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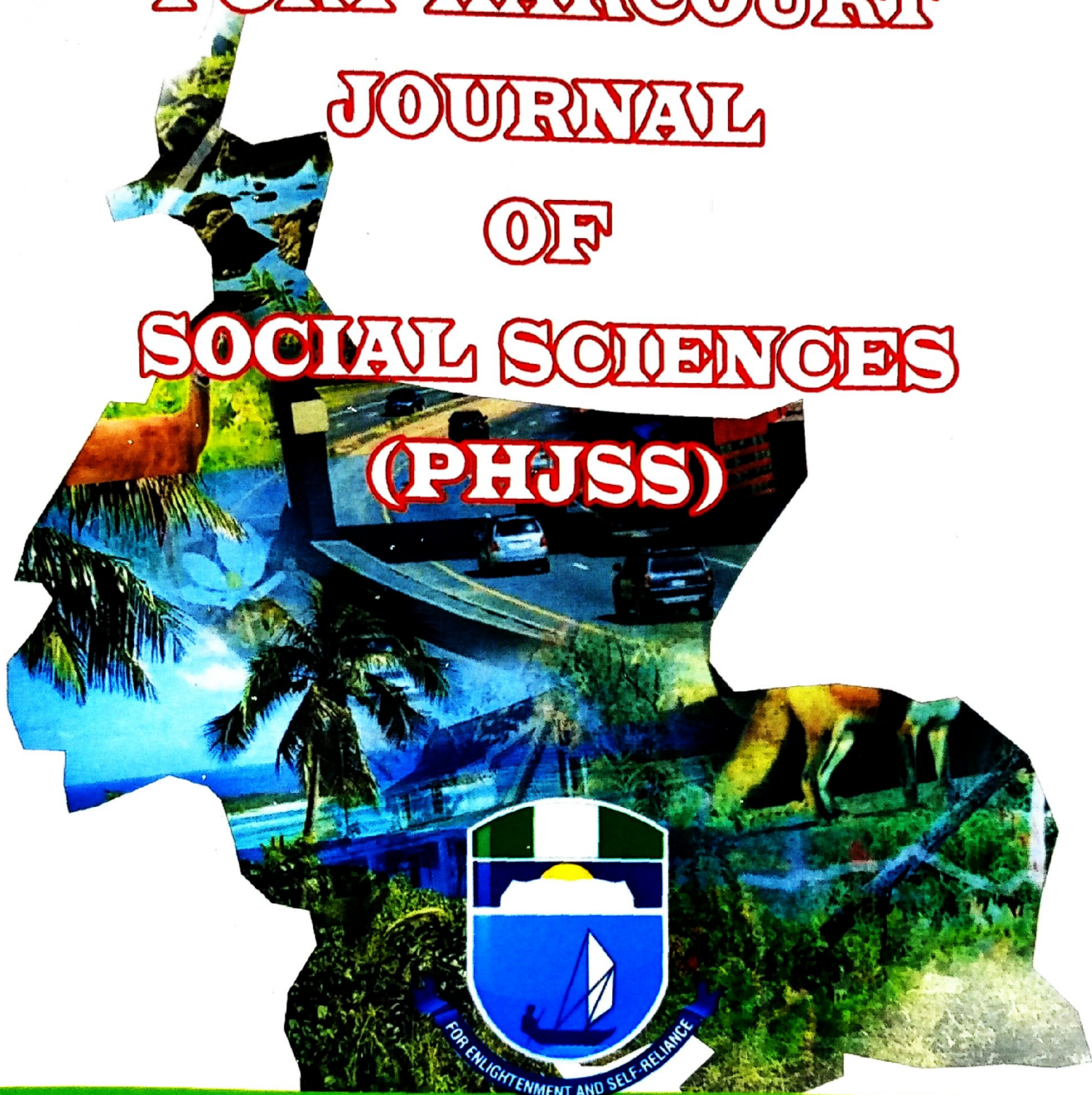
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Public Transport Affordability of Households in Metropolitan Lagos, Nigeria

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Abstract

This paper assessed the affordability level of public transportation in Metropolitan Lagos, Nigeria. Data were collected on household travel characteristics and behavior using stratified sampling and stated preference methods. The data collected were used to calculate the public transport affordability index of households in Metropolitan Lagos, while the 't' test was carried out to test the level of variation that exist between Lagos transport affordability and international benchmark. The results show that public transport affordability index ranges from 2.2% to 18.7%, it varies among different income groups and differs also from one location to another within the Metropolis. A Student T- test was also used to show whether the public transport affordability level in Lagos is in conformity with global standards. It was revealed that the transport affordability level is higher than the global index, because high percentage of commuter incomes was spent on public transportation. The paper therefore recommends that Lagos State Government should improve work places accessibility to reduce commuting cost to work.
Keywords: Affordability Index, Public Transport, Commuting, Metropolitan, Cost

1.0 Introduction

One important element in the process of public transport policy formulation and implementation is transport affordability, which refers to the easiness or difficulty at which people are able to pay for transportation services in order to access basic social and economic centres such as healthcare, shopping, school, work and other social activities (Litman, 2015). Carruther, et al (2005) submitted that affordability refers, to the extent to which the financial cost of journeys put an individual or household in the position of having to make sacrifices to travel or the extent to which they can afford to travel when they want to. They explained further that affordability can be considered as the ability to make necessary journeys to works, school, health and other social services and make visit to other family members or other urgent journeys without having to curtail other essential activities. Transportation affordability is conventionally measured by affordability index (AI), which tries to measure the relationship between the cost of commuting to work and worker income. In the recent times, there has been considerable interest in the relationship between poverty and transport among international development agencies. Incorporating poverty alleviation and pro-poor elements in transport project design has become an important criterion for lending by Multilateral Banks (Gannon and Liu, 1997; World Bank, 2005).

Affordability refers to the degree to which the financial cost of journeys puts an individual or household in the position of having to make sacrifices to travel or the extent to which they can afford to travel whenever they want to. While a low income family might be able to afford the necessary journeys to work for the income earners of the family, they might not be able to afford trips to school for their teenage children, or for their children to visit a grandparent in hospital. For such a family, urban transport would, by most standards, be considered unaffordable. Therefore, affordability can be considered as the ability to make necessary journeys to work, school, health and other social services, and make visits to other family members or urgent other journeys without having to curtail other essential activities (Carruthers, Dick and Saurkar, 2005). Many experts define affordability as households being able spend less than 35% of their budgets on housing (including rents or mortgages, property taxes, insurance and basic utilities), 20% of their budgets on transport, or less than 45% on transport and housing combined, in recognition that households often make trade-offs between these costs and overall affordability does not really increase if affordable transportation requires unaffordable housing, or vice versa (CTOD and CNT, 2006).

Gomez (2007) and Litman (2015) observed that most studies on poverty and transport estimate the percentage of monthly income or expenditure used in transport by poor families. Affordability is a critical equity objective, since it affects the cost burdens and opportunities available to disadvantaged people like low income group. They further stated that in modern industrialized economy, the portion of household budget devoted to transportation typically varies from 1 to 20%, depending on various factor including employment, income, car ownership, availability and efficiency of public transport system. The lower income households tend to spend less in total but more as a proportion of income than higher income households.

Determining the transport affordability of residents of metropolitan Lagos is an important input to required for transport policy formulation and implementation in Lagos Mega City. Armstrong-Wright and Thiriez (1987) considered that there is an affordability problem with public transport when more than 10 percent of households spend more than 15 percent of their income on work related commuting. According to Venter and Behrens (2005) the South African Government has established a 10 percent of income as a policy benchmark. Another useful policy direction guide on appropriate commuting affordability level is to review the outcomes of affordability studies that have been carried out for different cities in the world. For example, Carruthers, et al (2005) observed that each of the studies on public transport has taken its own perspective on which income measure to use (income or expenditure based, individual or household income, gross or disposable income etc.) and on which fare measure to use (actual expenditure in most cases but theoretical or average expenditure in others). The authors further noted that these differences make it difficult to compare the results between cities and that there was least documentation on affordability level in Africa Continents.

Understanding the intricacies of public transport affordability to workers and the implication of this on cost of living particularly in the developing countries is a great concern to transport planners and therefore deserves detailed studies. This paper therefore attempts to assess the level of affordability of public transport modes used by workers for commuting in Lagos Metropolitan City with a view to examining the effect of socio-economic characteristics of workers on their commuting time; and investigating the significant difference in the average transportation affordability index between Lagos Metropolis and global standard index.

.2.0 Methodology
The Study Area

Lagos State lies within latitude of 6° 23' N and 6° 41' N and longitude 30° 9'E and 3° 28' E Nigeria. It lies in the South Western part of Nigeria on the West coast of Africa. It is bounded in the North and East by Ogun State, in the West by Republic of Benin and in the South by Atlantic Ocean. The metropolitan Lagos constitutes about 2.5% of Nigeria's total land area of about 923,760km². The Lagos metropolitan as it exists today can be subdivided into Mainland and Island. Most of the population and industries of Lagos lies on the mainland. Lagos Mainland districts include Ebutemetta, Surulere, Yaba and Ikeja. The greater Lagos includes Mushin, Maryland, Somolu, Oshodi, Oworonsoki, Isolo, Ikotun, Agege, Iju Ishaga, Egbeda, Ketu, Bariga, Ipaja, Ajah and Ejigbo. The city of Lagos is the main city of the south-western part of Nigeria. The two major urban Islands of Lagos are Lagos Island and Victoria Island. These two Islands are separated from the mainland by the main channel draining the Lagoon into the Atlantic Ocean which form, Lagos Harbour. The islands are separated from each other by creeks of varying sizes and are connected to Lagos mainland by bridges.

The Metropolitan Lagos covers over 16 of the 20 Local Government Areas (LGAs) namely: Agege, Ajeromi-Ifelodun, Alimosho, Amuwo-odofin, Apapa, Eti-Osa and Ifako-Ijaye. Others are Ikeja, Kosofe, Lagos Island, Lagos Mainland, Mushin, Ojo, Oshodi-Isolo, Somolu and Surulere. The Metropolitan Lagos contains 88% of the population of Lagos State and includes some semi-rural areas (Adalemo, 1981). The 2006 National Population Census of Nigeria put the population of the metropolitan area of Lagos 7,937,932. Figure 1 shows the metropolitan area of Lagos.
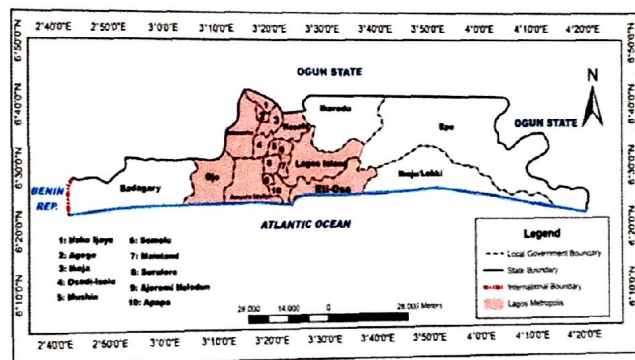
Figure 1. Metropolitan Lagos

Lagos has one of the largest and most extensive road networks in West Africa. It also has suburban trains and some ferry services. Lagos is naturally endowed with creeks, lagoon and navigable water bodies that are suitable for urban transit service. The rail line runs, longitudinally along the south-north axis of the metropolis. Highways are usually congested in peak hours, due in part to the geography of the city, as well as to its explosive population growth. Taiwo (2005) noted that there are about 2,600km of roads in Lagos that are usually congested with over five million people plying them daily. Oni (2004), observes that Lagos State has the potential to benefit from a seamless multi-modal transportation system. But in spite of this, road transportation dominates more than 90% of intra-urban movement in Lagos State. Figure 2 shows the transport network of metropolitan Lagos.
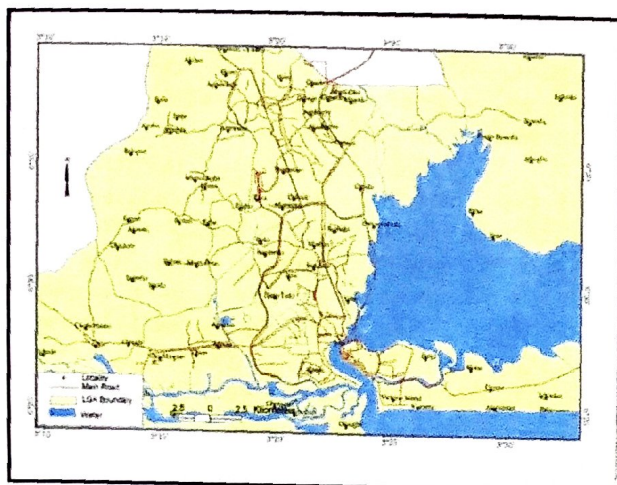
Figure 2. Transport network of Metropolitan Lagos

The economic dominance of Lagos in Nigeria's foreign trade remained at about 70% in 1967 and further rose to 90% during and after the Nigerian civil war in 1970 (Badejo, 1990). Lagos port handles about 80% of the total value of imports. Lagos is Nigeria's economic focal point generating a big significant portion of the country GDP. The geographical location of Lagos State as a coastal state is a major selling point which makes international trade easy. Lagos port handles substantial volume of about 60% of the trading activities of the port across the country. The 180km coastline of Lagos presents enormous opportunities for tourism. As a major financial centre of the country, Lagos provides infrastructure and access not only to financial services that international business depend upon but also the leisure that the international operators will need. The Metropolis has numerous industrial zones which include Ikeja, Apapa, Opebi, Ilupeju, Ogba, Matori and Oregun housing multi-national, large, medium and small scale industries.

This study collected data on the household socio-economic attributes such as income, wages, household size, age structure, car ownership and occupational types. The second category of data collected was trip behavior and characteristics which include modal choice, household expenditures on commuting, trip purpose, origin and destination of trips, travel time and public transport service availability. Other data collected include job location choices by households, residential price/rent, distance between the origins, (home) and destination, (work place), and residential and job location factors (affordability convenience, transportation mode availability, accessibility, acceptability etc.).

The sampling frame used for the survey is the households' records of the Lagos Metropolitan Area. The current total projected population of Lagos metropolitan areas from 2006 census was 7,937,932. A report of survey of water supply,

sanitation and refuse services in Urban Areas of Lagos (2012) (www.stoveco.com/Lagos/sider/household.htm/1997) showed that the average household size of metropolitan Lagos is 6 persons. Thus the estimated number of household in metropolitan Lagos is 7937932/6 which is 1, 322,989. The study therefore, sampled 3,307 households representing 0.24% of the estimated total number of households in Lagos. This sample size is considered adequate considering Borg and Gall's suggestion (2001), that researchers should weigh the factors of accuracy, cost, time available for the survey, homogeneity of the accessible population, type of sampling, and the size of the study area to determine the best sample size for his study using the rule of thumb. Furthermore, Odugbemi and Oyesiku (2000) posited that, when sampling frame is large and resources are limited, representation perhaps is the best option. Therefore, out of 3,307 questionnaires administered 3,061 were completed and returned for analysis giving a response rate of 92.56%.

The stratified sampling technique (using each Local Government areas as stratum) was employed. The number of questionnaires administered to each Local government areas is proportional to the population size as shown in Table 1.

Table 1. Sampling Frame

LGAs	Population size	Sampling frame (household)	Sample size (selected households)	Completed questionnaires
Agege	459,939	76,657	192	177
Ajeomi-Ifelodun	684,106	114,018	285	264
Alimosho	1,277,714	212,952	532	493
Amuwo-Odofin	318,166	53,028	132	122
Apapa	217,363	36,227	90	83
Etiosa	287,785	47,964	140	111
Ifako-Ijaiye	427,878	71,313	178	165
Ikeja	313,196	52,199	130	121
Kosofe	665,393	110,899	277	257
Lagos Island	209,437	34,906	87	80
Lagos Mainland	317,720	52,953	132	122
Mushin	633,009	105,502	264	245
Ojo	598,071	99,679	249	231
Oshodilsolo	621,509	103,585	259	240
Shomolu	402,673	67,112	168	156
Surulere	503,975	83,996	210	194
TOTAL	**7,937,932**	**1,322,989**	**3,307**	**3,061**

Sources: National Population Census (2015)

Affordability index of not more than 10% of workers spend up to 10% of their income on commuting to work was used. This was used to construct location affordability index for households in Lagos Metropolitan Area. The data were analyzed by constructing affordability index using three pieces of information on working households in Lagos Metropolis: levels of incomes, number of travels and amount of fares.

Affordability index formula provided by Gomez-Lobo Echenique (2007) was adopted,

$$Affi = \frac{\sum_{i=1}^{N} xi\,(Pi,y).P}{y}$$

....

...1

Where $xi\,(Pi,y)$ is the numbers of trip; usually public transport trips or work related trips – taken during the month by household member i and y is household income or expenditure. Affordability of public transport system in Lagos metropolis is used basically. Student t-test analytical tool was used to test significant difference in the average transportation affordability index between Lagos Metropolis and global standard index. Descriptive statistical method is also adopted to describe the degree of responsiveness of the commuters to changes in the attributes of public transportation in Lagos.

3.0 Results and Discussions

Affordability as earlier stated is the extent to which the financial cost of journeys put an individual or household in the position of having to make sacrifices to travel or the extent to which they can afford to travel where they want to. Public transport affordability refers to the proportion of workers income expended on public transport modes for commuting. It represents workers financial commuting burden. Public transport affordability index can be defined as:

$$Affi = \frac{\sum_{i=1}^{N} xi\,(Pi,y).P}{y} \qquad x \qquad 100\%$$

....

...2

Where Aff$i$ are the number of trips-usually public transport trips or work related trips taken during the month by household members, and y is household income or expenditure. The number of trips is presented as an explicit function of the price of trips (fare) and household income.

Affordability Index Construction

Table 2 shows the percentage of household income spent on public transport in relation to monthly household income while Figure 2 shows the proportion of households in each income group that spends more than 20 percent income on public transport. Table 1 shows that 31.4% of all income groups spend nothing on public transport. However, the richest groups of households (with 300,001 – 500,000 income monthly) have the highest percentage (54.0%) of respondents that spend nothing on public transport. This is due to the fact that this category has private means of transportation. The lowest income group of monthly income of N100,000 and below has 30.5% of its group members spending nothing on public transport. This is accounted for by the fact that a reasonable proportion of the poor trek to their work places because this group include petty traders, artisans whose business and trade centres are located near their residence.

Table 2. Household Income Spent on Public Transport in Relation to Monthly Income (Affordability index)

Monthly household income	Percentage of household income spent on public transport (Affordability index).				
	0%	1 - 5%	6 - 10%	11 - 20%	>20 %
N100,000 and below	30.5%	16.6%	23.6%	24.7%	4.7%
N100,000 - N300,000	29.0%	35.2%	35.8%	0.0%	0.0%
N300,001 - N500,000	54.0%	2.0%	0.0%	44.0%	0.0%
Metropolitan	31.4%	19.2%	24.6%	21.2%	3.6%

Figure 2: Households spending more than 20 per cent of income on public transport

Figure 2 revealed the greater burden of the cost of transport on low income group in respect of the proportion of household income consumed on travel. For household as a whole the proportion of household that spend more than 20% on public transport is 3.6 percent. While for the lowest income group 4.7 percent of the groups spend more than 20 percent of their income on public transport. A negligible 0.2% of middle income group (N100,000-N300,000) household spend more than 20 percent of their income on public transport and the highest income group spend nothing on public transport.
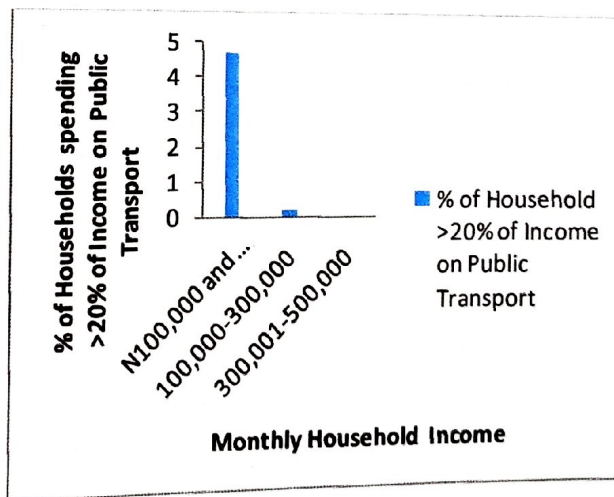
Table 2 further revealed that public transport modes in Lagos Metropolis cannot be considered to be affordable since as much as 24.8% of the households spend above 11% of their income on public transport. This affordability level is not as good as Armstrong and Thirez's (1987) benchmark which consider that there is an affordability problems whenever more than 10% of households spend above 10% of their income on work related trips. In South Africa, the government has established 10% of workers income as a policy benchmark (Venter and Behrems, 2005)

Household Income Spend on Public Transport by Mode

Table 3 shows the percentage of personal income spent on public transport by users of the main public transportation modes. It is evident from the table that majority of other commercial bus users (almost 80 percent) are spending less than 11 percent of their income on public transport to work.

Table 3. Percentage of Household Income Spent on Public Transport by Mode

Mode	Percentage of Household Income Spent on Public Transport to Work/ by public transport modes			
	<5%	6 - 10%	11 - 20%	>20 %
BRT/LAGBUS	16.3%	20.6%	56.5%	6.6%
Other Commercial Bus	34.5%	44.1%	21.4%	0.0%
Taxi	7.0%	29.3%	56.1%	7.6%
Walking	47.8%	49.2%	3.0%	0.0%
Metropolitan	26.4 %	35.8 %	34.3 %	3.6%

At the other end of the spectrum, the majority of taxi users spend more than 10 percent of their income on travel to work (63.7%). For BRT/LAGBUS a 56.5% of their users spend between 11 to 20 percent of their income on public transport to work. These results imply that the modes of public transportation used by commuters have effect on the level of their transport affordability

Commuter income spent on travel to work by income groups

Figure 3 shows the average percentages of income spent on commuting in each of the three income groups. Respondents earning ₦100, 000 and below spend over 13 percent of their income on commuting. On the other hand, the highest income group of ₦300, 001 – ₦500, 000 spends only 2.49 percent of their income on commuting.
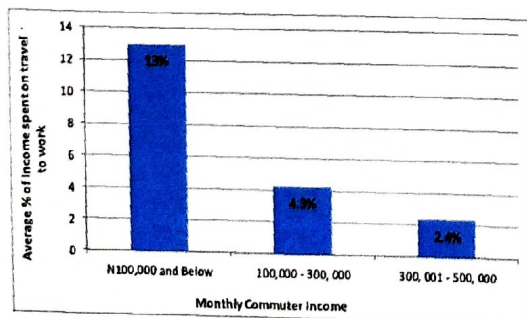

Figure 3. Average percentage of commuters' income spent on travel to work by income group

Spatial pattern of transport affordability Commuters

As part of this study an attempt to quantitatively analyze the monetary cost of commuting to work in different LGAs in Lagos Metropolis. Table 4 shows the average income of workers in different parts of Lagos, expenditure on commuting and affordability index for the study area. The table reveals that Surulere has the highest transport affordability index of 18.70, this is followed by Oshodi Isholo LGA with affordability index of 10.65. Eti-Osa LGA has the lowest index of 2.13. The spatial pattern of this affordability index is presented in Figure 3.

Table 4: The average monetary cost of commuting to work

S/ N	L.G.A	Average Workers Income	Average Expenditure on Commuting	Affordability index =
1	Agege	₦ 100,000	₦8,332	8.33
2	Ajeromi Ifelodun	₦ 200,000	₦13,017	6.51
3	Alimosho	₦ 150,000	₦6,028	4.02
4	Amuwo Idofin	₦ 200,000	₦8,913	4.46
5	Apapa	₦ 150,000	₦9,448	6.30
6	Eti Osa	₦ 350,000	₦7,456	2.13
7	Ifako Ijaye	₦ 100,000	₦7,063	7.06
8	Ikeja	₦ 200,000	₦4,460	2.23
9	Kosofe	₦ 200,000	₦4,348	2.17
10	Lagos Island	₦ 200,000	₦8,735	4.37
11	Mainland	₦ 200,000	₦6,443	3.22
12	Mushin	₦ 75,000	₦4,837	6.45
13	Ojo	₦	₦3,348	3.35

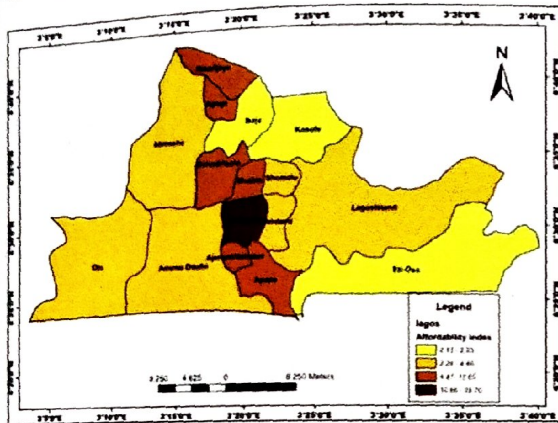|		100,000		
		₦ 100,000	N10,647	10.65
14	Osodi-Isolo	₦ 100,000	N4,635	3.09
15	Somolu	₦ 150,000	N9,350	18.70
16	Surulere	₦ 50,000		

Figure 3. Spatial pattern of Affordability index of Lagos Metropolis

What could be responsible for this variation may be due the type and density of land use in these locations, the dominant socio-economic group residing in the area and the main modes of transportation accessible to the commuters. The 't' test is carried out to test the level of variation that exist between Lagos transport affordability and international benchmark (Table 5).

Table 5. Group Statistics

Group Statistics				
Transportation Affordability	N	Mean	Std. Deviation	
Affordability index (Lagos Metropolis)	3061	8.75	6.96	
Affordability index (global standard of 10%)		10.00	.000	

Table 6. Independent Sample Test

Independent Samples Test							
		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	
Transportation Affordabil...	Equal variances	3366.488	.000	-5.328	6120	.000	
ity	assumed						
	Equal variances not assumed			-5.328	3060	.000	

Using an alpha level of .05, an independent-samples t-test was conducted to evaluate whether the average transportation affordability index for Lagos metropolis differed significantly from the global standard index. The test as shown in Tables 4 and 5 was significant, $t = -5.328$, $p < .05$. Therefore, we reject H_0 which assumes equality of mean. The result shows a significant difference between the average transportation affordability index for Lagos metropolis and the global standard index. An examination of the group means above indicate that global standard for transportation affordability index $(M=10)$ is significantly greater than the affordability index for Lagos metropolis $(M = 8.75, SD = 6.96)$.

4.0 Conclusion and Recommendations

The study has been able to establish that households' public transport affordability index in Metropolitan Lagos, Nigeria, is relatively high and it also varies from one location to another and among different income groups because of the influence of residential proximity to work places and the level of wages paid to the workers. The need to reduce the overall cost of public transportation is therefore a critical policy goal that should be pursued by the concerned authorities. This however can only be achieved by developing different strategies that will reduce both the time and distance of work place commuting; and on the other hand, there may be need to increase the general wage level or reducing rental value of residential accommodations to the working population.

On the strength of the findings of this study, it is recommended that there is need to consider full development of suburban neighborhoods near job centers with good transportation access to job centers. This will help more working families to reduce their transportation costs and commute times. By adopting policies to ensure that homes to be provided in these suburbs are affordable, the density in these neighborhoods will increase; thereby add to ridership level of public transportation.

The study equally suggests that the finding that 4.7 percent of lowest income group (poor workers) spends more than 20 percent of their income on commuting is a pointer to policy makers that the present transportation unaffordability is a significant economic and social problem that has to be addressed. It constraints people economic

opportunities (access to employment opportunities) and forces household to spend excessive portion of their budgets on transport thereby limiting their ability to purchase other essential goods and services. This is one of the major causes of poverty among city dwellers. Policy makers need to set a target for transportation and housing affordability to guide investments in transportation and housing infrastructure. For example an ideal target that households spend less than 20 percent of their total budget on transport and less than 45 percent on transport and housing combined can be considered.

The finding that over 70 per cent of workers are not willing to pay higher fare for improved public transport services (reduced accessibility time, reduced waiting time, reduced commuting time) is an indication that the present public transportation system is not affordable to workers and so workers cannot bear extra burden of commuting cost. This implies that improved transport services have to be provided through government investment and subsidy.

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