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An investigation of challenges in the existing pattern of intra-city traffic in Enugu metropolis

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Abstract
Cities all over the world are characterized by a set of activities, which account for the concentration of people in them, achievable by means of transportation. However, this integral aspect of urban infrastructure face great challenge in most urban areas. This research examines the challenges in the existing pattern of intra-city traffic in Enugu metropolis. Six neighbourhood make up the study population drawn from three high, two medium and one low residential densities neighbourhoods based on stratified and simple random sampling technique. Data collection instrument were questionnaires administered to 400 respondents. The result of the study indicates that major travel mode within Enugu metropolis is mini buses and tricycles while commuters undergo stress during their trips regardless of the good condition of roads within the metropolis. Furthermore, it highlights traffic congestion during peak period and narrowness of most roads within the metropolis as the main challenge to existing pattern of intra-city traffic. It concludes and recommend for the re-introduction of Non-motorized transport mode of walking and cycling complemented by the Coal city public transit shuttles that once existed. It also advocates for policies that ensure decentralization of activity to reduce congestion and the need for daily travel.

Keywords
Transportation; Enugu metropolis; Intra-city traffic; Congestion.

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1. Introduction

Transportation is a process that involves movement of commuters, goods and services from a given point of origin to a specific destination (Ikya, 1993). It determines the regional patterns of development, economic viability, environmental impacts, and maintenance of socially acceptable levels of quality of life (Solanke, 2013). It also paves way for growth of economic activities in both rural and urban areas, which serves as a catalyst to rapid development of all nations. Thus, just like the circulatory system in the human body, transport system in urban metropolis are the veins and arteries that drives development, links people, connects local communities to the world, build markets and facilitates trade. According to Moeinaddini et al. (2012) Mobility and accessibility are important indicators of urban growth. However, Intra-urban mobility, in particular, functions to integrate various parts of the city into a unified whole (Solanke, 2013). This implies that transportation is an integral part of the functioning of any society and advances in transportation have made possible changes in the way we live and the way societies are organized.

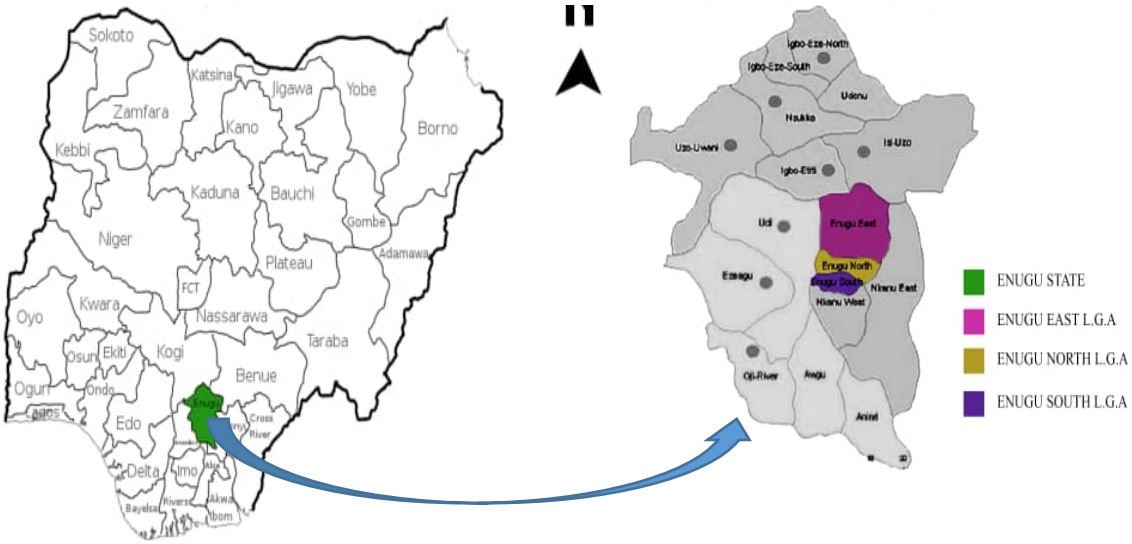
The major urban challenge of the twenty-first century includes the rapid growth of many cities (Nnaemeka-Okeke, 2016) which has given rise to concerns about their sustainability. Cities in developing economies, including Nigeria, are currently expanding to a point where it is threatening to smother the transportation system that prepared and promoted its growth. Specifically, in recent time, urban transportation in Nigerian cities have metamorphosed into a chaotic, complex and almost intractable nature such that most of them are perceived to have almost reached a level of relative immobility (Ikya, 1993; Solanke, 2013). Urban transport problem in most Nigerian cities can be adduced to incessant urban growth associated with rising urbanization which inevitably has resulted to an increased demand for the provision of transport. This increasing demand has, however, not always been met and efforts to provide adequate transport infrastructural facilities are ad-hoc, uncoordinated and poor (Aderamo, 2010). This situation has resulted to plaguing urban transport challenges such as excessive high travel demand relative to supply, traffic congestion, reduced accessibility to and through commercial centres, contumacious driving, parking problems, increased travel time, loss of productive hour, increased spending on automobile-friendly infrastructure, urban sprawl, etc. (Ekong, 1977).

Similarly, Enugu metropolis, which is also one of the cities in south-east Nigeria, has been experiencing a huge population increase in the past few decades. This situation has been adduced mainly to the effect of galloping urbanization and massive rural exodus. For instance, the population of people in Enugu metropolis in 2006 was given to be 276,337 but it was observed to have increased to about half a million people as at 2018. The profligate urbanization rate has promoted and ingrained various changes in urban structure characterized by urban sprawl with the obvious effect of generation of traffic congestion, longer trip distances, and traffic accidents. According to Okeke et al, (2020) the colonial city of Enugu is gradually drifting with signs of urban fragility and consequently is currently faced with enormous challenges in terms of infrastructure provision and the need to cope with the increasing demand of transport. More worrisome is the fact that the dominant mode of intra city transport is usually by road (90%) with automobiles having the largest modal share (between 70 – 72%). Thus, high dependence on private cars as well as poorly developed alternative transport systems in Enugu metropolis is currently reported to have adverse effects on intra-city mobility in Enugu metropolis in recent times (Ogunsanya, 2002). Considering the fact that effective transportation system is essential for the economy of a city, the priority and attention accorded to the planning of intra-urban transportation system by policy makers in Enugu metropolis should be given urgent consideration. Therefore, this study was carried out in order to examine the challenges in the existing pattern of intra-city traffic in Enugu metropolis with a view to proffering solution to traffic and transportation problems experienced in the study area. The importance of carrying out such a study draws from the fact that none of such study, had been carried out in Enugu state. Consequently, the outcome of the study will advance and contribute to measures towards formulating appropriate policy for enhancing intra-city travel in Enugu and other Nigerian cities.

The research faced a limitation of non-availability of the current demographic statistics and population of residents in Enugu urban, based on the fact that the no population census had been carried out in recent time. Nonetheless, the findings from the study proffers solution for policy makers and transportation experts to ensure that current transport planning in Enugu metropolis reflects all the essential preferences/requirements of commuters in the metropolis.

1.1 Context of the study

Enugu State is one of the states in the south-eastern part of Nigeria. It shares borders to the south with Abia State and Imo State, to the east with Ebonyi State, to the northeast with Benue State, to the northwest with Kogi State and to the west with Anambra. Enugu is the capital city of Enugu State which lies between latitude 06˚ 21˝ N and 06˚ 30˝ N and between longitude 07˚ 26˝ E and 07˚ 37˝ E. It is bounded in the East by Nkanu East Local Government Area, in the West by Udi Local Government Area, in the North by Enugu East Local Government Area and in the South by Nkanu West Local Government Area (see figure 1).



(a) (b)

Fig. 1 (a) Map of Nigeria Showing Enugu State and (b) Map of Enugu State Showing the study area

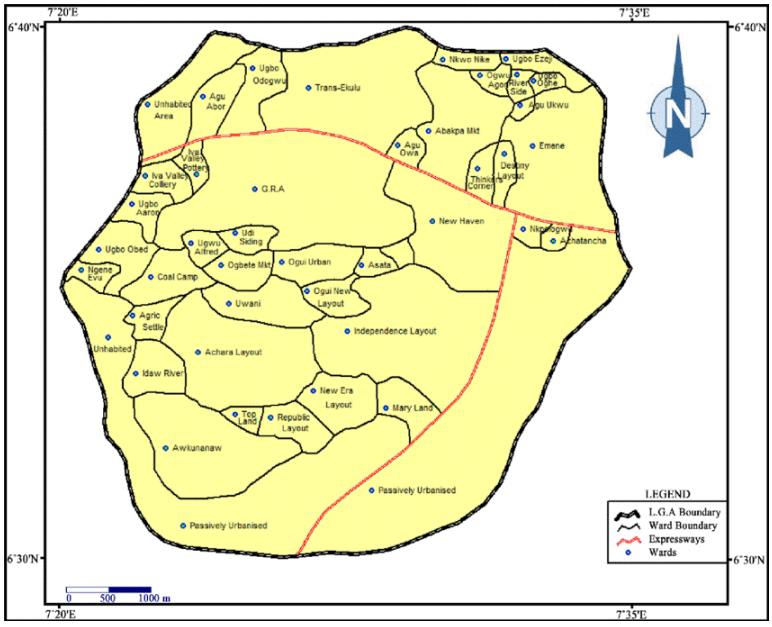


Fig. 2 Map of Enugu Metropolis (Study Area) showing the Neighbourhoods

Enugu metropolis is made up of three Local Governments areas namely Enugu East, Enugu South and Enugu North Local Governments (see figure 1). Dominantly populated by people of the Igbo ethnic group, it is a medium-size, but rapidly growing urban centre witnessing immense growth in the size of built-up areas, a number of immigrants, transportation and commercial activities (Okeke et al., 2019). It ranks 9th most populous city according to the 2006 Nigerian population census and covers a total area of 215m^2 (556 km2) with a population density of 3,400/sq mi (1,300/km^2). The increasing growth of the city is evident from the various population census figures from 1952 to 2006 and projected for 2018. It recorded a population of 62,764 in 1952; the 1991 Census puts the population figure of Enugu to be 462,514, accommodated in the residential layouts. The 2006 Census records the population of Enugu to be 722,664 (NPC 1991, 2006). The projected population of Enugu in 2018 is 1,064,983 with Abakpa and Maryland (neighbourhoods) having the highest and lowest population figures respectively.

Road transport is the chief means of transportation and as shown in Fig.2 above the city has only two major expressways and the main modes for intra-urban transportation in Enugu metropolis are private cars, coal city shuttles, buses, mini-buses, taxi/cabs and tricycles (keke NAPEP). Traffic data of Enugu metropolis reveals that private cars have the highest modal share (71%). This is followed in descending order by buses, taxis, tricycle, lorry, articulated vehicles and bicycles (18%, 9%, 1.4%, 0.9%, 0.2%, and 0.03% respectively). As the urban area have grown in population, it also have spread outward organically. Undeniably, the lack of land-use controls and effective planning has occasioned rampant sprawled developments extending rapidly in almost all directions and stretching far beyond old city boundaries. Increased number and length of trips for most resident is inevitable, causing growing reliance on motorized transport. Longer trip distances have also made walking and cycling less feasible, while increasing automobile traffic makes walking and cycling less safe. Consequently, high dependence on private cars as well as poorly developed alternative transport systems in Enugu metropolis is currently reported to have adverse effects on intra-city mobility in the metropolis in recent times. This scenario is believed to have encouraged informal transport services (such as the use of tricycles) to gradually become a dominant mode for intra-city travel in the metropolis since, commercial motorcycles (popularly called "okada") that once served as a public means of intra city transportation with the advantages of short travel time and convenience was placed on outright ban by the government from plying the road in 2012. Majority of the roads in the metropolis are mostly single lane with little or no sidewalks and has a gridlock road network inherited from the past colonial administration.

2. Literature review

2.1 Intra-city mobility pattern in Nigeria

Oladipo (2012) defined a city as an area or town inhabited by a large population of people while intra-city transportation involves the movement of goods and people within a city. He opined that intra-city transport is an integral element necessary for development in any rapidly urbanizing city. Haider and Badami, (2004) postulated that mobility is the backbone of the activity system of human race and observed that improved mobility or accessibility to employment, education, health and other urban services is necessary for enhanced welfare of the urban poor. This was further buttressed by Kumar, (2011) who posited that the key modes for mobility in a city include non-motorized (walk, bicycle) and motorized modes of transport. He revealed that the motorized modes include vehicles owned and operated by individuals for private use and those available to the public under public or private ownership.

Oyesiku and Odufuwa (2002) said that the situation of mobility in Nigeria is disheartening considering the fact that road movements accounts for about 90 percent of the movement of passengers and freight. Usually, the provision of intra city public transport is considered to be government's responsibility however, due to resources and weak management capacity government-provided intra city transport is inadequate and

dysfunctional. Informal public transit services owned and managed by private individuals or establishment have dominated the transport sector and exploiting the poor masses with higher fare rates. Similarly, Schintler (2001) revealed that a significant positive relationship has been found between intra-urban travel and psychological distress in various Nigerian cities. He adduced mobility distress in Nigerian cities to differences in gender mobility pattern, namely, journey-to-work trip, complexity of trip making, shorter work trip, making of domestic related trips, trips generated by substitution of home production to market production and females' preference for public transport as well as their conservative nature in selection of travel alternatives.
Kumar, (2011) attributed mobility stress in Nigerian cities to deficient basic infrastructure which he opined is usually characterized by insufficient quantity and quality of the road networks. He opined that roads were poorly managed, intersections were spaced closely together and ill-designed for turning. Also, commercial activities (such as street vendors) and parked vehicles force pedestrians off the sidewalks into the roadway thereby reducing the capacity of the roadway and posing safety hazards.

2.2 Challenges in existing intra-city traffic in Nigeria

Despite the significant role of transport in the life of city dweller or society, there are problems that affect this sector and have made its operations sluggish and disappointing. Hougendoorn and Bovy, (2001) and North County Times (2004) opined that traffic flow, traffic growth and congestion are some of the main economic and societal problems related to transportation in industrialized countries. These problems according to Ogunsanya, (2006) manifest in the form of environmental pollution, delay, accidents and land use severance amongst others. However, Pucher et al. (2005) noted that in developing countries much of the population is so poor that they cannot afford any means of motorized transport at all and must spend up to three or even four hours a day for travel. While the poor suffer the most from severe and worsening transport problems in cities, government policies generally focus on serving the needs of an elite minority. Although the nature and extent of intra urban transport challenges obviously vary from one country to another, virtually all developing countries are plagued with one or all of the following challenges as elicited by Pucher et al. (2005):

- Unplanned, haphazard development at the suburban fringe without adequate infrastructure, transport, and other public services;
- Limited network of roads, often narrow, poorly maintained, and unpaved;
- Extremely congested roads with an incompatible mix of both motorized and non-motorized vehicles traveling at widely different speeds;
- Rapidly increasing ownership and use of private cars and motorcycles;
- Inadequate roadway accommodations for buses and non-motorized transport;
- Primitive or non-existent traffic control and management, often without even the most basic street signage;
- Extremely high and rapidly rising traffic fatalities, especially among pedestrians and motorcyclists;
- Overcrowded, uncomfortable, undependable, slow, uncoordinated, inefficient, and dangerous public transport;
- Extremely high levels of transport-related pollution, noise and other environmental impacts, especially in large cities.

According to Ayeni (1983) these problems are some of the most pressing and perhaps most visible urban problems in Nigeria. He argued further that one of the most serious problems in the cities is "livability" which manifest itself inform of environmental deteriorations, overloading and congestion (Ayeni, 1992). While the average income citizen struggle with inadequate housing accommodation and transport, the poor are already disadvantaged. The limited supply of decent and affordable housing around the city centres forces a rising proportion of the middle class to reside in distant suburbs leading to long, exhausting commutes to daily

activities by either private automobile or slow, overcrowded public transport or dangerous motorcycles. Adefolalu (1993) observing the city of Lagos, stated that traffic congestion is the most serious and intractable transportation challenge. This explains why the transport sector in the city of Lagos is described as 'organized chaos' (Oni, 2002). In examining the causes of urban traffic congestion, Adefolalu (1993) attributed the causes to inadequate road infrastructure to accommodate the increasing number of vehicles and poor driving habits. Roadside and on-road parking, roadside trading and total disregard for traffic regulations by road users are significant human contributions to urban traffic congestion (Ibrahim–Adedeji, 2014). However, Ogunsanya (2006) study in Ilorin stated that traffic delays, congestion and parking problems are mere systems of malfunctioning urban traffic design.

Some of the other basic reasons advanced for urban traffic problems are route inadequacy, human misuse of available road infrastructure, poor traffic management, absence of effective traffic and transportation planning and the unprecedented surge in urban travel demand these urban traffic problem is believed to induce stress, some level of discomfort and affect the psychological health of many commuters during and after daily trips. Observing the effect of traffic congestion on the environment, Ogunsanya (2006) argues that automobiles emit pollutants into the urban environment. Its effect on the health of people, community values and environs ecology, to say the least, are deplorable.

3. Research methodology

The study employed a cross-sectional survey design aimed at determining the challenges in the existing pattern of intra-city traffic in Enugu metropolis. Disaggregate data for this study was obtained from transportation survey (questionnaire) conducted by the authors in 2018. The survey was structured in such a way that the researchers can easily achieve the objectives of the study. The questionnaire had 2 sections; A and B. Section "A" contained 6 items eliciting socio-demographic information while Section "B" contained 5 items eliciting information on challenges of intra-urban traffic in Enugu metropolis. Considering the fact that majority of the commuters in Enugu metropolis speak English, the questionnaire was designed in English language.

The study identified three study groups for investigation from the different residential densities that categorize residential areas in Enugu metropolis, namely, the high, medium and low residential density areas. From the eighteen neighbourhoods that make up the study area, the researchers randomly selected 3 neighbourhoods from the high density residential area, 2 neighbourhoods from the medium density residential area and 1 neighbourhood from the low residential density using a combination of stratified and simple random sampling technique. Specifically, this was done by dividing the study area into three different strata representing the residential densities from which households were randomly selected without replacement in order to ensure a proportionate representation of the densities. The randomly selected neighbourhoods were Abakpa, Gariki and Ogbete (high density), New haven and Uwani (medium density) and Trans-Ekulu (low density). The population of residents that make up the randomly selected neighbourhoods was given as 418,122.

Neighbourhoods	Density	1991 Population Figure	2006 Population Figure	2018 Projected Population
Abakpa	High	90,619	126,232	190,998
Ogbete	High	25,994	36,209	54,789
Gariki	High	19,662	27,389	41,442
Uwani	Medium	31,875	44,401	67,183
New haven	Medium	18,753	26,123	39,526
Trans Ekulu	low	11,474	15,983	24,184
Total		**198,377**	**276,337**	**418,122**

Tab.1 Selected Sample Neighbourhoods and their Population (Source: National Population Commission, 2006 projected to 2018 by researchers).

This was arrived at by projecting the 2006 Nigerian population census figure to 2018 using the Thomas Malthus exponential model (NPC, 2006) because no other official national census has been conducted in Nigeria since 2006. This is shown in Tab.1.

In determining the sample size that was adequate for the study, the Taro Yamane (1967) model was used. The formula is stated thus:

$$n = \frac{N}{1 + N*(e^2)}$$

Where:

n = required sample size

N = the whole population under study

e = the level of precision or sample error i.e., 0.05.

Applying this formula with 418,122 as the population of the study (Enugu metropolis), we have

$$n = \frac{418,122}{1 + 418,122*(0.05^2)}$$

$$n = \frac{418,122}{1046}$$

$$n = 400$$

Thus, a total of 400 respondents (members of households who were within the ages of 18 years and above) were involved in the study. In addition, the researcher also used proportionate allocation strategy to get the sample size for each of the neighbourhoods using their various household sizes. The formula that was used is stated thus:

Sample size of the neighbourhood = percentage of neighbourhood's household population multiplied by the total sample size for the study

For instance, the sample size for Abakpa is expressed as 46% of 400 which gives 184 respondents. Further details in shown in Tab.2.

Neighbourhoods	2018 Projected Population	Household Population	Percentage %	Sample Size
Abakpa	190,998	31,833	46	184
Ogbete	54,789	9,132	13	52
Gariki	41,442	6,907	10	40
Uwani	67,183	11,197	16	64
New haven	39,526	6,588	9	36
Trans Ekulu	24,184	4,031	6	24
Total	**418,122**	**69,687**	**100**	**400**

Tab.2 The Sampled Neighbourhoods and Sampled Sizes (Source: Researcher's Survey, 2018)

In analysis, the data collected was subjected to descriptive and inferential statistics. Specifically, correlation model was used for the analysis at 0.05 level of significance with the aid of Statistical Package for Social Sciences (SPSS) version 23. Correlation model was used to ascertain if there was a significant relationship between the various residential densities in Enugu metropolis and the challenges in intra-city traffic pattern in Enugu metropolis.

4. Results and analysis

Neighbourhoods	No of questionnaires	Successfully filled	Incomplete	Response rate
Abakpa	184	174	10	94.6
Ogbete	52	50	2	96.2
Gariki	40	38	2	95.0
New haven	36	34	2	94.4
Uwani	64	60	4	93.8
Trans Ekulu	24	24	-	100
Total	**400**	**380**	**20**	**95.0**

Tab.3 The Response rate in each of the Sampled Neighbourhoods (Source: Field Survey, 2018)

From Table 3, it is observed that Trans Ekulu had a 100% response rate unlike other neighbourhoods in Enugu metropolis. Perhaps, this could be adduced to the more superior educational status of the respondents in this neighbourhood (when compared to other neighbourhoods). Similarly, it could be based on the stance that the number of questionnaires that was allocated to Trans Ekulu was relatively smaller. However, other neighbourhoods also reported an encouraging response rate. Generally, the findings indicate that the response rate of the respondents was highly encouraging as 95% success was achieved.

4.1 Personal data and socio-economic characteristics of the respondents

Characteristics	Frequency	Percent (%)
Gender		
Male	195	51.3
Female	185	48.7
Age Groups (years)		
20 years and below	54	14.2
21 – 40 years	227	59.6
31 – 60 years	97	25.5
> 60 years	2	0.5
Mean ± SD (years)	33.4 ± 8.6	
Marital Status		
Single	199	52.4
Married	163	42.9
Widowed/Divorced/separated	18	4.7
Level of Education		
Primary school	24	6.3
Secondary school	80	21.0
OND/NCE	117	30.8
HND/B.Sc	98	25.8
Post-tertiary	61	16.1
Occupation		
Civil servant	86	22.6

Business person/ Self-employed/ Trader	100	26.3
Private employed	63	16.6
Unemployed	35	9.2
Student	96	25.3
Monthly income (N)		
Below N 10,000	24	6.3
N 10,001 - N 20,000	68	17.9
N 20,001- N 30,000	91	23.9
N 30,001 – N 40,000	63	16.6
N 40,001 - N 50,000	39	10.3
Above N50,000	95	25.0
Mean ± SD (income)	32,224 ± 13,940	

Tab.4 Socio-demographic characteristics of respondents (n = 380) (Source: Field Survey, 2018)

Tab.4 above shows the socio-demographic characteristics of the respondents. A little More than half (51.3%) were males and 48.7% female showing almost equal representation of gender in the investigation while their mean age was 33.4 (± 8.6) years indicating that respondent were adults, matured enough to give valid responses. More than half (59.6%) were within the ages of 21 – 40 years while 52.4% were singles. Majority of the respondents had one form of formal education and therefore were considered literates. Also, their major occupation was business/trading (26.3%) and civil servants (22.6%) while their average monthly income was 32,224 (± 13,940) Naira.

4.2 Commuters' perception and the challenges of intra-urban traffic in the city

This section presents data focused on the commuters' perception as well as the challenges in the existing pattern of intra-city traffic in Enugu metropolis.

Options	**Neighbourhoods**						**Total**	**percentage %**
	Abakpa	Gariki	Ogbete	New haven	Uwani	Trans Ekulu		
Daily	174	38	50	34	60	24	380	100
Thrice a week	-	-	-	-	-	-	-	-
Weekly	-	-	-	-	-	-	-	-
Fortnightly	-	-	-	-	-	-	-	-
Occasionally	-	-	-	-	-	-	-	-
Total	**174**	**38**	**50**	**34**	**60**	**24**	**380**	**100**

Tab.5a Frequency of Trips within Enugu Metropolis (Source: Field Survey, 2018)

Tab.5a shows the frequency of trips that commuters undertake in Enugu metropolis. It revealed that all the respondents in each of the selected neighbourhoods stated that they made trips daily within Enugu metropolis to reach for desired goods and services. The purpose for making the intra-urban travel was investigated and presented in table 5b below.

Tab.5b revealed the trip purpose of commuters in Enugu metropolis. It shows that 94 respondents (representing 24.7%) stated that the major trips that they made within Enugu metropolis was work trips, 74 respondents (representing 19.5%) stated that the major trips that they made within Enugu metropolis was school trips, 43 respondents (representing 11.3%) stated that the major trips that they made within Enugu

metropolis was social trips, 44 respondents (representing 11.6%) stated that the major trips that they made within Enugu metropolis was religious trips, 110 respondents (representing 28.9%) stated that the major trips that they made within Enugu metropolis was commercial trips while 15 respondents (representing 3.9%) stated that the major trips that they made within Enugu metropolis were not included in the afore-mentioned categories (e.g. recreational trips). This means that the major trips made in Enugu metropolis were commercial, work and school trips. Their travel mode was also investigated and presented below in the figure below.

Options	**Neighbourhoods**						**Total**	**percentage %**
	Abakpa	Gariki	Ogbete	New haven	Uwani	Trans Ekulu		
Work trips	41	10	14	5	18	6	94	24.7
School trips	36	10	8	6	10	4	74	19.5
Social trips	11	5	5	8	9	5	43	11.3
Religious trips	18	5	2	5	11	3	44	11.6
Commercial trips	60	6	21	5	12	6	110	28.9
Others	8	2	-	5	-	-	15	3.9
Total	**174**	**38**	**50**	**34**	**60**	**24**	**380**	**100**

Tab.5b Reason for Trips Made by the Respondents (Source: Field Survey, 2018)

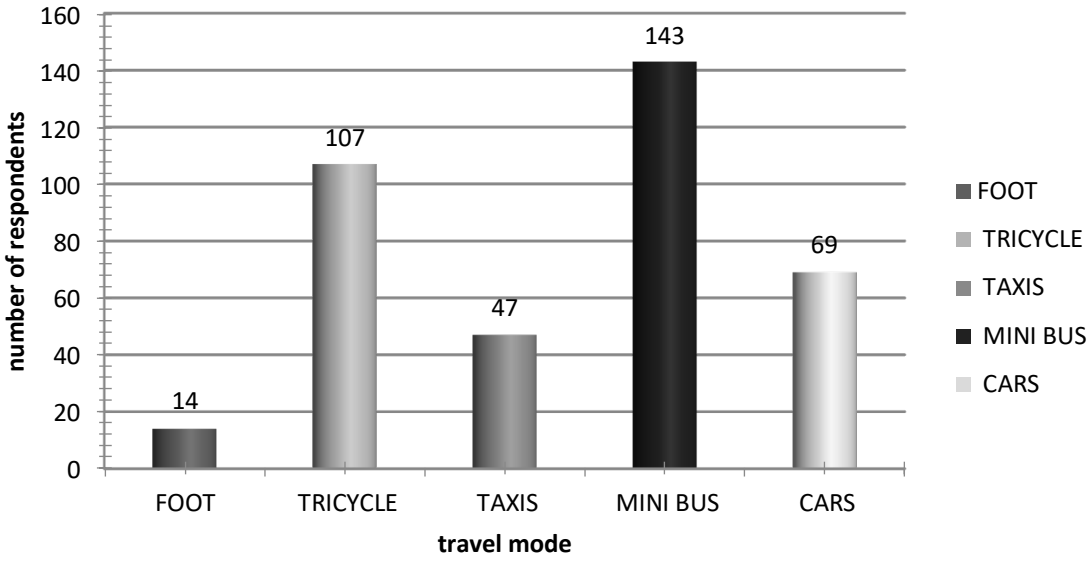


Fig. 3 Travel Mode used for Trips by the Respondents

Figure 3 revealed the travel mode used by commuters for trips within Enugu metropolis. It shows that 14 respondents (representing 3.7%) stated that the travel mode that they used predominantly was foot, 107 respondents (representing 28.2%) stated that the travel mode that they used predominantly was tricycle, 47 respondents (representing 12.4%) stated that the travel mode that they used predominantly was taxis, 143 respondents (representing 37.6%) stated that the travel mode that they used predominantly was mini bus while 69 respondents (representing 18.2%) stated that the travel mode that they used predominantly was

private cars. This means that the predominant travel mode used for intra-city mobility in Enugu metropolis was mini-bus and tricycle.

Options	**Neighbourhoods**						**Total**	**percentage %**
	Abakpa	Gariki	Ogbete	New haven	Uwani	Trans Ekulu		
Excellent	-	-	-	10	19	3	32	8.4
Good	90	30	45	20	31	18	234	61.6
Fair	57	8	5	4	10	3	87	22.9
Poor	27	-	-	-	-	-	27	7.1
Very poor	-	-	-	-	-	-	-	-
Total	**174**	**38**	**50**	**34**	**60**	**24**	**380**	**100**

Tab.6 State of Road Infrastructure in Enugu Urban (Source: Field Survey, 2018)

Table 6 reveals respondents' perception of the state of road infrastructure in Enugu metropolis. It showed that 32 respondents (representing 8.4%) stated that the roads within Enugu metropolis was in an excellent condition, 234 respondents (representing 61.6%) stated that the roads within Enugu metropolis was in a good condition, 87 respondents (representing 22.9%) stated that the roads within Enugu metropolis was in a fair condition while 27 respondents (representing 7.1%) stated that the roads within Enugu metropolis was in a poor condition. This means that majority of the roads in Enugu urban are in good condition.

Options	**Neighbourhoods**						**Total**	**percentage %**
	Abakpa	Gariki	Ogbete	New haven	Uwani	Trans Ekulu		
Strongly agree	52	8	11	7	15	6	99	26.1
Agree	61	10	23	4	14	3	115	30.3
Indifferent	6	4	6	3	4	1	24	6.3
Disagree	24	6	8	17	12	7	74	19.5
Strongly disagree	31	10	2	3	15	7	68	17.9
Total	**174**	**38**	**50**	**34**	**60**	**24**	**380**	**100**

Tab.7 Respondents' Perception on Stress during Trips (Source: Field Survey, 2018)

Tab.7 showed respondents' perception on mobility stress in Enugu metropolis. It revealed that 99 respondents (representing 26.1%) strongly agreed that stress during trips was a challenge of intra-city mobility in Enugu metropolis, 115 respondents (representing 30.3%) agreed that stress during trips was a challenge of intra-city mobility in Enugu metropolis, 74 respondents (representing 19.5%) disagreed that stress during trips was a challenge of intra-city mobility in Enugu metropolis while 68 respondents (representing 17.9%) strongly disagreed that stress during trips was a challenge of intra-city mobility in Enugu metropolis. This means that stress during trips was a challenge of intra-city trips within Enugu metropolis.

Tab.8 shows the major impediment facing commuters' in their daily travel in Enugu metropolis. It revealed that 170 respondents (representing 44.7%) stated that traffic hold ups was a major impediment to free flow traffic in Enugu metropolis, 51 respondents (representing 13.4%) stated that bad roads was a major

impediment to free flow traffic in Enugu metropolis, 34 respondents (representing 8.9%) stated that high transport costs was a major impediment to free flow traffic in Enugu metropolis, 45 respondents (representing 11.8%) stated that 'dropping and picking passengers' was a major impediment to free flow traffic in Enugu metropolis while 76 respondents (representing 20%) stated that narrowness of roads was a major impediment to free flow traffic in Enugu metropolis.

Options	**Neighbourhoods**						**Total**	**percentage %**
	Abakpa	Gariki	Ogbete	New haven	Uwani	Trans Ekulu		
Traffic hold ups	53	18	21	26	38	14	170	44.7
Bad roads	41	5	5	-	-	-	51	13.4
High transport costs	12	2	4	6	10	-	34	8.9
Dropping & picking passengers	18	7	6	2	12	-	45	11.8
Narrowness of roads	46	6	14	-	-	10	76	20.0
Few roads	4	-	-	-	-	-	4	1.1
None	-	-	-	-	-	-	-	-
Total	**174**	**38**	**50**	**34**	**60**	**24**	**380**	**100**

Tab.8 Major Impediments to Free Flow Traffic (Source: Field Survey, 2018)

This means that the major impediments to free flow of traffic within Enugu metropolis were traffic hold ups and narrowness of roads. Furthermore, major transport challenge experience in the study area were highlighted and the perception of inhabitant investigated and shown in the figure below.

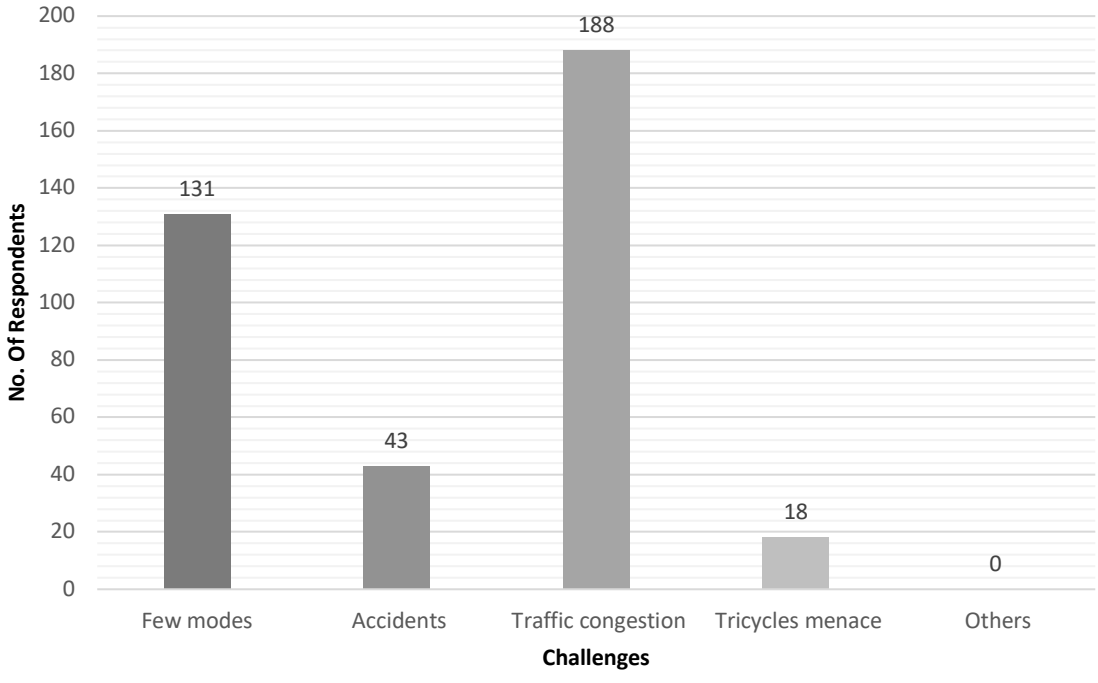


Fig. 4 Respondents' Perception on Major Transport Challenges

Fig.4 reveals respondents' perception to transport challenges in Enugu metropolis. It revealed that 131 respondents (representing 34.5%) stated that few public transport was a major challenge of transportation in Enugu metropolis, 43 respondents (representing 11.3%) stated that vehicular accidents was a major challenge of transportation in Enugu metropolis, 188 respondents (representing 49.5%) stated that traffic congestion was a major challenge of transportation in Enugu metropolis while 18 respondents (representing 4.7%) stated that menace of tricycles operators was a major challenge of transportation in Enugu metropolis. This means that the major challenges of transportation in Enugu urban were traffic congestion and fewer modes of public transport.

4.3 Test of hypothesis

H_0: There is no significant relationship between the various residential densities in Enugu metropolis and the challenges in intra-city traffic pattern in Enugu metropolis.

T_0 test the hypothesis, the responses to questions bordering on the location of respondents as well as their perception on intra-urban transport challenge were used. The result was presented in Tab.9.

		Location	**Transport challenges**
Location	Pearson Correlation	1	0.138**
	Sig. (2-tailed)		0.007
	N	380	380
Transport challenges	Pearson Correlation	0.138**	1
	Sig. (2-tailed)	0.007	
	N	380	380

** Correlation is significant at the 0.05 level (1-tailed).

Tab.9 Correlation Test (Source: Researcher's SPSS Analysis, 2018)

The result of the Pearson Product Moment Correlation shows that there was a statistically significant relationship between the various residential densities in Enugu metropolis and the residents' perception of the challenges in intra-city traffic pattern (i.e. $p < 0.05$ at 0.05 significance level). It also indicates that the relationship between the respondents' location and their perception was positive. Also, it indicates that the strength of relationship between the residential density and perception of challenges in intra-city traffic pattern was weak ($R = 0.676$).

In addition, the coefficient of determination (R^2) which explains the variance explained between residential densities in Enugu metropolis and residents' perception of the challenges in intra-city traffic pattern indicates 0.02% percent shared variance. This implies that the residents' neighbourhoods influence their perception of the challenges in intra-city traffic pattern in Enugu metropolis by 0.02%. This is quite a little amount of variance explained.

5. Discussion

From the findings of the study, it was reported that residents of Enugu metropolis make daily intra-urban trips with the primary purpose being to access goods and desired services regardless of the day of the week. Interestingly, this finding suggests that residents in Enugu metropolis, regardless of their residential neighbourhood, make trips ranging from work trips, school trips, recreational trips, religious trips, etc. At Abakpa, the predominant trips made by residents were commercial trips and work trips (34.4% and 23.6% respectively). At Gariki, the predominant trips were work and school trips (26.3% each). At Ogbete, the predominant trips were commercial and work trips (42% and 28% respectively). At New haven, the

predominant trips were commercial and work trips (23.5% and 17.6% respectively). At Uwani, the predominant trips were work and commercial trips (30% and 20% respectively) while at Trans Ekulu, the predominant trips were commercial and work trips (25% each). Impliedly, the major trip purpose of residents in high density residential area in Enugu metropolis were commercial trips, work trips and school trips while the major trip purpose of residents in medium density residential areas in Enugu metropolis were commercial and work trips. The same applies for commuters residing in low density residential area in Enugu metropolis whose major trip purpose were work and commercial trips. Having commercial, work and school trips as the major trip purpose in Enugu metropolis, corroborated the results in Tab.4 that the occupation of most residents are businessmen/trading or civil servants who work for the government and other establishments.

It can be deduced from the finding that the trip purpose in Enugu metropolis across the neighbourhoods was similar apart from those in the high density area which varied a little. This finding can be supported with the result on Table 9 which showed that the residential neighbourhood of residents in Enugu metropolis was found to only influence their intra-urban trip pattern by 0.02% ($R = 0.138$, $P = 0.007$). These findings agree with the assertion of Okeke et al., (2020) who said that transportation is the hallmark of every city growth and development, the artery to which all land uses are accessed and the requisite for mobility. Unlike, other countries in East Africa and Kingdom of Saudi Arabia where due to cultural and religious beliefs intra-urban trips has limit for the female gender (Tesoriere & Errigo, 2018), in Enugu (the study area) there is no such restrictions as everybody have equal right to movement and free to use any means of transportation readily available. However travel behaviour is equally affected by other socio-economic and socio-demographic factors. (Stamos et al., 2015)

Generally, it can be deduced that the major travel mode in Enugu metropolis for intra-urban travel was mini-buses (37.6%). This was followed by use of tricycles (28.2%), private cars (18.2%), taxis (12.4%) and use of foot (3.7%). This can be attributed to the fact that travel modes are under the influence of infrastructures and facilities which are fragments of availability factors. Although the prevailing intra urban travel mode in the city of Enugu varies with that of other developed cities like Jakarta, Verde, Guatemala, Dublin, Auckland etc. Possible reasons could be adduced to the low socio-economic status of majority of residents in Enugu metropolis with majority reported to be earning an average of 32,224 (± 13,940) Naira/month and also non availability of other forms of non-motorized transportation modes. The findings confirm part of the postulations of study of Koushki (1987), which focused on the effects of socio-economic traits such as family size, family income, employment and car ownership utilized as the explanatory variables in transportation choice. Furthermore the above findings is in-line with the study of Adeel, (2018) who revealed that majority of urban transport demand in Pakistan is catered by privately owned fleet of buses and minivans which are often despised by the users for their poor quality service and lack of coverage. In view of the scenario, personal automobile based mobility provides an ideal choice for the urban commuters (Haider & Badami, 2004).

The study also revealed that commuters within Enugu urban undergo stress during their trips regardless of the good roads within the metropolis. According to Odofuwa, (2006), the high rate of mobility distress in Enugu metropolis is also complicated by the non-standardized ergonomic design of most intra-city buses and taxis. Their seat sizes, height and spacing results in excessively cramped travel condition responsible for sitting, standing and aisles passing discomfort among commuters. This situation, according to Filani, (2002) is becoming more and more acute in Enugu metropolis. Little wonder, informal transport services (such as the use of tricycles) have become a dominant mode for intra-city travel in Enugu metropolis. Tricycle and mini buses have become the predominate intra-urban travel mode within the neighbourhood (see figure 3) because just like the commercial motorcycles (popular called Okada) that offers comfort and short trip time for commuters, tricycles and minibuses are considered as a replacement and offer almost the same advantages. This view is corroborated by Moeinaddini et al., (2012) who believed that urban public transport usage is under the influence of convenience, safety and security. Subsequently, Kumar (2011) has a different perspective on

the mobility stress in Enugu metropolis and attributes it to deficient infrastructure characterized by insufficient quantity and quality of roads. However, in situations where the roads are sufficient, a part of it is usually taken up by pedestrians, street vendors and parked vehicles. Moreover, facilities for pedestrians and cyclists are becoming extinct, thus forcing them to share crowded rights of way with rapidly moving automobile.

It was also discovered from the study as seen in table 8, that the major impediments to free traffic flow in Enugu urban was traffic congestion during peak hours as well as narrowness of most roads in the city. This finding could be adduced to the issue of near-side parking that is seen on most roads in Enugu urban. This challenge is worsened by the fact that most roads in Enugu are relatively narrow as seen in areas like Ogbete, New layout, Gariki, etc. This finding agrees with that of Adefolalu, (1993) who opined that traffic flow and traffic congestion are the main societal problems related to transportation in developing countries. Furthermore, commuters stated that the major transport challenges that characterizes intra-city mobility in Enugu urban are traffic congestion and few modes of public transport. This is in line with the studies of Okeke et al., (2020) who said that traffic congestion is viewed as the principal urban transportation problem in recent time in Mayor, Amechi, Amuokwe, Gariki and Ogbete market areas and traffic congestion emerged as the foremost justification for large-scale road construction in Enugu urban.

Moreover, the challenge of few modes for public transport could be explained by the fact that the most predominant modes are mini-buses, taxis and tricycles and this agrees with the finding of Solanke, (2013) that majority of the urban populace depend on public transport for their mobility needs dominated by the private sector operating such vehicles as taxi; para-transit mini buses, fare paying passenger carrying private cars (also known as 'kabu kabu'), motorcycles (two wheel) and three-wheeled motorcycles operated in most urban centres. From all indication, these automobiles are designed to convey at least 1–12 commuters. Other mode of non-motorized transport or public transit infrastructure are non-existent putting pressure on the insufficient and unsustainable means of mobility. City Planners are sometimes oblivious of the fact that the development and expansion of roads to reduce congestion and/or increase traffic speeds would promote increased use of automobile (Okeke et al., 2020). This situation could be improved if coal city shuttles are revived for intra-city mobility in Enugu urban. This view is supported by Rahman, (2004) who posited that improvement in public transportation as well as in traffic management is a pivotal way of reducing the effects of traffic congestion in Nigerian cities.

6. Conclusions and recommendation

In line with the aim of this research which is to investigate the challenges in the existing pattern of intra-city traffic in Enugu metropolis, the findings of this research have identified three key issues:

- The major travel mode within Enugu urban is mini buses and tricycles due to the fact that these modes are the most readily available modes for public transportation in Enugu urban. The use of tricycle is traceable to the flexibility that the mode provides when compared to other modes;
- Commuters within Enugu urban undergo stress during their trips regardless of the good condition of roads within the metropolis;
- The challenges to existing pattern of free traffic flow in Enugu urban is traffic congestion during peak hours and narrowness of most roads in within the city.

The implication of these challenges is that it has the tendency to hinder rapid economic growth, urban development and may infuse traits of city fragility if not adequately addressed. The following are recommendation from the study.

- The re-introduction of Non-motorized transport mode of walking and cycling with adequate provision of Pedestrian walkway on streets, in public squares and traffic-free shopping streets be adopted and implemented. This is because walking and cycling is a form a physical exercise that promotes good health while reducing demand for mini buses and tricycles;

- Urban transportation policies, which emphasize accessibility i.e. reducing the need for much travel should be pursued. Such policies relate to land use planning and the decentralization of activity within the metropolis needs to be implemented;
- Coal city public transit shuttles that once existed should be revived to complement the existing public transport system. These would help to ensure that the modes of transportation address the determinants of intra-city mobility such as, affordable transport price, safety of passengers on board, environmental pollution, traffic congestion, time wasting etc.

The study has highlighted the challenges in the existing pattern of intra-city traffic in Enugu metropolis, recommendations have been proposed. However, different aspects of this line of research needs to be investigated. It is suggested that further detailed study on the determinants of intra-urban mobility in Nigeria be conducted.

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IMAGE SOURCES

Fig. 1: Map of Nigeria Showing Enugu State; Map of Enugu State Showing the study area - Authors.

Fig. 2: Map of Enugu Metropolis (Study Area) showing the Neighbourhoods -Google Earth Imaging, 2018

Fig. 3: Map of Enugu Metropolis (Study Area) showing the Neighbourhoods - Authors field survey, 2018

Fig. 4: Respondents' Perception on Major Transport Challenges – Authors field survey, 2018.

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