



SPATIAL CORRELATION ANALYSIS OF TRAFFIC VIOLATIONS AND ROAD CRASHES IN OGUN STATE NIGERIA

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ABSTRACT

The relationship between traffic violations and road crashes is investigated in this study which aims to analyze the correlation between violations and crashes that occurred in major traffic zones with similar enforcement architecture in Ogun state, Nigeria: a five-year road traffic violation and crash data obtained from Federal Road Safety Corps, Ogun state command. Statistics mean, percentage, chart, and Pearson r correlation were used to analyze the data, result revealed that Abeokuta, Ijebu-Ode, Ota, Sagamu, Idi-Iroko, Itori, Mowe, and Ogere are high-risk locations with higher mean violations and crashes. The correlation analysis revealed that of the twelve locations considered only two (Mosimi and Ilaro) locations present positive significant values at 0.05 and 0.01, while others present weak positive and negative relationships. The study concluded that violations alone cannot induce crashes but with other factors, it therefore recommends, intensified enforcement, driver education, and traffic calming installation to orientate and moderate drivers' behaviours toward compliance and safe road usage.

Keywords: Crashes, High Risk, Road Traffic, Violations.

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1. INTRODUCTION

Disregarding traffic rules and regulations is a common behaviour of road users across the globe, and effective deterrents through enforcement have been the moderating measures. However, road traffic violations as an underlying factor of crashes have called for concern, because of the increasing rate of mortality and morbidity resulting from road crashes.

The relationship between road traffic violations and crashes has been studied with a focus on different violations such as speeding, using mobile phones while driving [1], Reckless driving, like running red lights, violating stop signs, failure to yield right-of-way, driving under the influence of alcohol or drugs [2], and other driving-related offenses.

The UN Decade of Action on Road Safety outlined five pillars of action of which the establishment of a lead agency in road traffic management is included. The agency is responsible for policing the road to minimize violations and ensure safe road system. Most member countries set up specialized agencies to monitor and ensure safe road traffic management. In Nigeria, the Federal Road Safety Corps was established in 1988, while the individual state also established complementary agencies of the state. Between the year 2000 to date, nearly all (65%) of the states in the country have agencies responsible for deterring road traffic violations and ensuring road safety [3].

The relationship between road traffic violations and crashes has been studied with a focus on different violations such as speeding, dangerous driving, drunk driving, use of mobile phones, and other driving-related offenses. These studies have looked at the effect of different violations as a causative factor of crashes, especially speeding, which was reported to account for approximately 30% of fatal crashes while, dangerous driving, a distraction that includes the use of a mobile phone increases the risk of crashes by up to 4 times [1]. Similarly, [2] reported that drunk driving increases the risk of fatal crashes by up to 17 times, thus there is a correlation between violations and crashes.

Alrejjal study investigated the impact of traffic violations on crash injury severity using the multinomial logit (MNL) model. The model showed that traffic violations, crash characteristics, and environmental characteristics among other factors impact crash injury severity on Wyoming's interstate highways. , driving too fast for prevailing conditions, and driving under the influence of alcohol and drugs were identified as the main violations that significantly influenced crash severity, high speed behavior by non-truck drivers in adverse weather conditions is ranked as one of the hazardous traffic violations on Wyoming's interstates [4].

Shaaban investigate characteristics of traffic violations and crashes in Qatar, identify the trend, and describe the pattern in a different population group. The study shows that the number of violations and crashes is increasing with the increase in population while the fatality per 100,000 is decreasing. Speeding and careless driving were the main violations identified as the main contributing factors, Shaaban looked at the violations and crashes in relation to the population [5].

Osisiogu, Usman, and Mmahi argue that incessant road traffic crashes on Nigerian roads are mostly occasioned by traffic violations, which are traceable to an ineffective enforcement system [6]. The author suggested adequate enforcement to deter violations through sanctions and a penalty points system. However, enforcement of traffic laws and adoption of safety standards constitute a challenge across the globe [1], and inadequate enforcement personnel, bribery and corruption, and increased porosity of the road transport system are some of the challenges. Thus traffic violations are on the increase, especially in developing countries.

Asadu & Ayuwo also investigate the underlying factors of increased violation, by assessing the relationship between drivers' knowledge of traffic rules and traffic violation. The study revealed that drivers have fair knowledge which does not have a positive correlation to compliance, the author concluded that drivers deliberately disregarded the rules [7]. Contrary to this, Irunokhai attributed traffic violations to a lack of knowledge demonstrated by road users, the author asserted that the drivers only know how to move the vehicle but lack adequate knowledge of traffic rules and regulations, and added that inpatient on the part of the commercial driver also responsible for increase violations [8].

Emenike, and Akpu's Assessed Road Traffic Violations in Port Harcourt Metropolis, Nigeria, and discovered that drivers in the city frequently engage in risky driving behaviours as the drivers ply the road, hence violating the traffic rules and regulations [9]. The Federal Road Safety Corps identified the common violations that often result in fatal crashes including speeding, use of mobile phones, dangerous overtaken, poor vehicle maintenance, and overloading of vehicles and conclude that these violations are responsible for over 50 percent of the road crashes [10].

Road traffic crashes are one of the leading causes of death, especially in low and medium-income countries, where the more active population is the most affected. The World Health Organization put the statistics at 1.35 million deaths each year, with 20 -50 million people sustaining different degrees of injuries, many of which lead to permanent disability and economic incapacitation [1]. Nigeria as a country has a record of 27.25 per 100,000 population death rate [11], putting the country in the 54th position in the world. Every region of the county contributed to the national road crash statistics, no doubt, the locational attributes of each region are significant to the effectiveness of measures to reduce the number of crashes occurrence [12].

In a comparative study of 15 African countries, Nigeria was found to record the highest number of crashes, injuries, and deaths compared to other countries [13]. This was corroborated by the World Health Organization (WHO) report 2019, that about 39,000 deaths occur in Nigeria every year, caused by RTC [14]. Despite various traffic legislations and, the establishment of national and state enforcement agencies, Nigeria roads remain unsafe [6].

In a review of the road transport system in Nigeria, Yakeen and Ajala observed that the global effort at stemming the tide of road crashes yielded a reduction in the cases of road crashes and causality in Nigeria, the estimated reduction between 2011 and 2019 were put at 26.5% and 25.5% respectively [3]. However, the situation in Ogun state has been different, as one of the leading contributors to national statistics on road traffic crashes, the annual report of FRSC shows that Ogun state has consistently maintained the second position next to FCT Abuja in the last few years [10]. The statistics revealed that between 2019 and 2022, the state recorded 736, 924, and 1114 cases respectively, given an increasing trend of 25.5% in 2020 and 20.5% in 2022.

Road traffic rules enforcement measures and compliance level are very central to improved road safety, the less the violation, the more compliance, and the more compliance the less the crashes. Folarin and Onifade affirmed this assertion in a study of the effect of traffic law enforcement on road crashes in Ogun State. The study used the Markov Chain Model and came to the conclusion that drivers must have violated traffic rules 55 times and engaged in unsafe conditions 16 times before experiencing a crash. The author was able to establish a positive relationship between traffic rule violations and road traffic crashes [15].

Ogun state over the years was labeled the mortuary of the nation, this nomenclature was justified by the statistics of road traffic crashes attributed to the state from the national record. Since 2012, the Ogun state has been the 2nd largest contributor to the national mortality and morbidity by road traffic crashes, and up till now, the state remained in the top position with leading casualty, cases, or fatality. Efforts geared toward reduction in road traffic crashes, such as the establishment of a state-owned traffic management agency in 2005 and the deployment of officers and men to all the major towns and cities within the state to complement the Federal Road Safety Corps in road policing have little to show, this is contrary to the view that law enforcement present is a deterrent to traffic violation [16]. Hence, there is a need to further examine the relationship between violations and crashes in the identified traffic zones within the state for a more locational-specific measure.

The study analyzes the correlation between violations and crashes that occurred in major traffic zones in Ogun state, with the objectives of examining the spatial distribution pattern of road traffic violations, and crashes, and assessing the relationship between violations and road traffic crashes within the major towns and cities of the state.

2. METHODOLOGY OF STUDY

Ogun state is one of the thirty-six states of Nigeria, located in the south-west part of the country, laying on the longitude 6.9980° N and latitude 3.4737° E. The state is crescent the gateway state because of its strategic location as the border state to the national commercial hub of Lagos state. Ogun state shared border with Lagos state in the south, Republic of Benin in the west, and Oyo and Ondo in the north and eastern parts. The state is one of the urbanized states with evidence of urban population spillover from Lagos state, the population of Ogun state has increased from 300,000 in 1976 when it was created to 3 million in 2006 [17] and is estimated as 6,379,500 in 2022 [18]. The state is spatially divided into twenty local government areas, namely Abeokuta South, Abeokuta North, Odeda, Ewekoro, Ifo, and Owode-Obafermi in the Ogun Central District. Ijebu-Ode, Ogun Waterside, Ijebu East, Ijebu North, Ijebu North-East, Remo North, Ikenne, Sagamu, and Odogbolu local government area in the Ogun East district. Ogun West district comprised of Yewa South, Yewa North, Imeko-Afon, Ado-Odo/Ota, and Ipokia local government.

Ogun state is a network of regional and international road corridors, many of which are characterized by all-day busy traffic, in the Ogun east district, Sagamu-Bennin express, Ijebu-ode –Ibadan highway, and Ijebu-ode epe highway. In the Ogun central is Lago-Abeokuta expressway, Lagos Ibadan expressway, Abeokuta -Ibadan highway, and Lagos Sokoto highway. Similarly in the Ogun West district are papa-ilaro-Oja-odan Road, Owode-Idiroko Highway, Imeko Road, and Agbara–Nusada Highway to mention but a few.

Ogun state command of the Federal Road Safety Corps created an operational structure, of twelve unit commands to ensure adequate coverage of the state, giving consideration to the traffic pattern, population concentration, and the road infrastructure. This study adopts the road safety spatial operation structure for the data collection, collation, and analysis. The twelve operational commands/traffic zones are shown on Fig 1, and Table 1 present the local government area coverage by each zone.

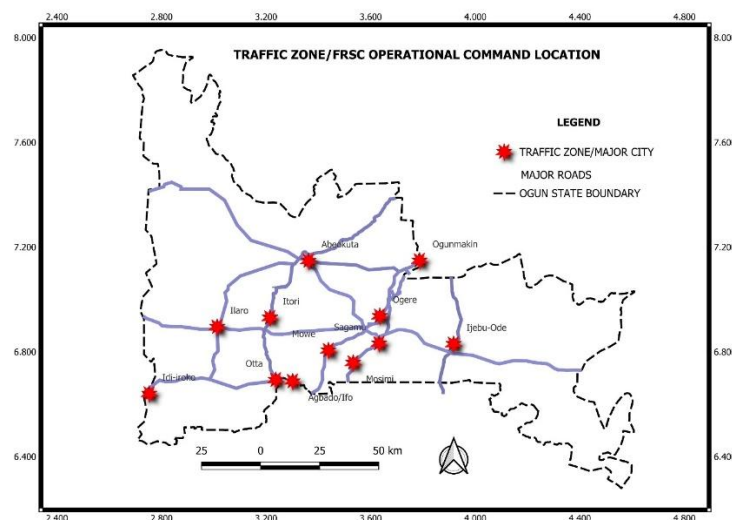


Figure 1: Map of major traffic zone/cities in Ogun state

Table 1 Operational unit commands locations and local government area coverage

Command	Locational Name	Area Covered
RS2.2	Abeokuta	Abeokuta south, Abeokuta North, Odeda,
RS2.21	Ijebu-ode	Ijebu-ode, Ogun waterside, Ijebu East, Ijebu North, Ijebu North-East, and Odogbolu
RS2.22	Ota	Ado-odo/ota
RS2.23	Mowe	Obafemi-Owode
RS2.24	Ogere	Remo North,
RS2.25	Sagamu	Sagamu, and Ikenne
RS2.26	Idiroko	Imeko-afon, and Ipokia
RS2.27	Agbado/ifo	Ifo
RS2.28	Itori	Ewekoro
RS2.29	Ogunmakin lag-ibd	Obafemi-Owode
RS2.210	Mosimi	Sagamu
RS2.211	Ilaro	Yewa South and Yewa North

Source: FRSC, Ogun state command

Road traffic violation and crash data were solely obtained from the Federal Road Safety Corps (FRSC), the data covers a five-year period from 2019 to 2023. The data was cleaned, moderated, and organized into pivot tables using MS Excel to enhance analysis. A descriptive analysis of mean and percentage was carried out, result is organized in a bar chart and line chart for the pictorial presentation of the traffic violation and crash distribution pattern by traffic zone. Person R correlation analysis was used to establish the relationship between the variables of traffic violations and road traffic crashes.

3. PRESENTATION OF RESULT AND DISCUSSION

3.1 Pattern of road traffic violations between the locations

Federal Road Safety Corps gazette 54 Traffic offenses that can be violated on Nigeria roads. The traffic violation data for the period of five years (2019-2023) were analyzed. The mean violation by location is presented in Fig. 2, to show the pattern of distribution of violations between the locations. The figure revealed that six locations (Abeokuta, Ijebu-Ode, Ota, Sagamu, Idi-Iroko, and Itori) are above the mean violation of 4000, five locations recorded a mean violation of above 1000 but less than 4000, while only Ilaro (RS2.211) zone has a mean less than a thousand violations. Itori (RS2.28) recorded the highest mean (5962.80) violations, while Ilaro recorded the lowest mean violations (414.60).

The traffic zones that have a mean of 4000 and above are major urban settlements with primary arterial roads, which justify the fact that urban drivers commit more infractions [9], other factors that may be responsible is the urban population which of course put pressure on the transport system and in turned induce violation and crashes [5]. Similarly, Itori is a wayside location, bisected by a high traffic volume expressway, no doubt, the intensity of traffic, vehicles, and people population are some of the underlining factors for the observed higher violations in the zone. Thus, Abeokuta, Ijebu-Ode, Ota, Sagamu, Idi-Iroko, and Itori are none conforming locations with higher traffic violations.

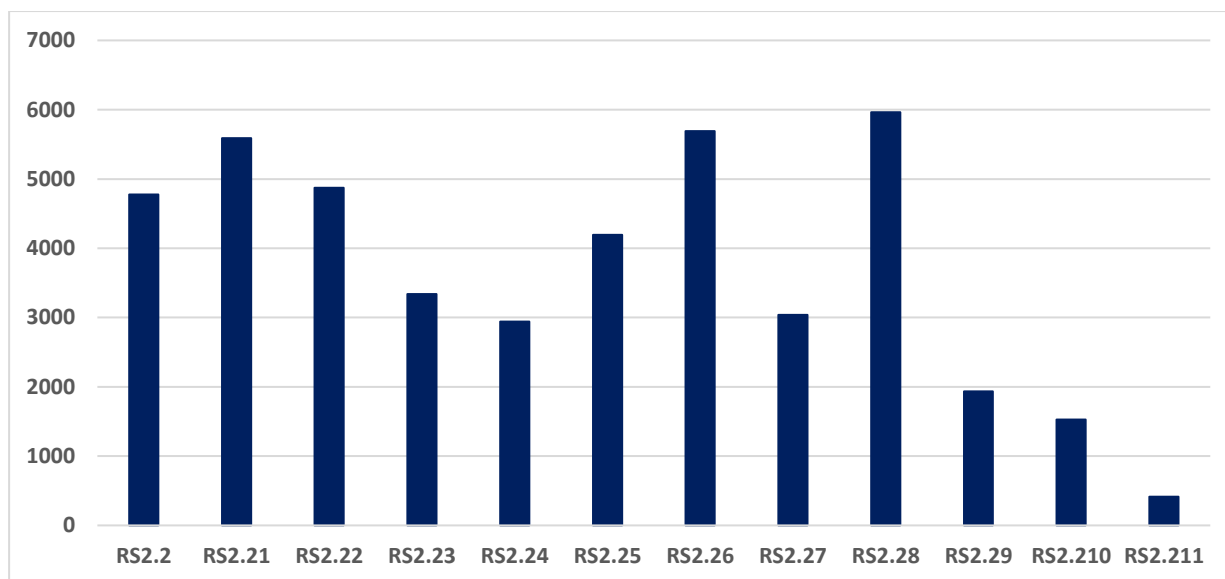


Figure 2: The mean road traffic violation

Source: Researchers' self-computation

3.2 Pattern of Road Traffic Crashes between the locations

The crash data present a different distribution pattern from violations, though the count of crashes is relatively low in violations. However, the mean crash for each location revealed that four locations (Ijebu-Ode, Mowe, Ogere, and Sagamu) have a mean crash of above 100, significantly Mowe recorded the highest mean crash count of over two hundred (222.40). Another four locations (Abeokuta, Ota, Itori, and Ogunmakin) have a mean crash of between 50 and 100, while Idi-Iroko, Agbado/Ifo, Mosimi, and Ilaro have a mean crash lower than 50, with the lowest being Ilaro (2.0).

Interestingly, the zones with high traffic crashes have the major primary arteries that link the Eastern part (Sagamu-Benin expressway) and the Northern part (Lagos-Ibadan expressway) of the country to the national commercial hub of Lagos, Mowe, Ogere, Sagamu, and Ijebu-Ode are cities along these major roads. These locations are the high-risk areas that are contributing more to the road traffic statistics in Ogun state. Similarly, Abeokuta, Ota, Itori, Ota, and Ogunmaking are also bisected by the primary arterial roads. It therefore revealed that among other factors traffic intensity is also contributing to crashes.

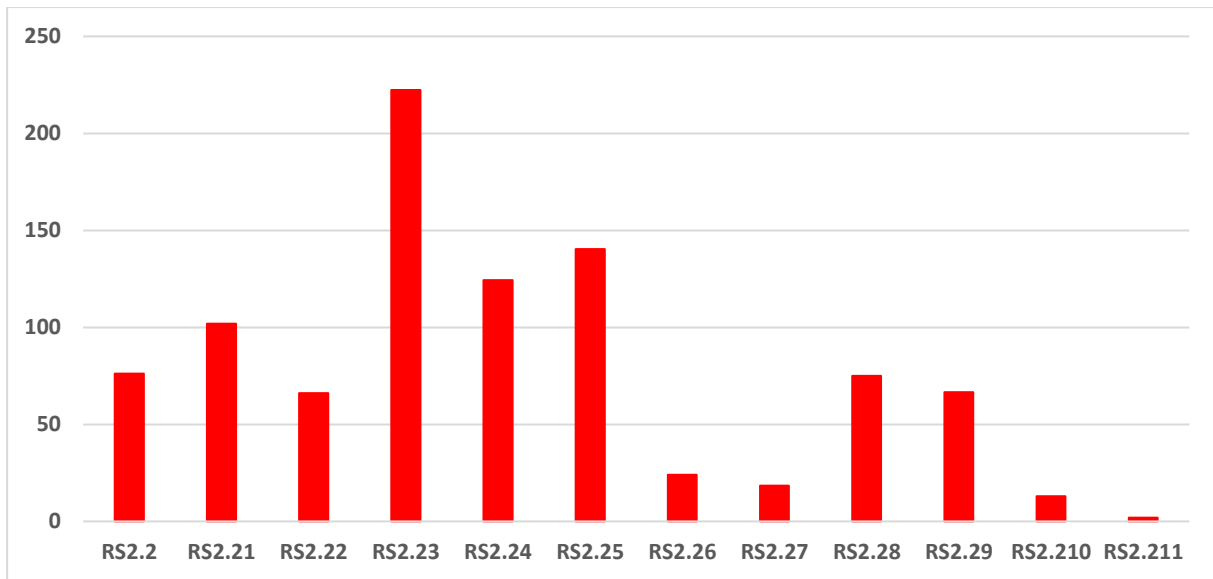


Figure 3: The mean road traffic crashes

Source: Researchers' self-computation

3.3 Comparison of the mean traffic violations and crashes

To provide a uniform unit of comparison, the mean distributions were computed into percentages of the total mean for each variable data (violation and crash). The percentages were plotted on a bar chart to establish the pattern of distribution between violations and crashes in the traffic zone. Fig. 4, revealed that violations and crashes are proportionally related among the locations, the pattern of violations and crashes for most of the locations were similar, such that the location with a higher proportion of violations shows a higher proportion of crashes and a lower proportion in violation come with lower proportion in crash when compared with other locations. The only exception is observed in RS2.23 (Mowe) where both violation and crash are of the same proportion (8%). From this analysis, it is concluded that the number of traffic violations in an area is proportional to crash cases occurring in the area.

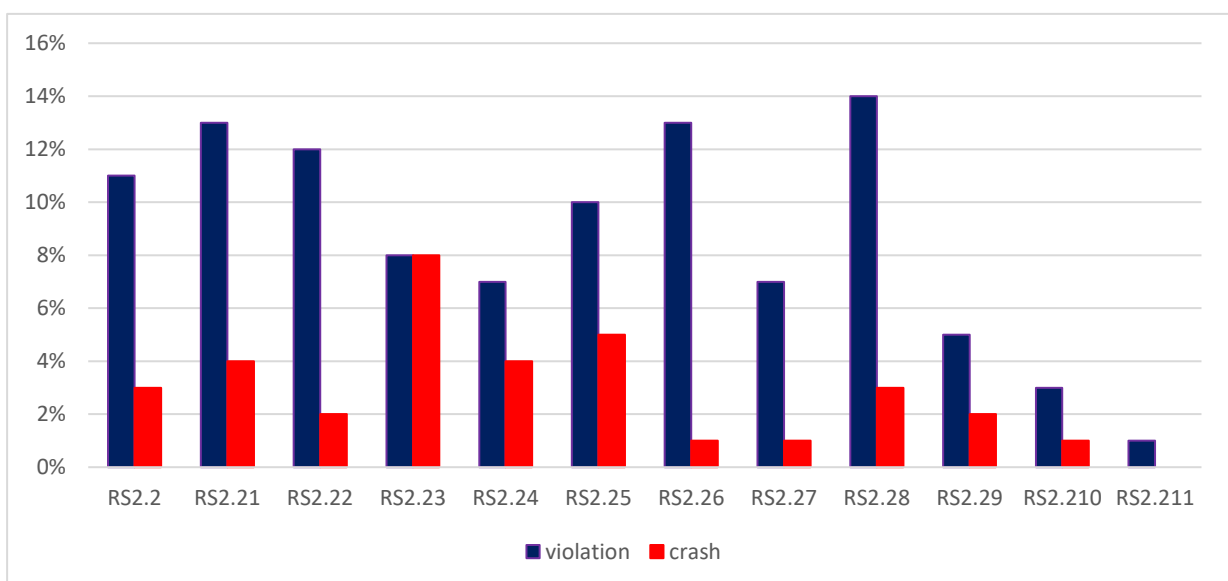


Figure 4: Comparison of the mean percentage

Source: Researchers' self-computation

3.4 Spatial correlation analyses of road traffic violations and crashes

From the correlation coefficients in Table 2, the result indicated from the statistically significant relationships of violations and crashes revealed that Sagamu (RS2.25) shows a statistically significant negative correlation at the 10% level, ($r = -0.809$, $p\text{-value } 0.097 < 10\%$) suggesting that higher traffic violations might reduce crashes. However, this is not within the priori expectation as traffic violations should have a direct relationship with crashes. Mosimi (RS2.210) shows a statistically significant positive correlation at the 5% level ($r = 0.939$, $p\text{-value } 0.018 < 0.05$), indicating that higher traffic violations are associated with more crashes. Ilaro (RS2.211) shows a perfect positive correlation at the 1% level, indicating a direct relationship between traffic violations and crashes. Most other commands show either weak or moderate correlations that are not statistically significant, implying that there is no strong evidence to suggest a consistent relationship between traffic violations and crashes.

In general, the analysis indicates that the relationship between traffic violations and crashes varies across different traffic zones. While some zones like Mosimi and Ilaro show a strong positive relationship, suggesting direct impacts, others like Sagamu show an inverse relationship. Most zones, however, show a positive not statistically significant relationship, indicating that other factors might be influencing the crash rates in these areas such as population, traffic, and locational characteristics among others [5][7][8]. This nuanced understanding can guide targeted interventions for traffic management and crash reduction.

Table 2: Relationships existing between traffic violations and crashes in Ogun State Commands

Command Code	Command Name	Correlation Coefficient	p-value	Direction	Remarks
RS2.2	Abeokuta	0.400	0.505	Positive	Not statistically significant
RS2.21	Ijebu-Ode	-0.653	0.232	Negative	Not statistically significant
RS2.22	Ota	0.053	0.932	Positive	Not statistically significant
RS2.23	Mowe	0.273	0.657	Positive	Not statistically significant
RS2.24	Ogere	-0.618	0.267	Positive	Not statistically significant
RS2.25	Sagamu	-0.809	0.097*	Negative	Statistically significant
RS2.26	Idiroko	0.414	0.488	Positive	Not statistically significant
RS2.27	Agbado/Ifo	-0.610	0.275	Negative	Not statistically significant
RS2.28	Itori	-0.146	0.815	Negative	Not statistically significant
RS2.29	Ogunmakin	-0.073	0.907	Negative	Not statistically significant
RS2.210	Mosimi	0.939	0.018**	positive	Statistically significant
RS2.211	Ilaro	1.000	0.000***	Positive	Statistically significant

*, **, *** represents significance of correlation coefficients @10%, 5% and 1% respectively

Source: Researchers' self-computation

4. CONCLUSION AND RECOMMENDATION

Traffic violations and crashes are two interconnected aberrations to the road transport system, the level to which they influence each other has not been adequately investigated, the studies examine the relationship between the two variables relating to traffic zones that have institutionalized road traffic policing system by the Federal Road Safety Corps and the state-owned traffic management agency, the statistic mean for each identified locations were computed and compared with other locations of similar road traffic policing system. Though the result is largely not significant, the few significant locations revealed a positive relationship, which is also corroborated by the bar charts

Ironically, locations with high traffic violations (Abeokuta, Ijebu-Ode, Ota, Sagamu, Idi-Iroko, and Itori) are not the same as locations with higher crashes (Ijebu-Ode, Mowe, Ogere, and Sagamu), except a few (Ijebu-ode and Sagamu). It is therefore concluded that there is variation in the violations and crashes between locations with similar enforcement architecture. This study therefore recommends intensified enforcement, driver education, and traffic calming installation to orientate and moderate drivers' behaviours toward compliance and safe road usage.

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