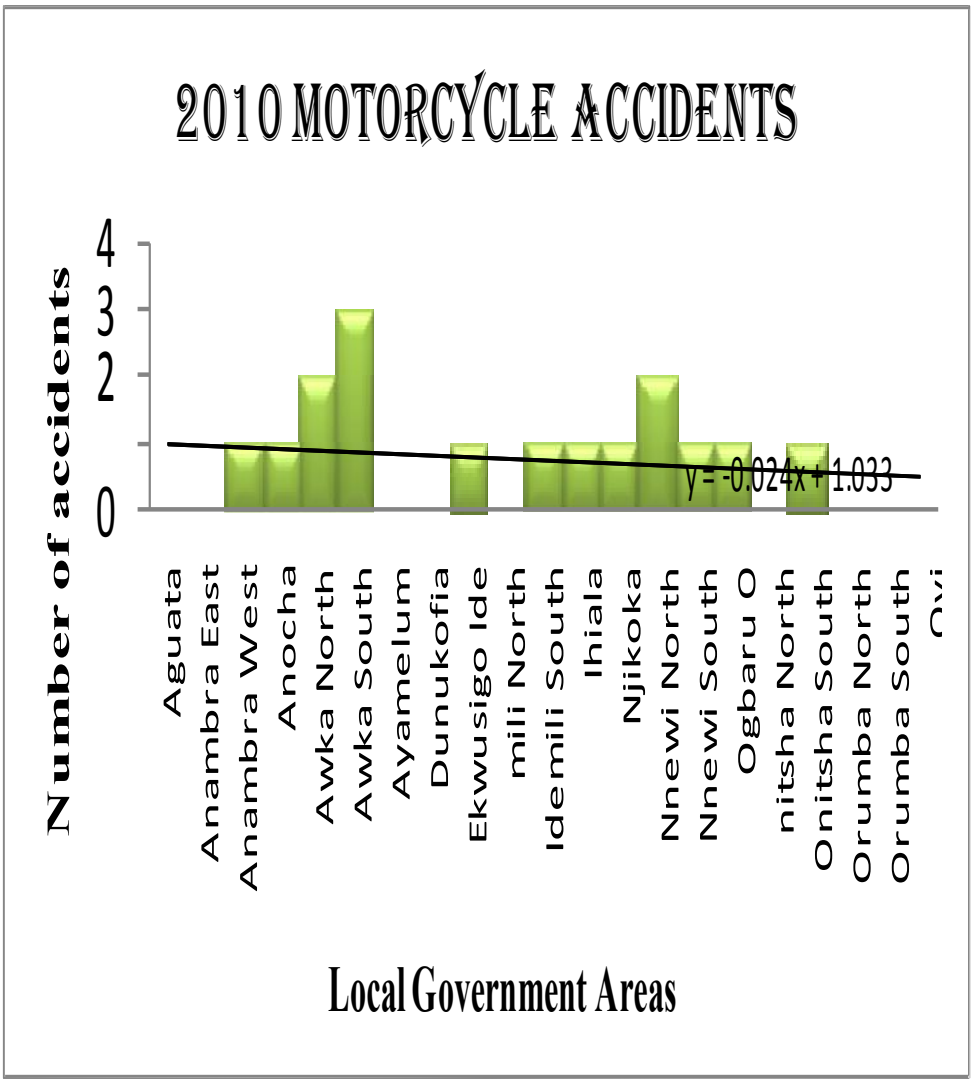

Figure 5: Spatial Variation of Motorcycle Accidents in Anambra state by LGA, 2010

Source: Authors' fieldwork, May, 2017

In the year 2011, Awka south local government area recorded 4cases. 3 crashes were recorded in Awka north local government area. This is followed by Onitsha north recorded 2 cases. Nnewi north, Idemili north, Njikoka, Anambra west and Anaocha local government area respectively recorded 1 case. No accident was recorded in Orumba north, Orumba south, Ihiala, Ogbaru, Ekwusigo, Nnewi south, Ayemelum, Anambra East, Oyi and Dunukofia local government area respectively (figure 6).

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In 2012, Anambra east, Awka south, Njikoka, Onitsha south, Nnewi south and Ekwusigo local government respectively recorded 2 cases (figure 7). 1 case was recorded in Awka north, Orumba south, Ogbaru, Onitsha north and Orumba north local government area respectively. Ihiala, Anambra west, Ayamelum, Oyi, Daunukofia, Anaocha, Aguata and Idemili north local government area respectively recorded no accident.

The year 2013, Idemili north local government recorded 3 cases, followed by Dunukofina and Idemili north local government area respectively with 2 cases. Awka north, Ayamelum, Awka south, Nnewi south, Oyi and Anambra east local government respectively recorded 1 case. Ogbaru, Ihiala, Orumba north, Orumba north, Onitsha north, Onitsha south and Ekwusigo local government recorded no accident (figure 8).

The year 2014, Awka south local government area recorded the largest incidence with 21 cases (figure 9). This is followed by Awka north and Ihiala local government area respectively recorded 17 cases. 14 cases were recorded Nnewi south. Njikoka local government area recorded 11 cases in 2014. Aguata local government area recorded 8 c crashes in the year 2014. Nnewi north and Onitsha south recorded 7 cases. Anaocha had 6 crashes in the year 2014. About 5 cases were recorded in Onitsha north and Orumba south local government area respectively. Ogbaru local government recorded 4 cases. 3 cases were recorded in Ayamelum and Idemili south local government area respectively. Orumba north and Ekwusigo local government respectively recorded 2 cases. Dunukofia and Oyi local government area respectively recorded 1 case. Ideimili north recorded no accident in the year 2014.

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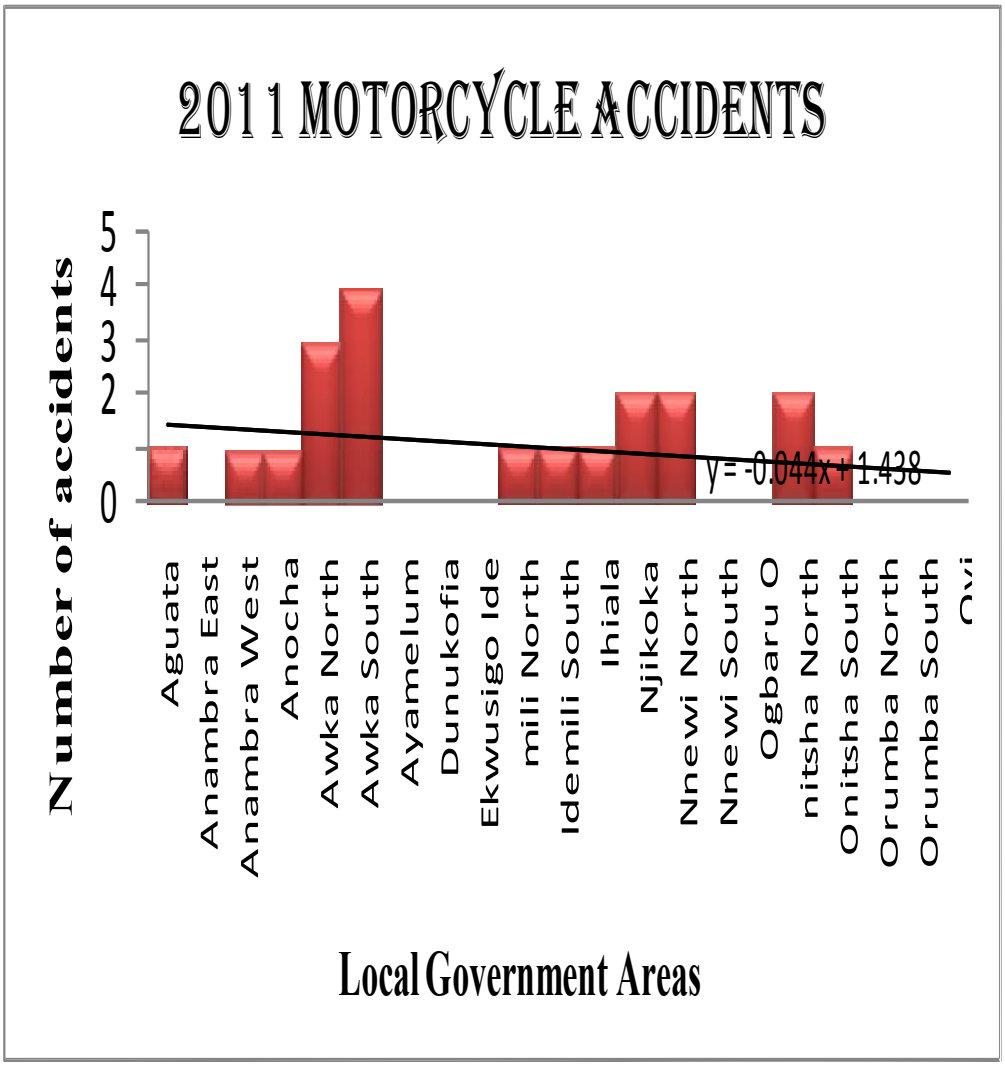

Figure 6: Spatial Variation of Motorcycle Accidents in Anambra state by LGA 2011

Source: Authors' fieldwork, May, 2017

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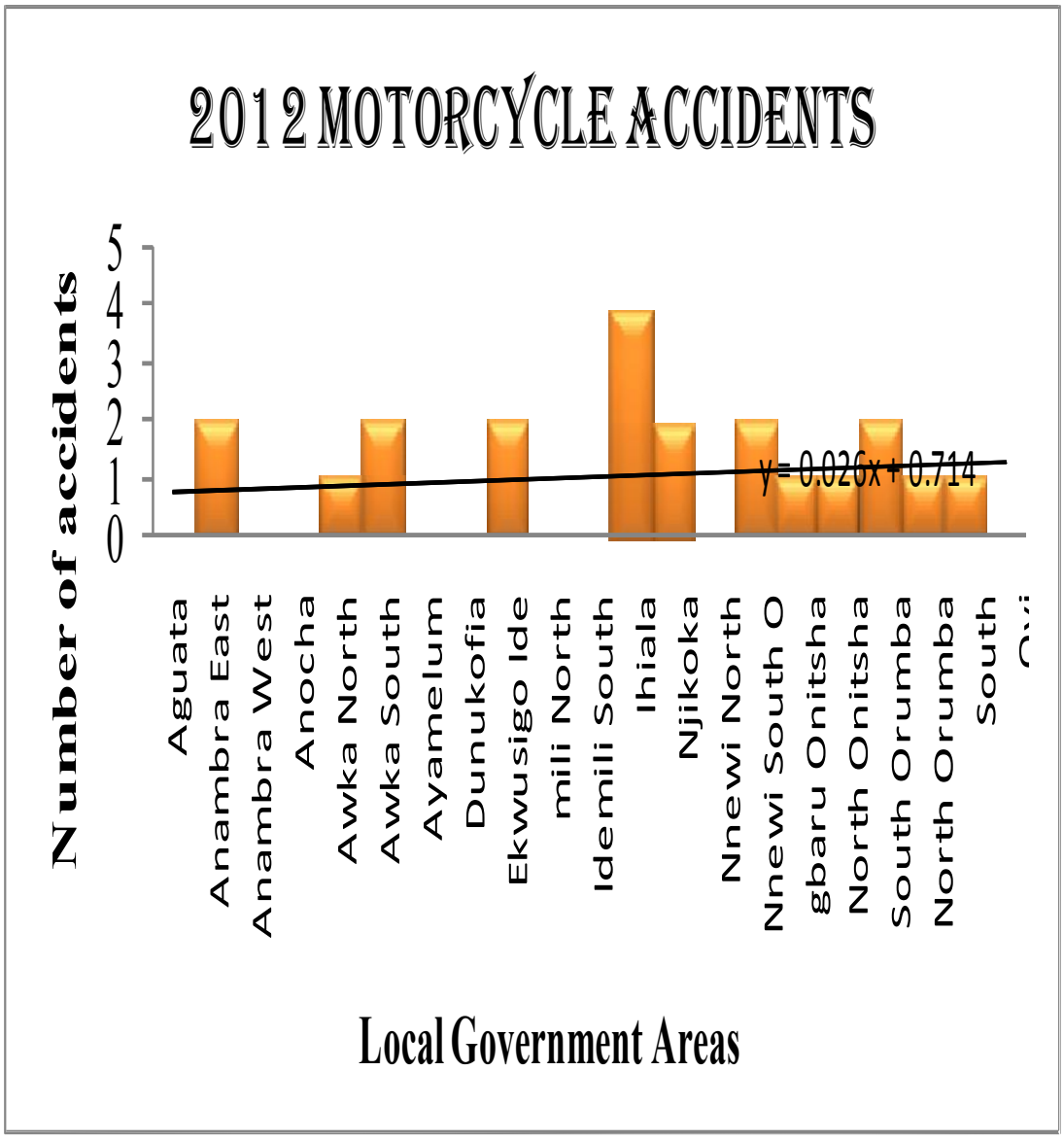

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235 Figure 7: Spatial Variation of Motorcycle Accidents in Anambra state by LGA 2012

236 **Source:** Authors' fieldwork, May, 2017

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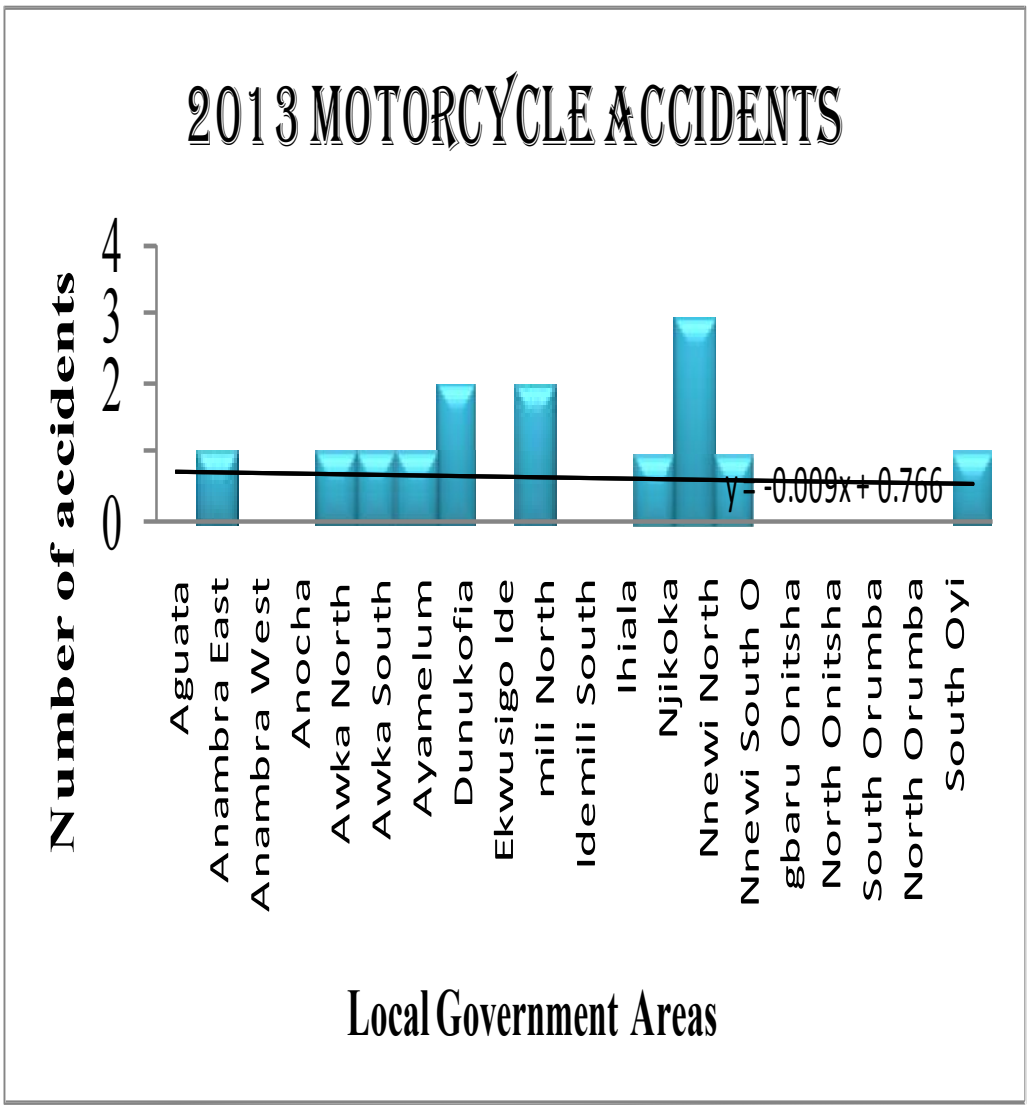

Figure 8: Spatial Variation of Motorcycle Accidents in Anambra state by LGA, 2013

Source: Authors' fieldwork, May, 2017

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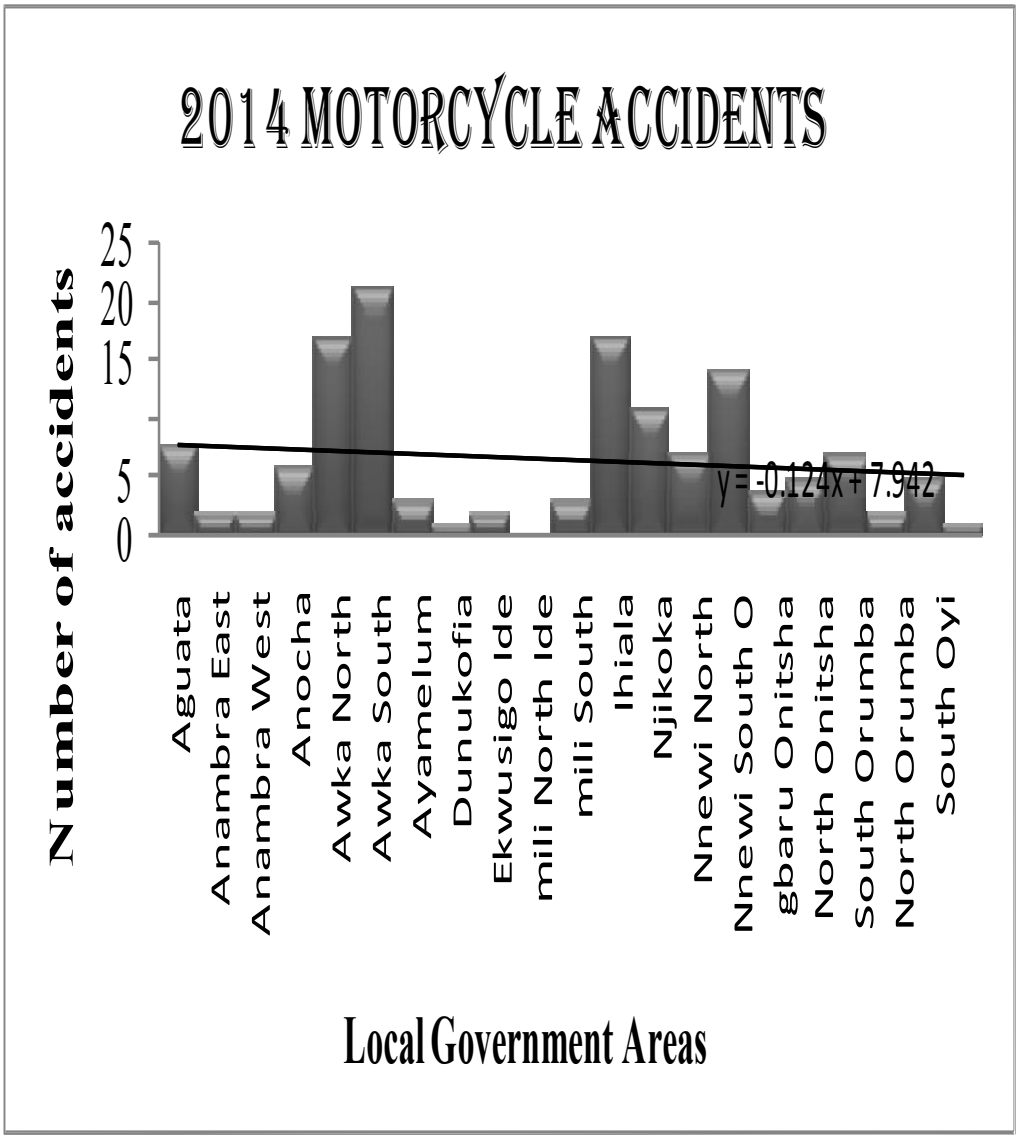

Figure 9: Spatial Variation of Motorcycle Accidents in Anambra state by LGA, 2014

Source: Authors' fieldwork, May, 2017

In 2015, Onitsha south local government recorded 9 cases. This is followed by Awka south local government with 8 cases (figure 10). Awka north, Ogbaru and Onitsha north local government area respectively recorded 7 cases. Specifically, Orumba north and Njikoka local

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government area respectively recorded 5 cases. 4 cases were recorded in Aguata and Nnewi north local government area respectively in the year 2015. Nnewi south local government recorded 3 cases. 2 cases were recorded in Anambra east, Ayamelum, Ekwusigo, and Ihiala local government area respectively. Anaocha, Idemili south and Orumba south local government area respectively recorded 1 case. No accident was recorded in Anambra west, Dunukofia and Oyi local government area respectively.

The year 2016, Awka north local government area recorded the largest crashes in 2016 with 12 cases. This is followed by Nnewi south local government with 9 cases. Awka south local government area recorded 8cases of accidents. 5 cases were recorded in Nnewi local government area in the year 2016. Ihiala and Onitsha south local government respectively recorded 4 cases. Aguata, Ogbaru, Onitsha north and Orumba north local government respectively recorded 2 cases. 1 case was recorded in Anambra east, Anambra west, Ayamelum, Ekwusigo, Idemili south and Oyi local government respectively. Anacha, Dunukofia, Idemili north and Orumba south local government recorded no accident (figure 11).

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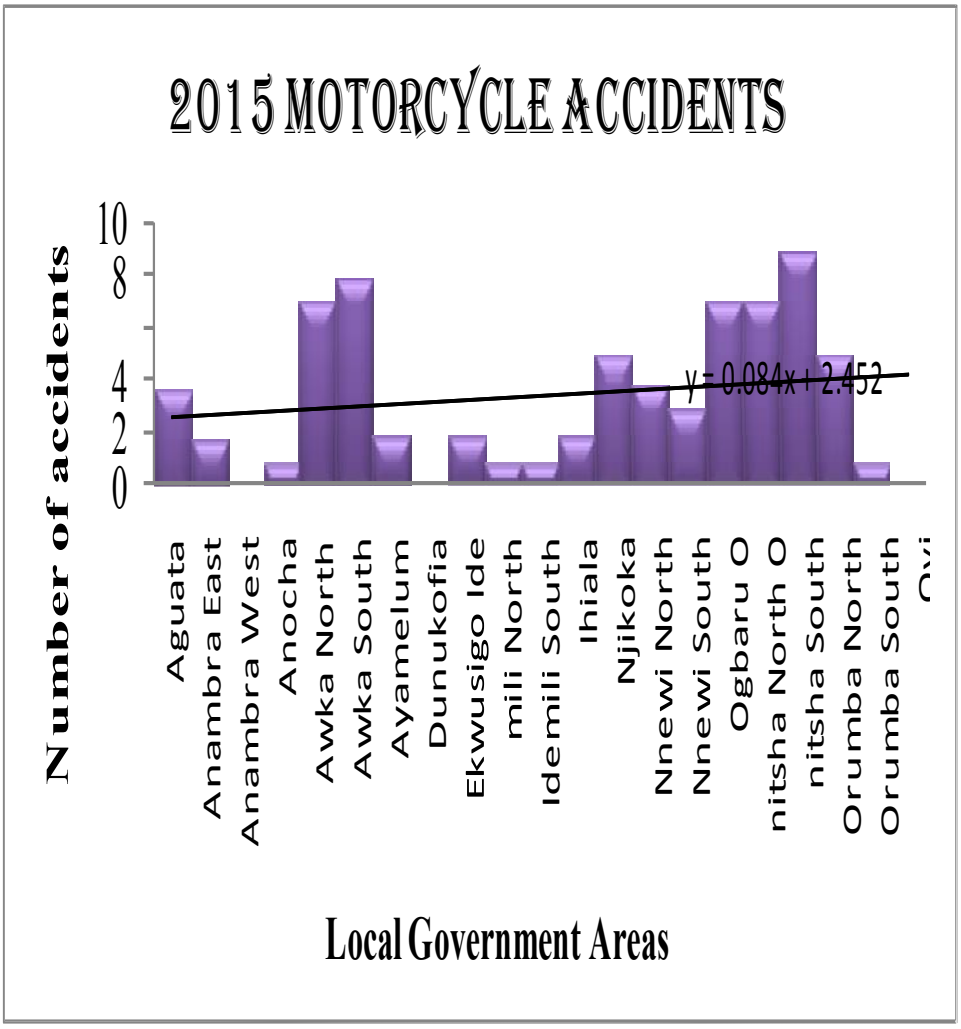

Figure 10: Spatial Variation of Motorcycle Accidents in Anambra state by LGA, 2015

Source: Authors' fieldwork, May, 2017

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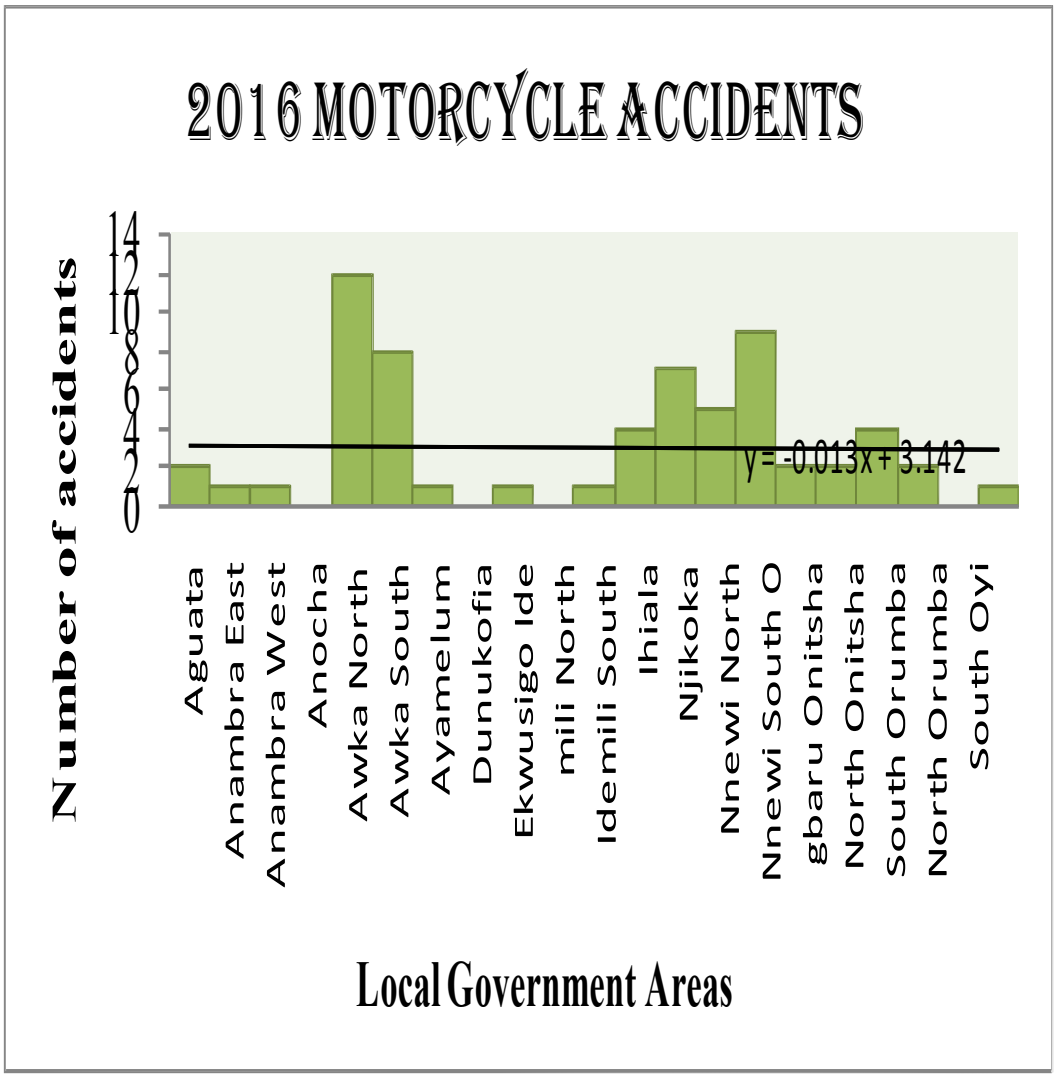

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280 Figure 11: Spatial Variation of Motorcycle Accidents in Anambra state by LGA, 2016

281 **Source:** Authors' fieldwork, May, 2017

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Table 1: One-way ANOVA Results

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	427.800	20	21.390	2.609	.000
Within Groups	1549.800	189	8.200		
Total	1977.600	209			

Source: Author's Analysis 2017

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Table 2: Influence of Some Characteristics of the Local Government Areas on Motorcycle Accidents in Anambra State (2011)

Variables	B	**T**	**P**	**R**	**R^2**	**F**	**Sig.**
Constant	-3.347	-2.099	0.090				
Projected population	0.272	1.237	0.284				
Police stations.	0.238	1.137	0.319				
Banks	0.274	1.382	0.239	0.877	0.770	16.739	0.009
Churches	-0.480	-2.068	0.107				
Hotels	0.231	1.039	0.358				
Markets	0.215	1.002	0.373				
Industries	-0.224	-0.648	0.552				
Health centres	-0.222	-0.264	0.805				
Schools	0.054	4.091	0.009				

Source: Author's Analysis, 2017.

It was observed that, there is a joint prediction of motorcycle accident by a combination of some of the characteristics of the LGA of the state ($p<0.05$). The table further shows the influence of each independent variable on dependent variable (motorcycle accident). It can be seen that the number of schools has the greatest influence on the number of motorcycle accident in 2011. Therefore, the hypothesis which states that the motorcycle accident in Anambra state is significantly explained by some of the characteristics of the Local Government areas of the state is accepted for the number of schools in the study area. This implies that other characteristics of the Local Government areas of the state played little influence on the number of motor cycle accidents that occurred in 2011.

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306 **3.2 The Temporal Variation of motorcycle accidents (2007-2016)**

307 The reported motorcycle accident in Anambra state from 2007-2016 is shown in figure. As
308 revealed in the figure, the total number of reported motorcycle accident for the period of the
309 study was 403 cases. However, the occurrence of motorcycle accident in Anambra state
310 varied both in time as well as space. In 2007, 10 cases of motorcycle accidents were
311 recorded. The number increase in 2008 with 15 cases. The number of motorcycle accident
312 reduced in 2009 with 10 cases. There were significant increases in 2010 and 2011 with 16
313 and 20 cases recorded respectively. In 2012, there was slight increase in the number of
314 motorcycle accidents recorded compared to that of 2011. A total number of 21 cases were
315 recorded in 2012. The number reduced in 2013 with 14 cases. There was drastic increase in
316 2014 and 2015 with 138 cases and 79 cases of motorcycle accidents recorded respectively
317 compared to the earlier years. There is general fluctuation in the magnitude of motorcycle
318 accidents recorded in these periods. In 2016, the motorcycle accidents case reduces with 63
319 cases.

320 The largest number of motorcycle accidents was recorded in the year 2014 and the lowest
321 was recorded in 2008 (figure 12).

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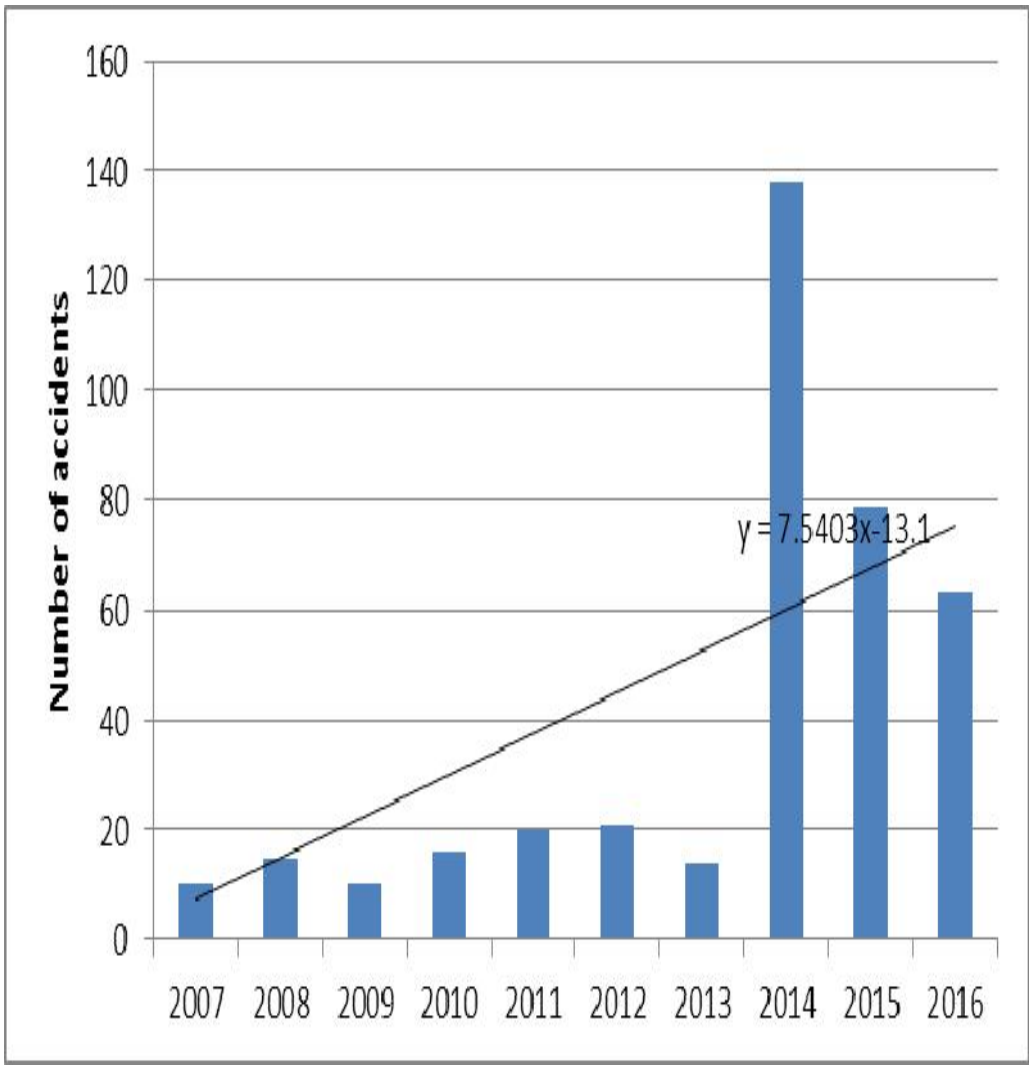

Figure 12: Number of motorcycle accidents from 2007-2016

Source: Authors' fieldwork, May, 2017

3.3 Temporal Variation of Motorcycle Accidents in Anambra state by LGAs

No accident was recorded in Aguata local government area between 2007 and 2008 (figure 13). 1 case was recorded in 2009. 2010 recorded no accident. 1 case was recorded in 2011. 2012 an 2013 respectively recorded no accident. About 8 cases were recorded in 2014 and the number decrease to 4 in 2015. 2 cases were also recorded in 2016

In Anambra East Local Government Area, no motorcycle accident was recorded in the year 2007. About 1 case was recorded in 2008. 2009 to 2011 respectively recorded no accident. 2

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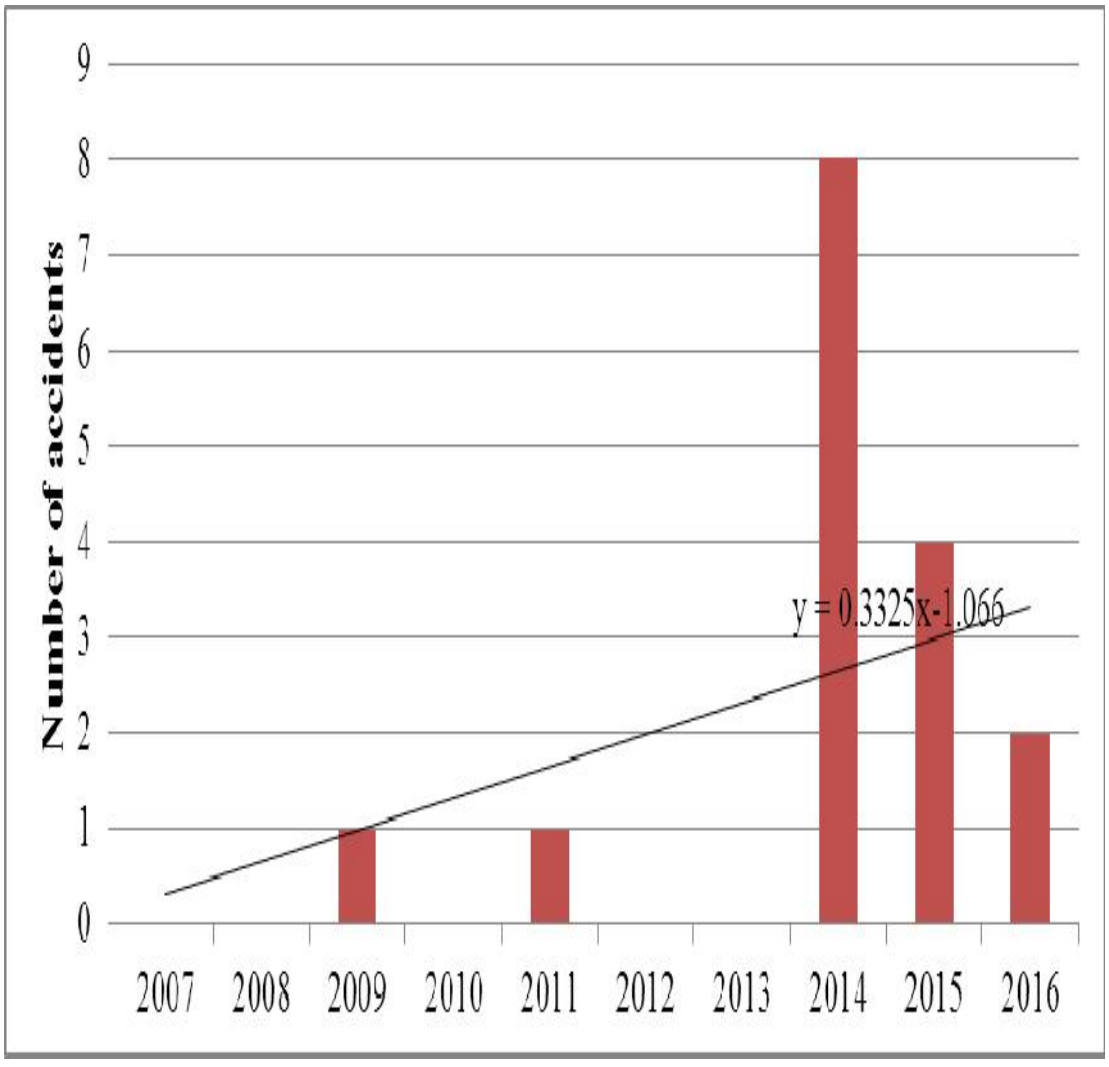
cases were recorded in 2012 and the number decrease to 1 in 2013(figure. 14). The number increases to 2 cases in 2013 and 2014 respectively and decrease to 1 case in 2016.

The year 2007 and 2009 respectively, Anambra West Local Government Area recorded no accident. 2010 and 2011 recorded 1 case respectively (figure 15). 2012 and 2013 recorded no accident. 2 cases were recorded in 2014. No record of motorcycle accident in 2015 and 1 case was recorded in 2016.

Figure 16 displays the temporal variation of motorcycle accidents in Anaocha Local Government Area from 2007 -2016. The year 2007 to 2009 respectively recorded no accident. 1 case was recorded in 2010 and 2011 respectively. 2012 and 2013 respectively recorded no accident. The number increase to 6 cases in 2014 and decrease to 1 case in 2015. 2016 recorded no accident.



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346 Figure 13: Number of motorcycle accidents in **Aguata Local Government Area** from 2007-
347 2016
348 **Source:** Authors' fieldwork, May, 2017
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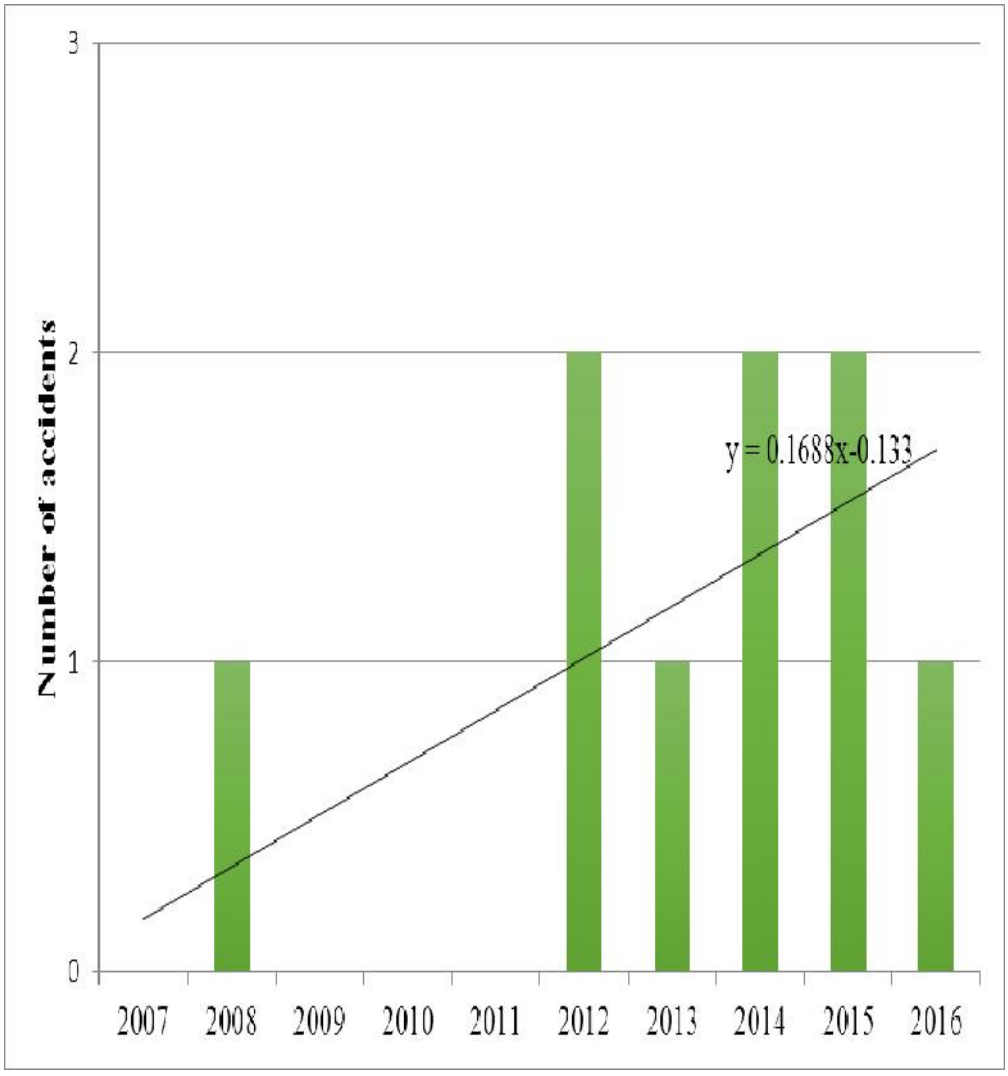

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352 Figure 14: Number of motorcycle accidents in **Anambra East Local Government Area**
353 from 2007-2016
354 **Source:** Authors' fieldwork, May, 2017
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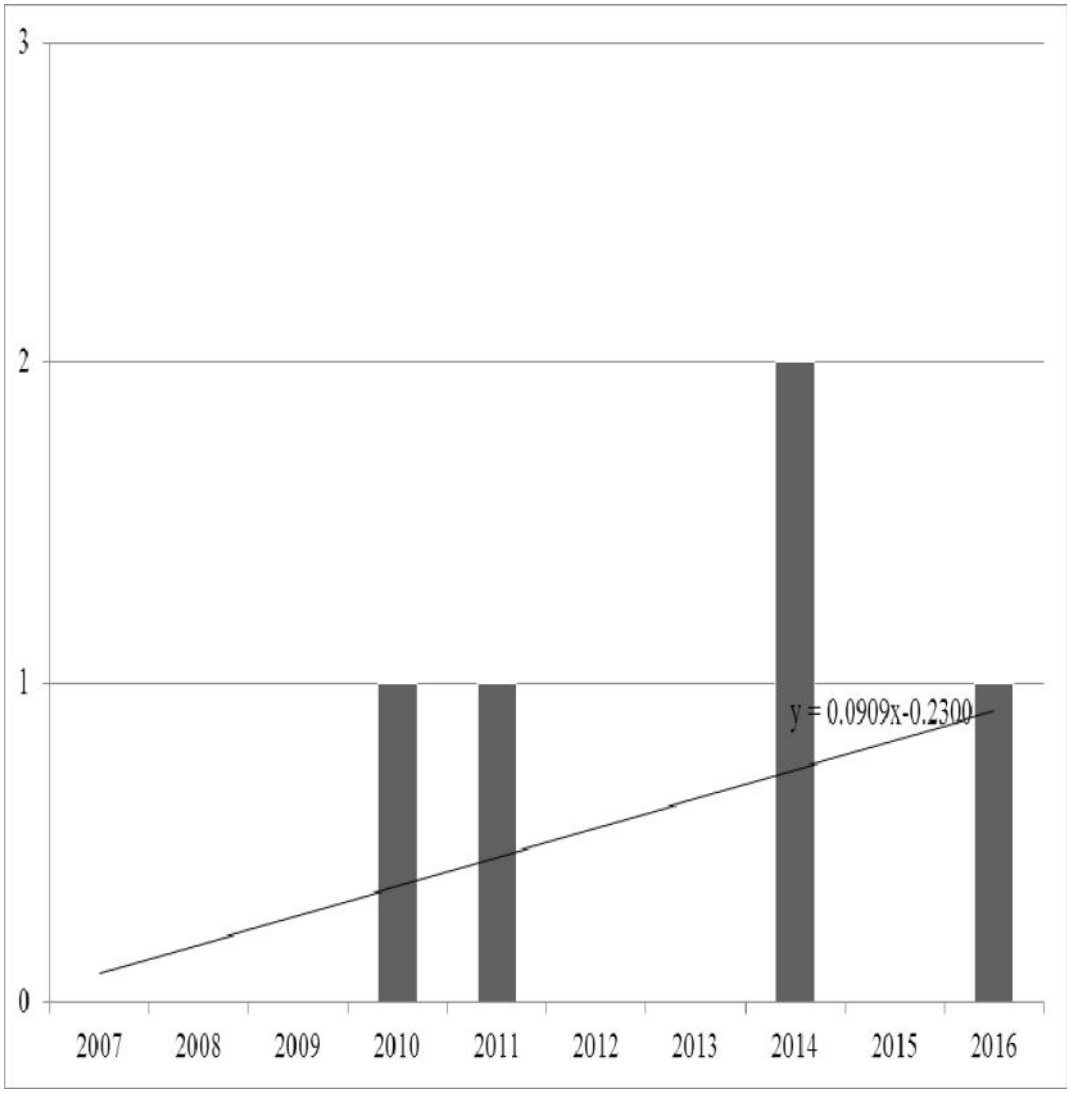

Figure 15: Number of motorcycle accidents in **Anambra West Local Government Area** from 2007-2016

Source: Authors' fieldwork, May, 2017

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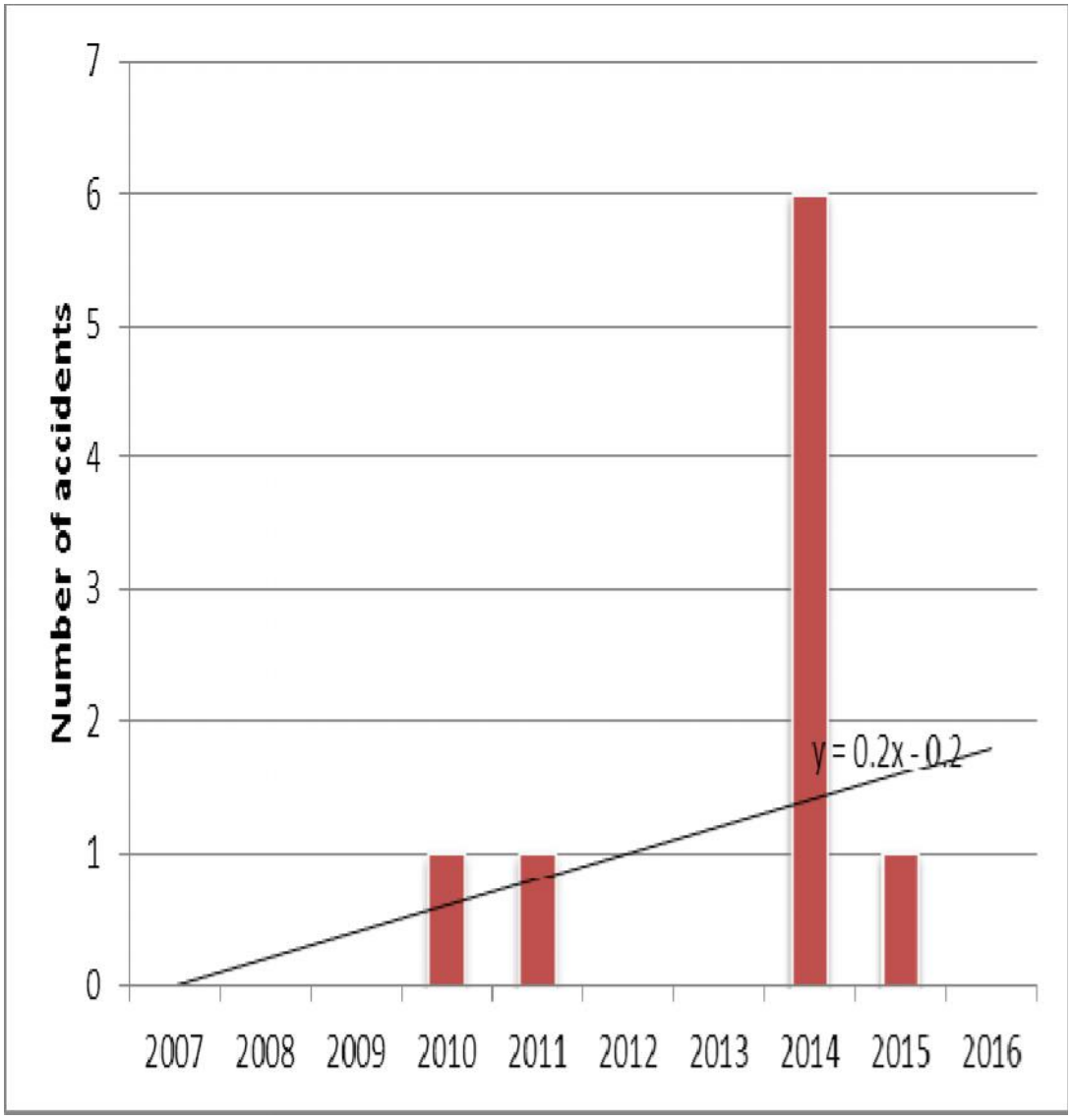

Figure 16: Number of motorcycle accidents in **Anaocha Local Government Area** from 2007-2016

Source: Authors' fieldwork, May, 2017

Turning to figure 17, Awka North Local Government Area recorded 1 case in 2007. In 2008, 4 cases were recorded and the number decrease to 1 in 2009. About 2 cases were recorded in 2010. The number increase to 3 in 2011 and decrease to 1 in 2012 and 2013 respectively. The number rose significantly with 17 in 2014 and decrease to 7 in 2015. The number increase again in 2016.

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Awka south Local Government Area recorded 1 case in 2007 (figure 18). The number increase to 2 in 2008 and 2009 respectively. The number rose from 3 in 2010 to 4 in 2011. The number decrease with 2 in 2012 and 2 in 2013. The number rose significantly with 21 in 2014 and decrease to 8 in 2015 and 2016 respectively.

No accident was recorded in Ayamelum Local Government Area in the year 2007 and 2008 respectively. 1 case was recorded in 2009. 2010-2011 recorded no accident. The number increase from 1 in 2013 to 3 in 2014. The number decrease to 2 in 2015 and 1 in 2016 (figure 19).

The year 2007-2012, no accident was recorded in Dunukofia Local Government Area (figure 20). 2 cases were recorded in 2013 and decrease to 1 in 2014. 2015 and 2016 recorded no accident.

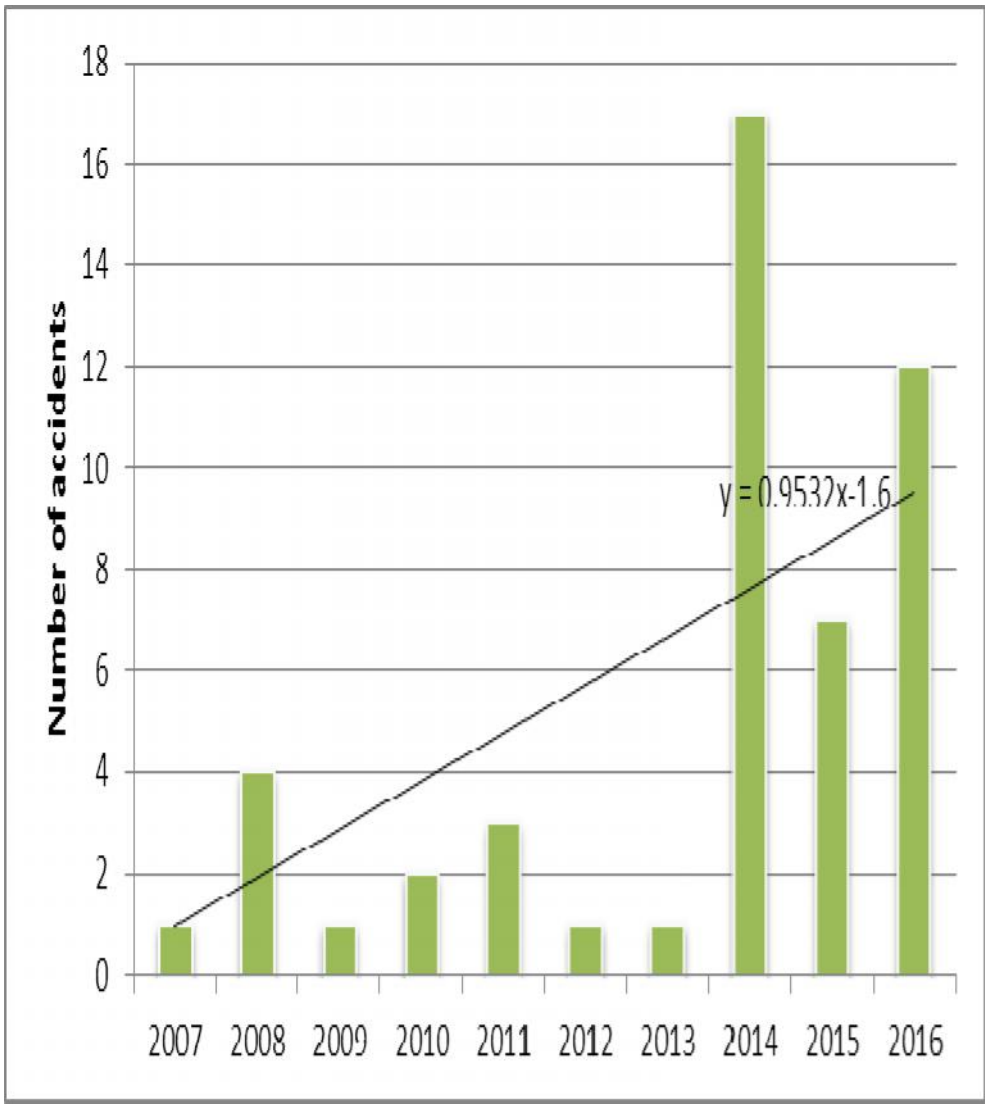

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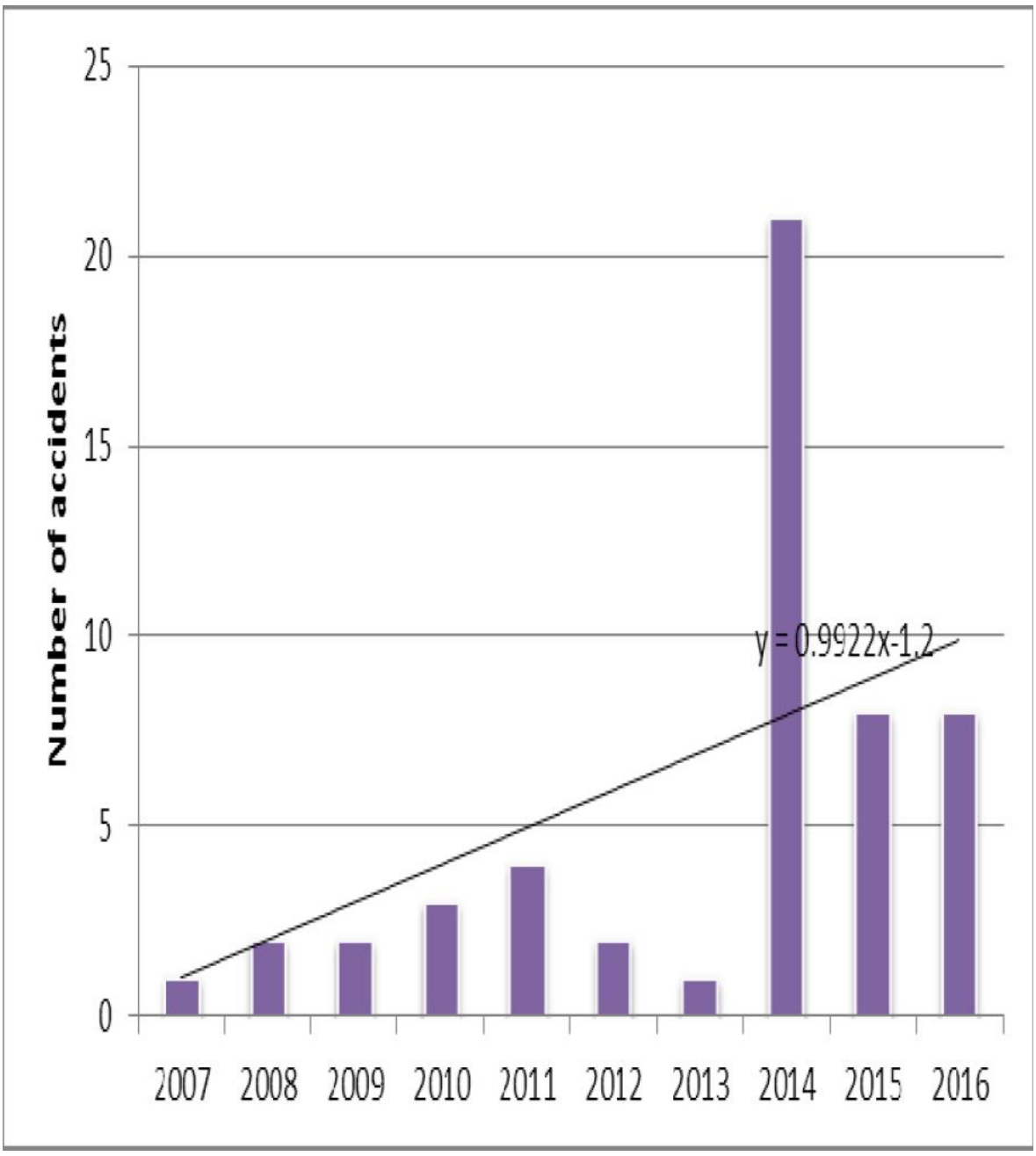
Figure 17: Number of motorcycle accidents in **Awka North Local Government Area** from 2007-2016

Source: Authors' fieldwork, May, 2017



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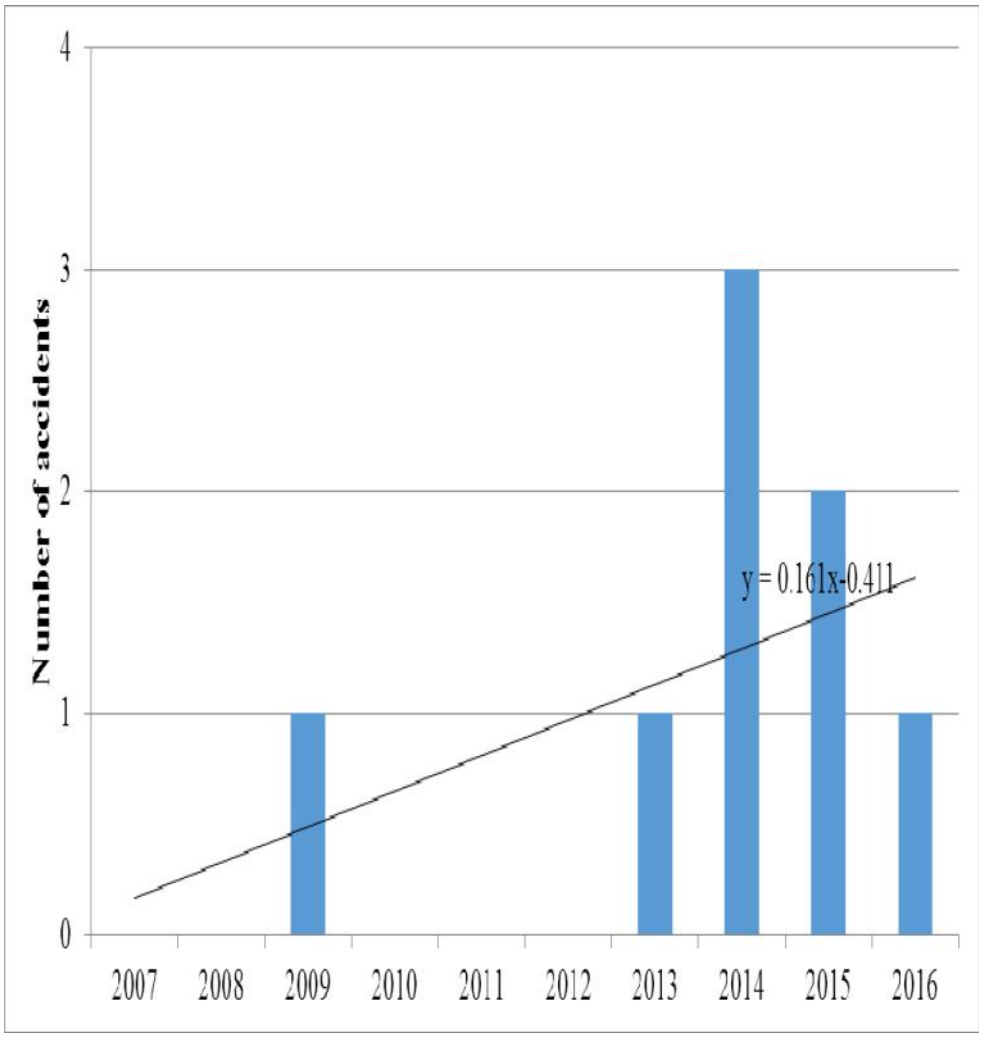
396 Figure 18: Number of motorcycle accidents in **Awka South Local Government Area** from
397 2007-2016

398 **Source**: Authors' fieldwork, May, 2017



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400

401 Figure 19: Number of motorcycle accidents in **Ayamelum Local Government Area** from
402 2007-2016

403 **Source**: Authors' fieldwork, May, 2017

404

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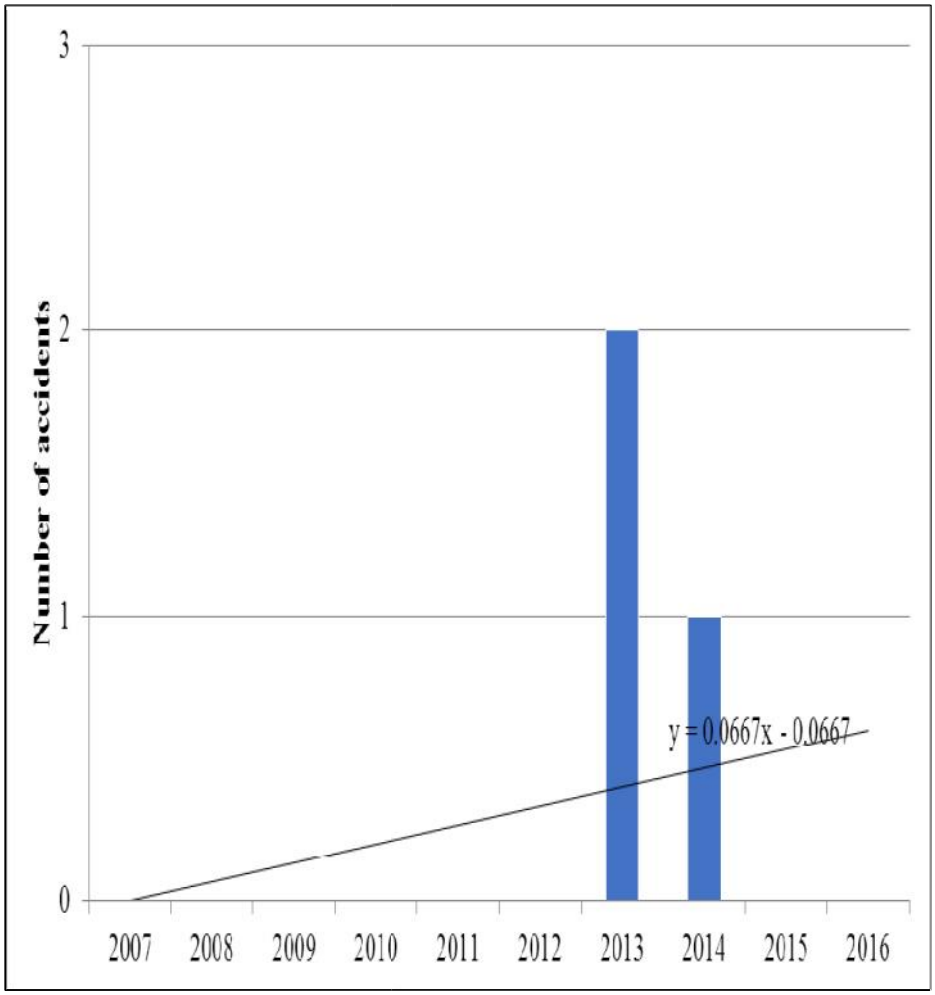

Figure 20: Number of motorcycle accidents in **Dunukofia Local Government Area** from 2007-2016

Source: Authors' fieldwork, May, 2017

The year 2007 and 2009, Ekwusigo Local Government Areas recorded no accident. 1 case was recorded in 2010 .No accident recorded in 2011. About 2 crashes were recorded in 2012 while 2013 had no accident records. The number increases to 2 cases in 2014 and 2015 respectively and decrease to 1 case in 2016 (figure 21).

The results in figure 22 presents number of motorcycle accidents in Idemili North Local Government Area from 2007-2016. The year 2007 and 2008 recorded no accident respectively. 1 case was recorded in 2009 and no accident in 2010. 2011 recorded 1 case while 2012 had no

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accident. About 2 cases were recorded in 2013. No accident recorded in 2014. 1 case was recorded in 2015 and 2016 had no accident in Idemili North Local government.

Idemili south Local Government Area recorded 1 case in the year 2007. The year 2008 recorded no accident (figure 23). The number increase with 2 cases in 2009 and decrease to 1case in 2010 and 2011 respectively. 2012 and 2013 recorded no accident. About 3 cases were recorded in 2014 while 2015 and 2016 recorded 1 case respectively.

1case was recorded in Ihiala Local Government Area in the year 2007. The number increase to 2 cases in 2008 and decrease to 1case in 2009, 2010 and 2011 respectively. The number raised to 4 cases in 2012 and 2013 recorded no accident. 17 cases were recorded in 2014. The number decrease again to 2 in 2015 and increase back to 4 in 2016 (figure 24).

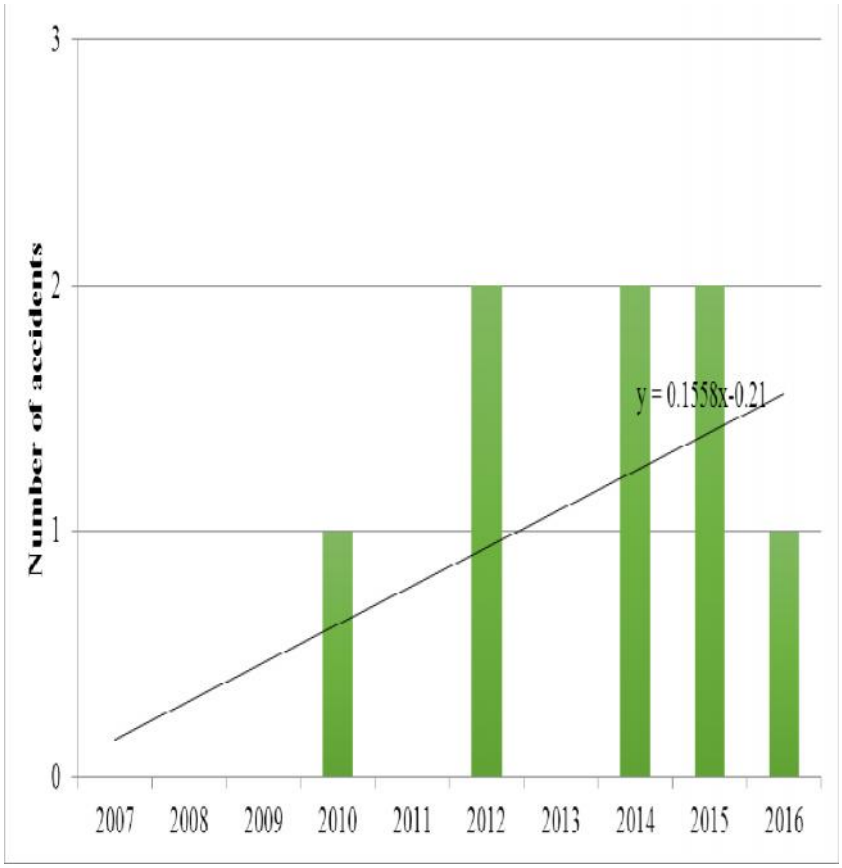

Figure 21: Number of motorcycle accidents in **Ekwusigo Local Government Area** from 2007-2016

Source: Authors' fieldwork, May, 2017

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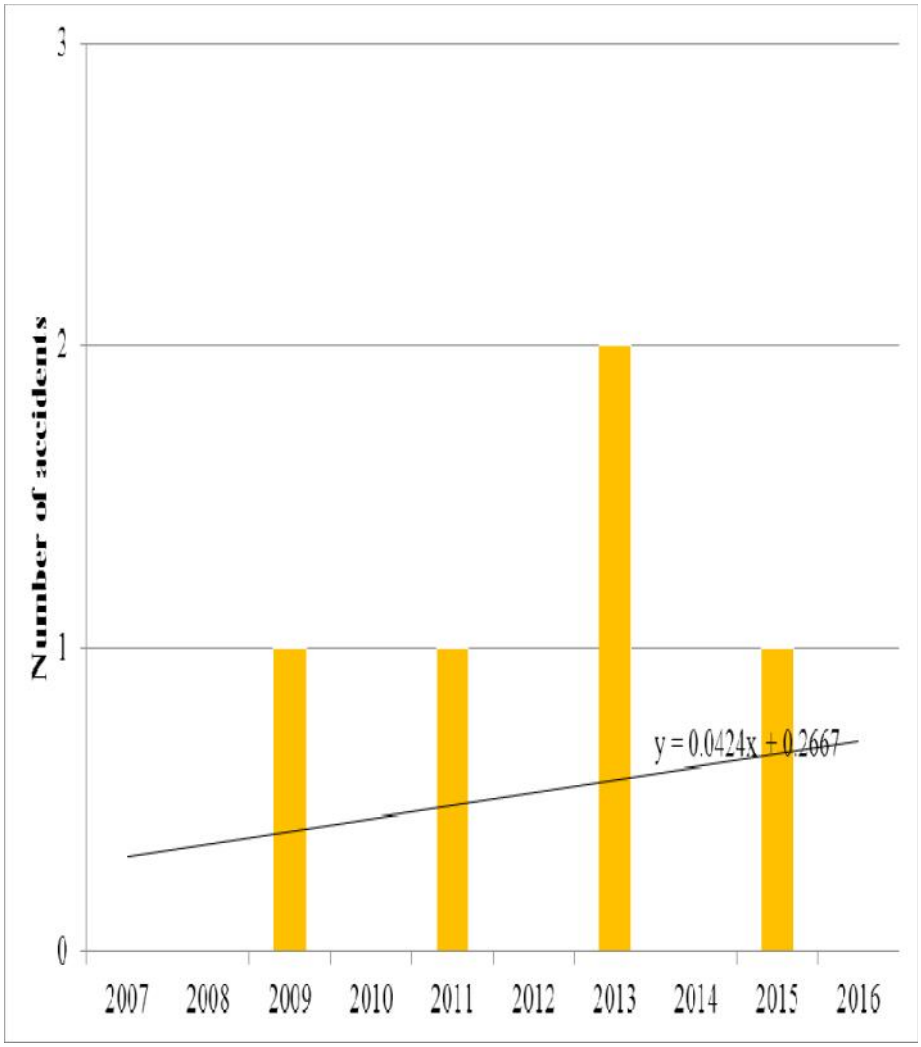

Figure 22: Number of motorcycle accidents in **Idemili North Local Government Area** from 2007-2016

Source: Authors' fieldwork, May, 2017

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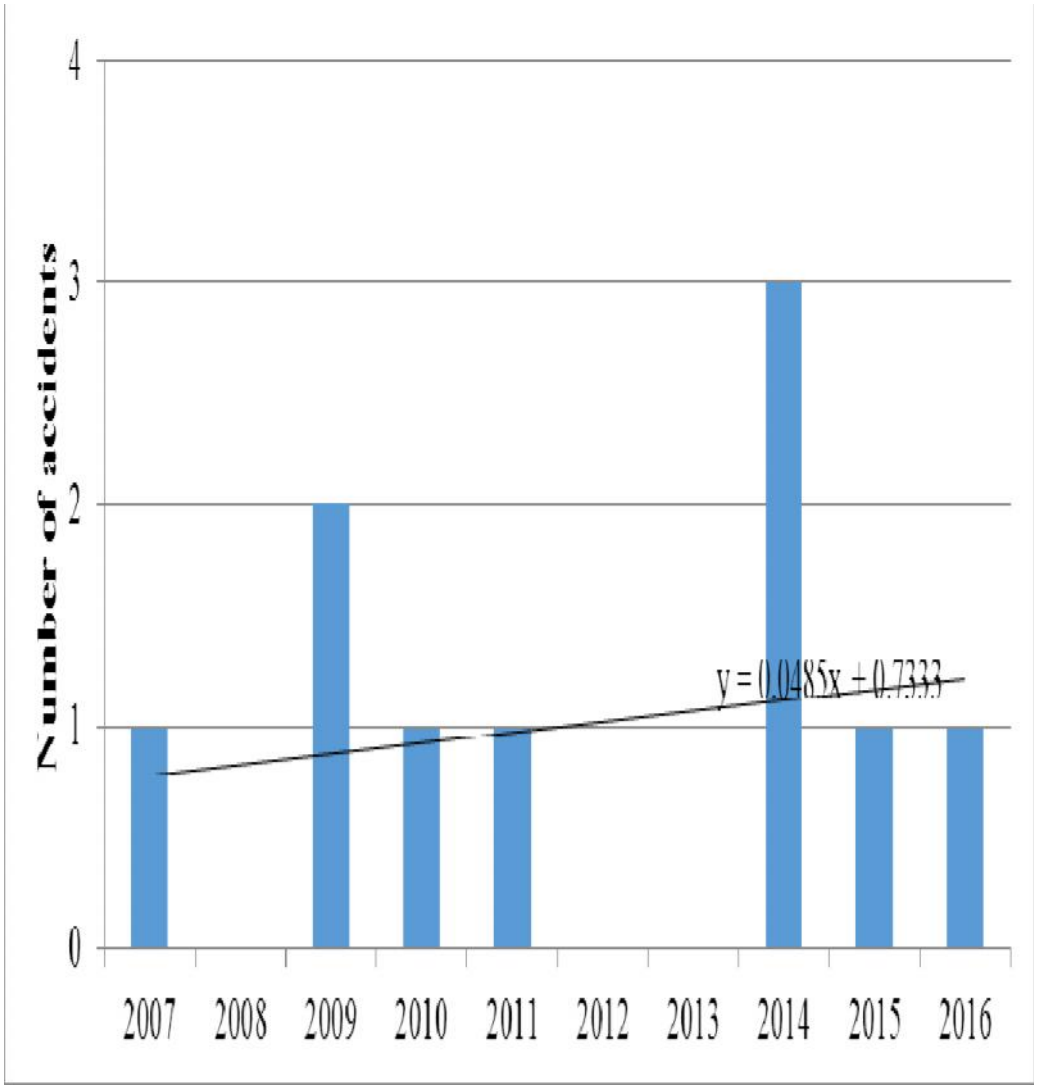

Figure 23: Number of motorcycle accidents in **Idemili South North Local Government Area** from 2007-2016

Source: Authors' fieldwork, May, 2017

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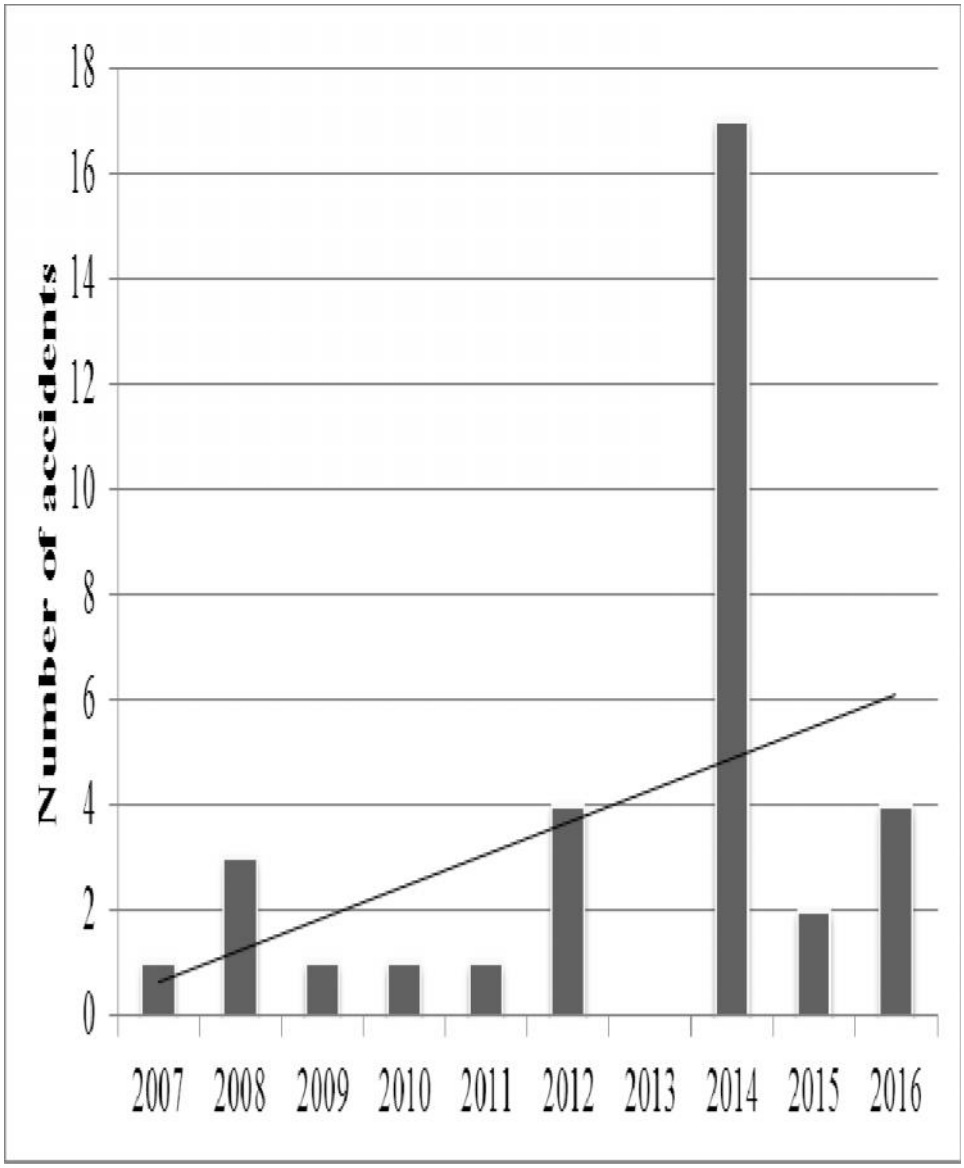

Figure 24: Number of motorcycle accidents in **Ihiala Local Government Area** from 2007-2016

Source: Authors' fieldwork, May, 2017

In 2007 and 2008, Njikoka Local Government Area recorded 1 case respectively. 2009 recorded no accident. The number increase to 2 cases in 2010 and 2011 respectively and decrease to 1 case in 2013. 2014 recorded the largest number of motorcycle accident in the local government with 11 cases. About 5 crashes were recorded in 2015 and the incident increase to 7 crashes in 2016 (figure 25).

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The year 2007, Nnewi North Local Government Area recorded 1case (figure 26).No accident was recorded in 2008 and 2009. The number increase with 1 in 2010 and 2011respectively. 2012 recorded no accident. About 3 cases were recorded in 2013. The number increase with 7 cases in 2014 and decrease to 4 in 2015. 2016 recorded 5 cases.

In 2007, Nnewi South Local Government Area recorded 1 case and the number increase to 2 cases in 2008. 2009 recorded no accident. 1 case was recorded in 2010 while 2011 recorded no accident (figure 27).The number increase with 2 crashes in 2012 and decrease to 1 in 2013. After this point the number rose significantly with 14 in 2014. The number decrease to 2 in 2015 and increase again with 9 in 2016.

Ogbaru Local Government Area recorded 1 case in 2007 (figure 28). 2008 and 2009 respectively recorded no accident. 1 case was recorded in 2010 and 2011 recorded no accident. Again 2012 recorded 1 case while 2013 recorded no accident. The number increase with 4 cases in 2014. 2015 recorded the highest number with 7 crashes and decrease with 2 cases in 2016.

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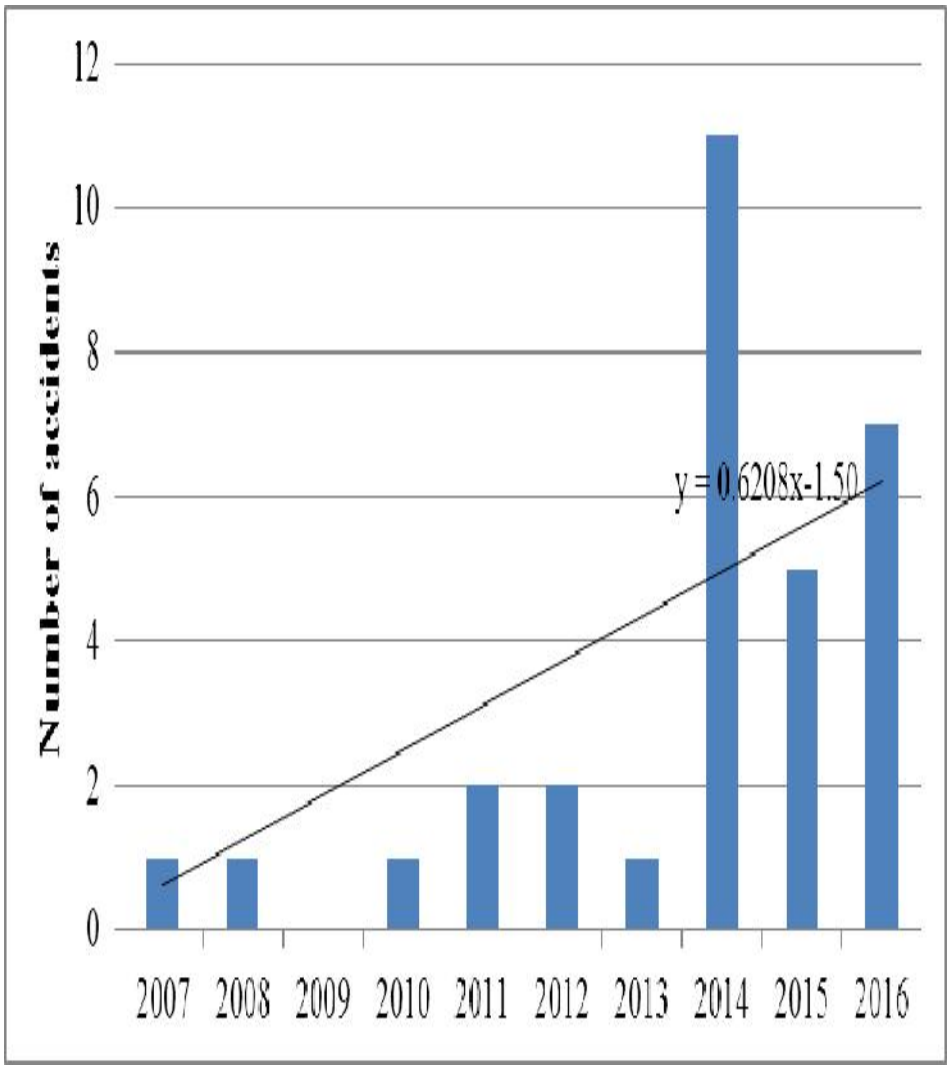

Figure 25: Number of motorcycle accidents in **Njikoka Local Government Area** from 2007-2016

Source: Authors' fieldwork, May, 2017.

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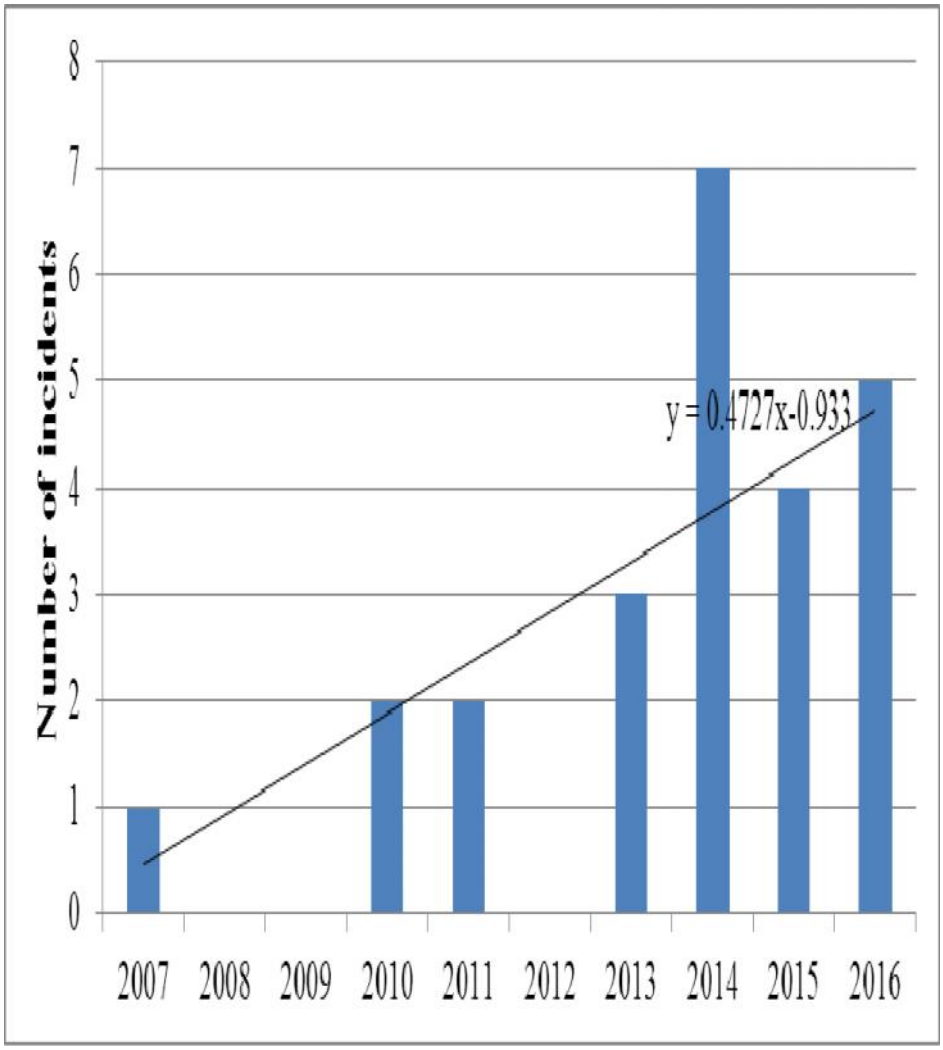

Figure 26: Number of motorcycle accidents in **Nnewi North Local Government Area** from 2007-2016

Source: Authors' fieldwork, May, 2017

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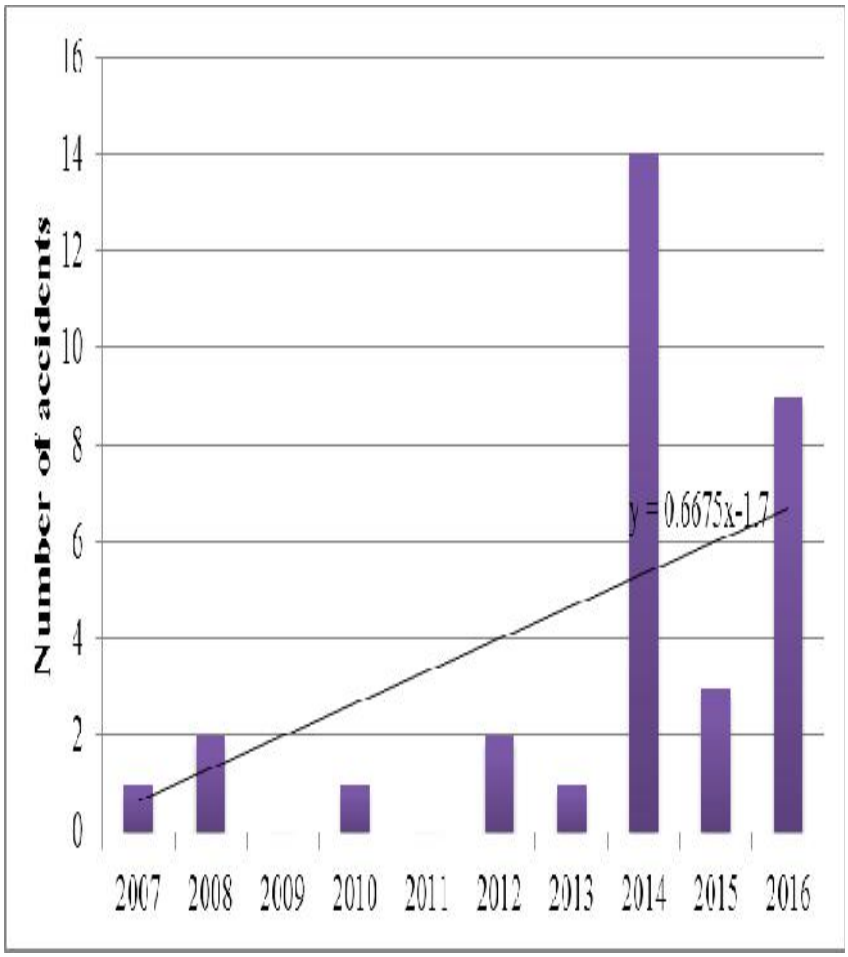

Figure 27: Number of motorcycle accidents in **Nnewi South Local Government Area** from 2017-2016

Source: Authors' fieldwork, May, 2017.

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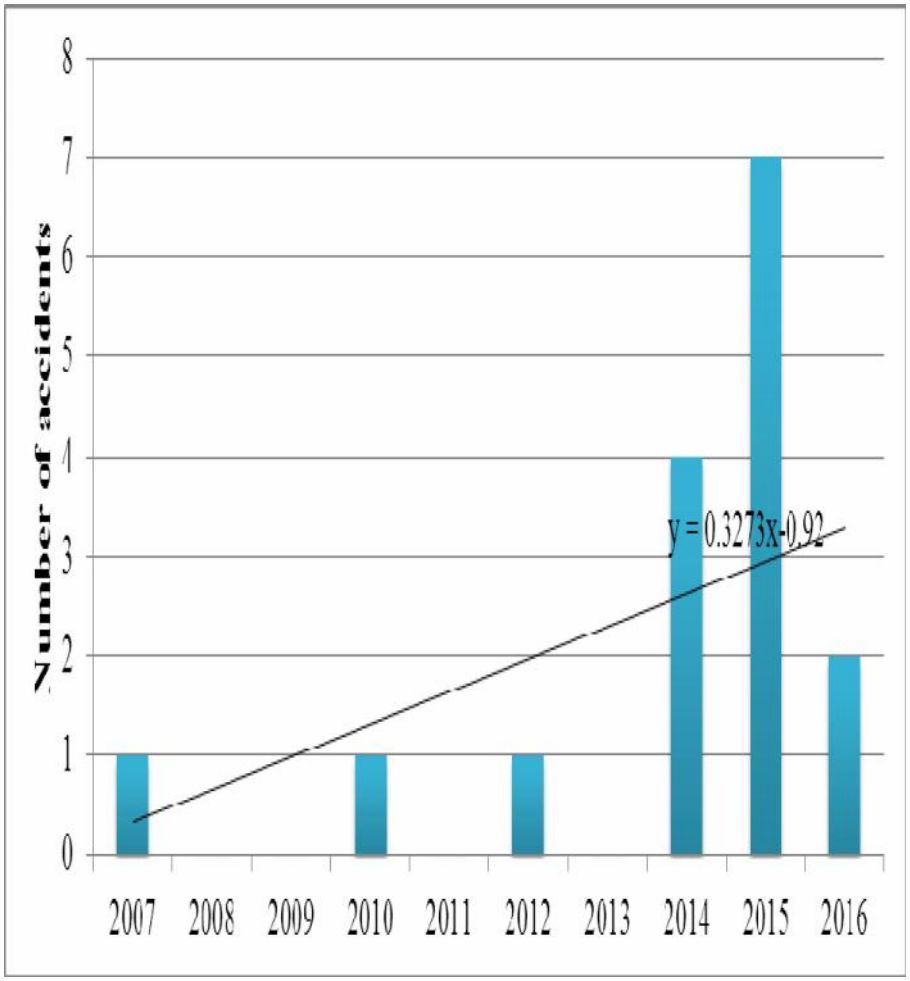

Figure 28: Number of motorcycle accidents in **Ogbaru Local Government Area** from 2007-2016

Source: Authors' fieldwork, May, 2017.

The year 2007, Onitsha North Local Government Area recorded 1 case and the number increase with 2 in 2008. 2009 and 2010 recorded no accident. The number rose with 2 in 2011 and decrease with 1 case in 2012. The year 2013 recorded no accident. About 5 cases were recorded in 2014. 2015 recorded the highest cases with 7 and the number decrease to with 2 in 2016 (figure 29).

Onitsha South Local Government Area recorded 1 case in 2007 and no accident was recorded in 2008 (figure 30). 2009 to 2011 recoded 1 cases of motorcycle accident respectively. The

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year 2013 recorded no accident. The number increase with 7 cases in 2014 and rose gain with 9 cases in 2015. The number decrease with 4 cases in 2016.

Turing to figure 31, no accident was recorded in Orumba North Local Government Area from 2007-2011. 1 case was recorded in 2012 while 2013 recorded no accident. The number increase to 2 crashes in 2014. The year 2015 recorded 5 cases and the number decrease with 2 in 2016.

The year 2007 to 2011, Orumba South Local Government Area recorded no accident. 2012 recorded 1 case and 2013 recorded no case. About 5 cases were recorded in 2014 and the number decrease with 1case in 2015. The year 2016 recorded no accident case (figure 32).

Oyi Local Government Area recorded no accident from 2007 and 2012 (figure 33). 1 case was recorded in 2013 and 2014 respectively. The year 2015 recorded no accident and 1 case was recorded in 2016.

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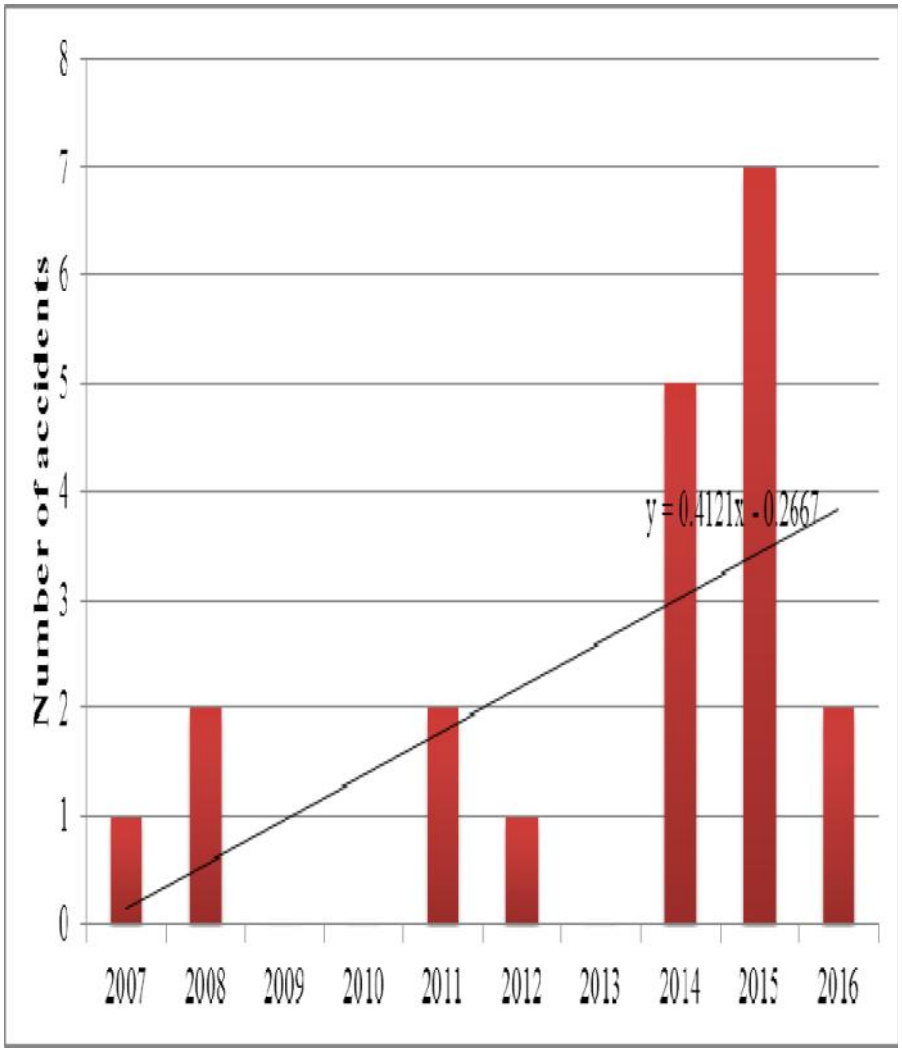

Figure 29: Number of motorcycle accidents in **Onitsha North Local Government Area** from 2007-2016

Source: Authors' fieldwork, May, 2017

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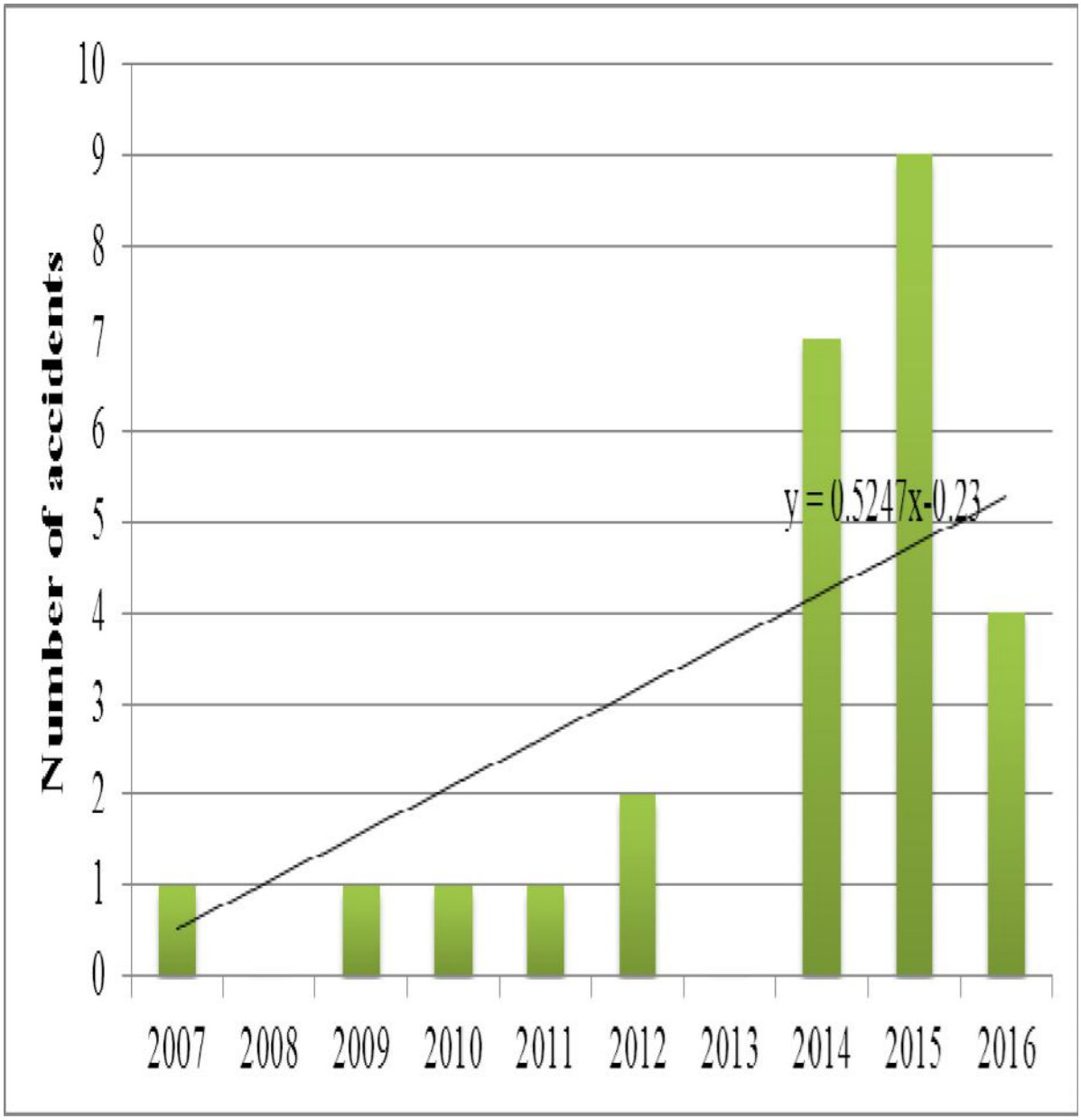

Figure 30: Number of motorcycle accidents in **Onitsha South Local Government Area** from 2017-2016

Source: Authors' fieldwork, May, 2017.

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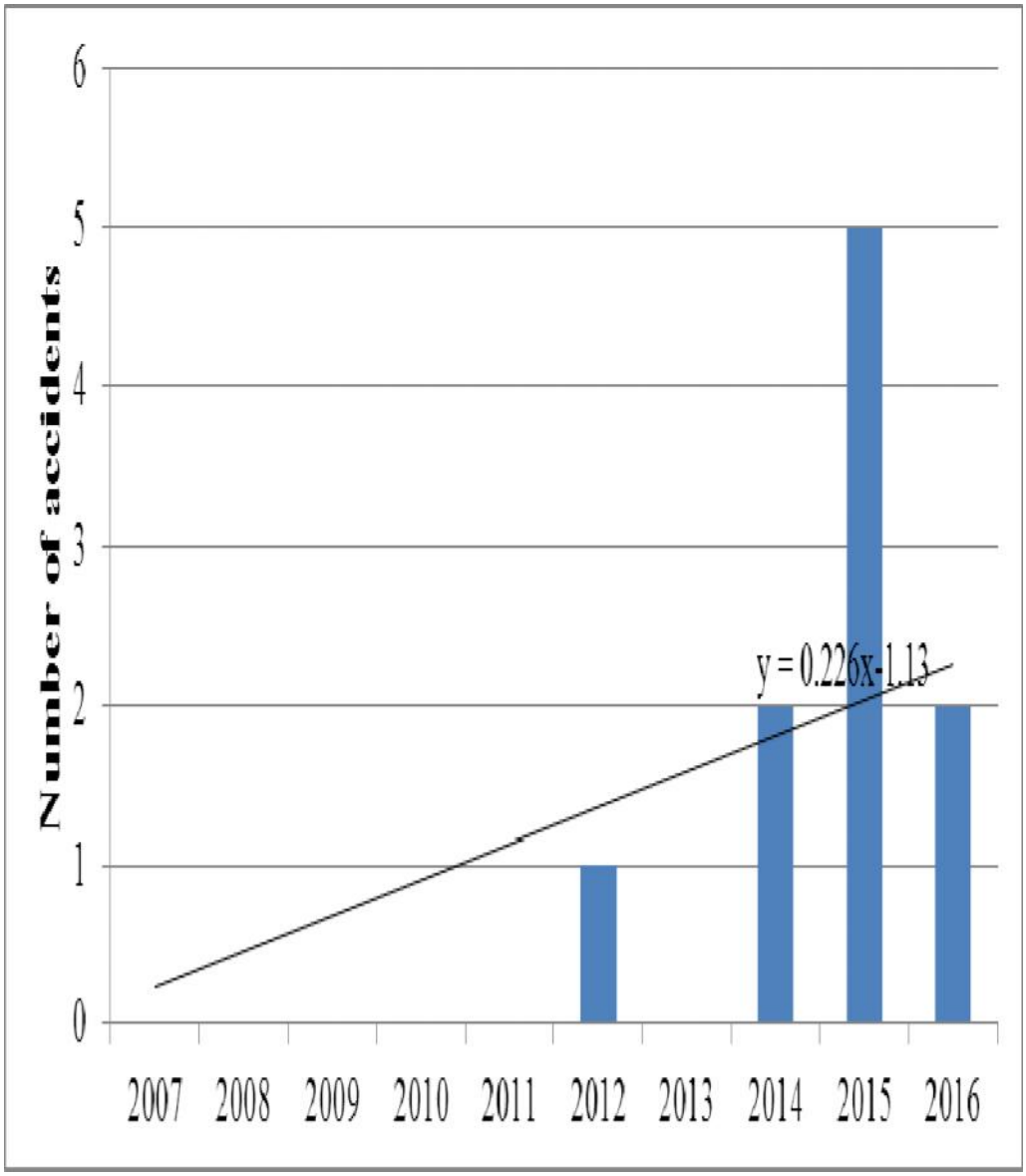

549
550

551 Figure 31: Number of motorcycle accidents in **Orumba North Local Government Area**
552 from 2017-2016

553 **Source**: Authors' fieldwork, May, 2017.

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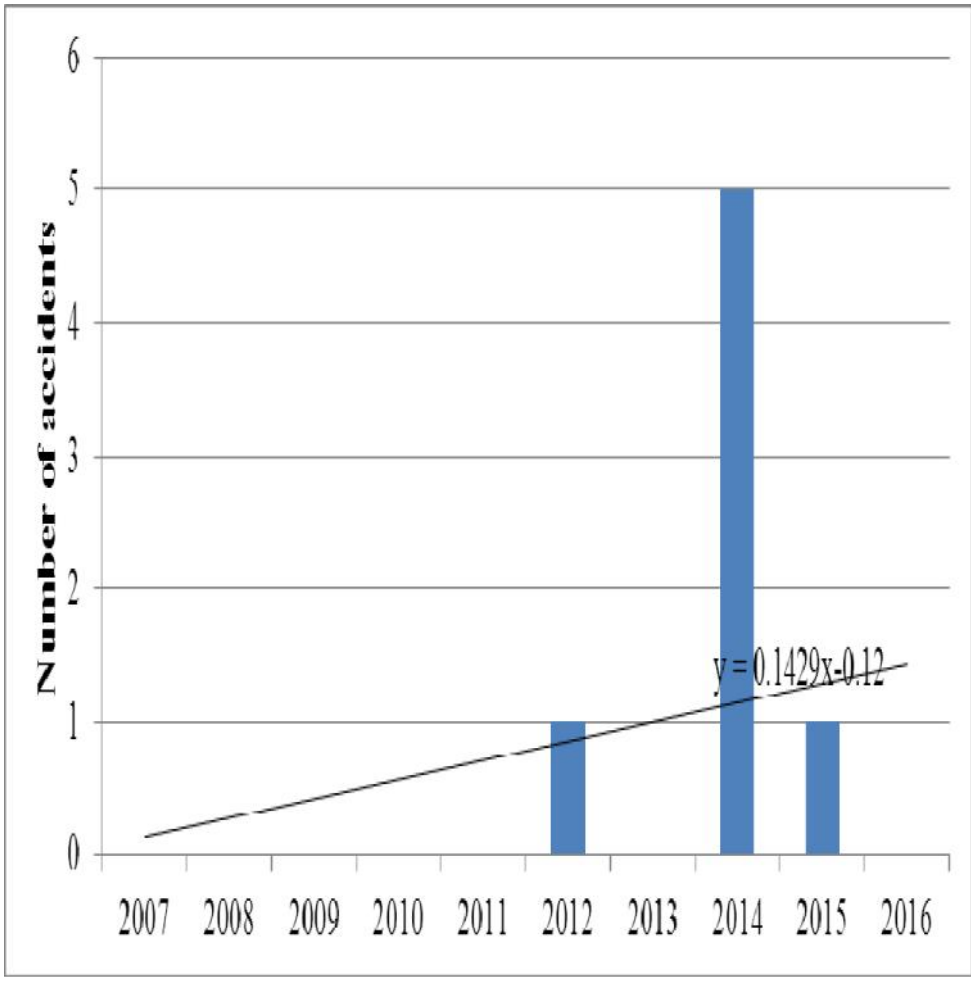

Figure 32: Number of motorcycle accidents in **Orumba South Local Government Area** from 2017-2016

Source: Authors' fieldwork, May, 2017.

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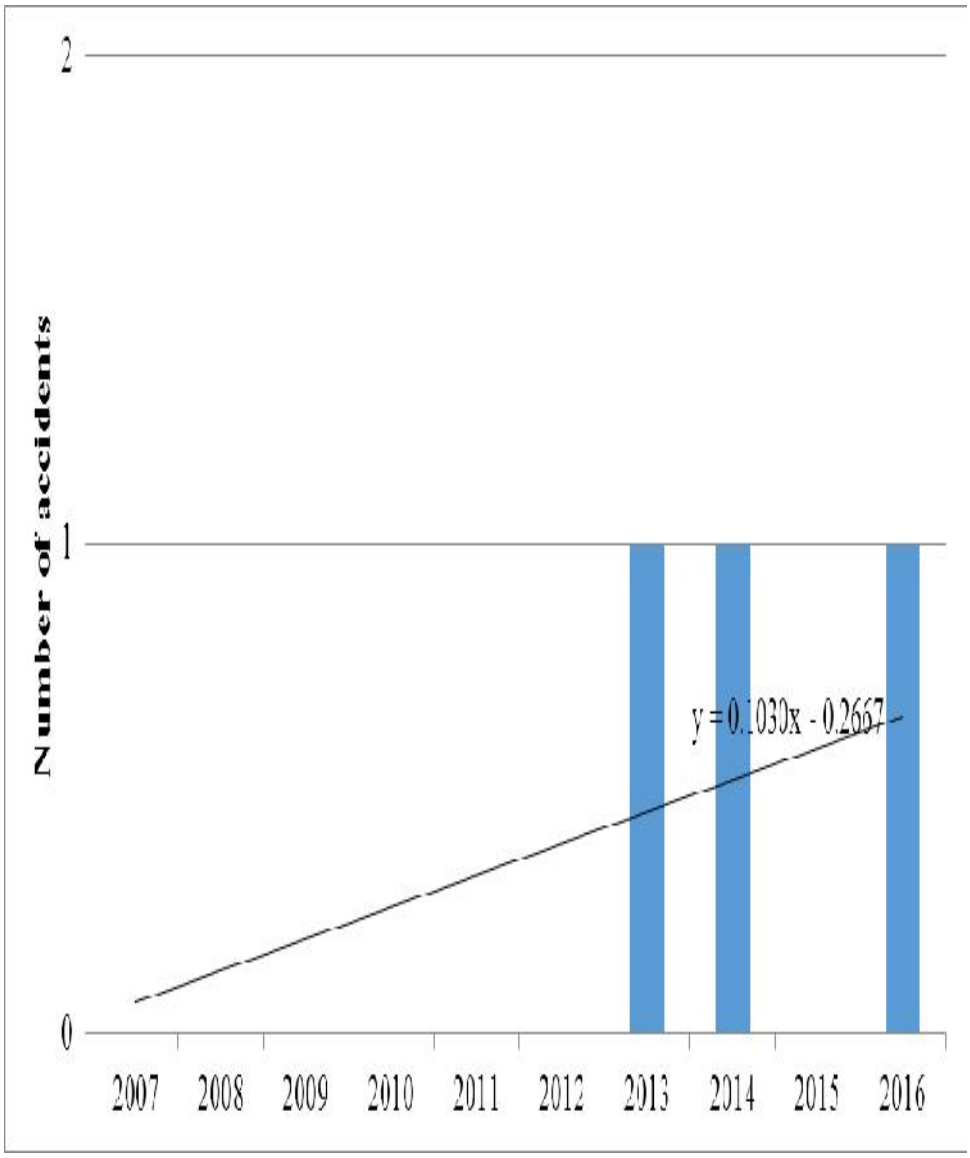

Figure 33: Number of motorcycle accidents in **Oyi Local Government Area** from 2017-2016

Source: Authors' fieldwork, May, 2017.

Table 3 shows an Analysis of Variance to determine whether significant difference exist in the number of motorcycle accidents in Anambra state over the period of ten years 2007-2016 (Appendix 1). The result indicates that there is a significant difference in the number of motorcycle accidents from 2007-2016 ($F_{9,\ 200}$= 13.210; $p<0.05$). The hypothesis is therefore accepted. This implies that the observed significance value for the number of motorcycle accidents confirming the existence of temporal pattern of motorcycle accidents in Anambra state from 2007-2016.

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Table 3: One-way ANOVA Results

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	737.314	9	81.924	13.210	.000
Within Groups	1240.286	200	6.201		
Total	1977.600	209			

Source: Author's Analysis, 2017.

Test of hypothesis on trends in motorcycle accidents in Anambra state from 2007-2016

Table 4: Results for time and number of motorcycle accident from 2007-2016

LGAs	Equation	R-square	R	F	p-value	Nature of trend
Aguata	y = 0.3325x-1.0667	0.3211	0.567	3.784	0.088	Increasing
Anambra East	y = 0.1688x-0.1333	0.4220	0.650	5.842	0.042	Increasing
Anambra West	y = 0.0909x-0.2300	0.1515	0.389	1.429	0.266	Increasing
Anocha	y = 0.2000x - 0.2000	0.1068	0.327	0.957	0.357	Increasing
Awka North	y = 0.9532x - 1.6000	0.4192	0.647	5.773	0.043	Increasing
Awka South	y = 0.9922x - 1.2000	0.3309	0.575	3.956	0.082	Increasing
Ayamelum	y = 0.2182x - 0.4000	0.4091	0.640	5.538	0.046	Increasing
Dunukofia	y = 0.0667x - 0.0667	0.0894	0.299	0.786	0.401	Increasing
Ekwusigo	y = 0.1939x - 0.2667	0.4083	0.639	5.520	0.047	Increasing
Idemili North	y = 0.0424x + 0.2667	0.033	0.182	0.273	0.615	Increasing
Idemili South	y = 0.0485x + 0.7333	0.0242	0.156	0.199	0.668	Increasing
Ihiala	y = 0.6061x + 0.0667	0.1363	0.369	1.262	0.294	Increasing
Njikoka	y = 0.8303x - 1.4667	0.5129	0.716	8.422	0.020	Increasing
Nnewi North	y = 0.6061x - 0.9333	0.6013	0.775	12.063	0.008	Increasing
Nnewi South	y = 0.9152x - 1.7333	0.3673	0.606	4.645	0.063	Increasing
Ogbaru	y = 0.4606x - 0.9333	0.3772	0.614	4.846	0.059	Increasing
Onitsha North	y = 0.4121x - 0.2667	0.2919	0.540	3.298	0.107	Increasing
Onitsha South	y = 0.7152x - 1.3333	0.4884	0.699	7.636	0.025	Increasing
Orumba North	y = 0.3879x - 1.1333	0.5172	0.719	8.569	0.019	Increasing
Orumba South	y = 0.2000x - 0.4000	0.1493	0.386	1.404	0.270	Increasing
Oyi	y = 0.1030x - 0.2667	0.417	0.646	5.723	0.044	Increasing
Anabra State	y = 7.54030x-13.100	0.459	0.677	6.783	0.031	Increasing

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584 Source: Author; from Fieldwork data, 2017
585

586 It can be seen in the multiple regressions for all the locations that there is a positive
587 relationship (R) between the dependent variable (number of motorcycle accidents) and
588 independent variables (time). The positive relationship between the two variables implies an
589 increase in the number of motorcycle accident in the state over the period of ten years (2007-
590 2016). The p-value from the regression analysis for Anambra East, Awka North, Ayamelum,
591 Ekwusigo, Njikoka, Onitsha South, Onitsha South, Orumba North and Oyi and the entire
592 state are less than the significant level ($p<0.05$). This implies that the number of motorcycle
593 accident in those areas is significantly influenced by years in which they occurred.
594 On the other hand, other local government areas such as Aguata,Anambra West,
595 Anocha, Awka South,Dunukofia, Idemili North, Idemili South, Ihiala, Nnewi South,
596 Ogbaru,Onitsha North and Orumba South are greater than the significant level ($p>0.05$),
597 meaning that years in which the incidents occurred were not good predictor of the incidents.
598 The R-square statistic also indicates a weak to moderate relationship between the two variables
599 (number of motorcycle accident and years). The low R^2 indicates that a model containing only
600 years is likely to be a weak predictor the number of motorcycle accident recorded. Again, on
601 fitting the linear trend line, it was observed that the trend is increasing for almost all the
602 locations and the entire state, although, the slopes of the trend lines are not very large in
603 magnitude for these Aguata, Anambra East, Anambra West, Anocha, Ayamelum, Dunukofia,
604 Ekwusigo, Idemili North, Idemili South, Ogbaru, Onitsha North, Orumba North, Orumba
605 South and Oyi, the trends apparently are not strong (Table 4)
606

607 **4. CONCLUSION**

608 The introduction and general acceptance of motorcycle as a means of public transportation
609 has had a great impact on transportation in both urban and rural areas. Its acceptance on
610 Nigerian roads has thus become a double edge development in transportation resulting in an
611 ever increasing occurrence of motorcycle accidents. There should therefore be concerns on
612 how polices formulated will aim at reducing the increase rate of motorcycle accidents. This
613 will ensure that use of motorcycle as a means of transport is safer, especially in urban areas
614 endowed with teeming young people.

615 However, to reduce and prevent motorcycle accidents occurrence in Anambra state, the
616 following may be considered as part of a meaningful approach: improving road

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conditions and management facilities, strict enforcement provision of adequate enlightenment for road users, drivers, motorcycle owners and all those connected with traffic movement in Anambra state and in Nigeria as a whole

5. RECOMMENDATIONS

In the light of the problems identified in the course of this study, there is need for recommendations which will guide the policy maker in implementing the most important policy in the study area. The following recommendations are made to curb the menace of motorcycle accidents in the state.

1) Motorcycle is known to be very prone to accident and the accident is usually very serious, therefore, efforts should be made by government to rehabilitate bad road roads and encourage the use of taxis and tricycle, thus reducing the influx of motorcycles in the Anambra state
2) There is a need to review the possession of driving license and enforce compliance by motorcyclist who is operating in towns and government should provide adequate road traffic enforcement agency that no rider beyond a speed limit.
3) More importantly, operators should be forced to wear head helmets whenever on duty. One way to do this is to subsidize the cost of helmets and other kits so that operators can have full access to the need for effective operation.
4) Since most of the people engaging in this work are the young individuals who could not secure good jobs, government should empower them to be self reliant in some economic viable activities rather than engaging in motorcycle operation that is prone to accidents.
5) Development and introduction of a reliable accident data recording system could provide more complete information on road traffic causalities including objective assessment of alcohol involvement

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APPENDIX 1

Test of Hypothesis on spatial pattern

Table 3.1 Data on Spatial pattern of motorcycle Accidents 2007-2016

LGAs	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Aguata	0	0	1	0	1	0	0	8	4	2
Anambra East	0	1	0	0	0	2	1	2	2	1
Anambra West	0	0	0	1	1	0	0	2	0	1
Anocha	0	0	0	1	1	0	0	6	1	0
Awka North	2	4	1	2	3	1	1	17	7	12
Awka South	4	2	2	3	4	2	1	21	8	8
Ayamelum	0	0	1	0	0	0	1	3	2	1
Dunukofia	0	0	0	0	0	0	2	1	0	0
Ekwusigo	0	0	0	1	0	2	0	2	2	1
Idemili North	4	0	1	0	1	0	2	0	1	0
Idemili South	6	0	2	1	1	0	0	3	1	1
Ihiala	1	3	1	1	1	4	0	17	2	4
Njikoka	2	1	0	1	2	2	1	11	5	7
Nnewi North	4	0	0	2	2	0	3	7	4	5
Nnewi South	1	2	0	1	0	2	1	14	3	9
Ogbaru	1	0	0	1	0	1	0	4	7	2
Onitsha North	5	2	0	0	2	1	0	5	7	2
Onitsha South	6	0	1	1	1	2	0	7	9	4
Orumba North	0	0	0	0	0	1	0	2	5	2
Orumba South	0	0	0	0	0	1	0	5	1	0
Oyi	0	0	0	0	0	0	1	1	0	1
Total	**10**	**15**	**10**	**16**	**20**	**21**	**14**	**138**	**79**	**63**

Source: Extracted from FRSC-Awka Records