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Research Article

# Ordinal Regression Modelling of Tricycle Modal Comfort in Calabar, Nigeria: Passengers' Perception

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**Abstract**

Tricycles constitute a major component of the informal transport system in many Nigerian cities. Their operation is fast becoming a parody to urban living and as such, require urgent regulatory attention. The paper examined the perception of comfort that passengers derive from the use of tricycles for urban mobility in Calabar metropolis, Nigeria. The study modelled different comfort levels based on demographic characteristics of the passengers, as derived from its use. Questionnaire and data from CRDoPT and other published materials were used to make inferences on the study. Analyses was by descriptive and inferential statistics. Ordinal regression analysis using the PLUM method in SPSS analysed data where the null hypothesis that, there is no statistical relationship between passenger demographic parameters and the feeling of comfort from the use of the tricycle in Calabar, was rejected. The feeling of comfort of the tricycle mode users is observed to be dependent ($p < .05$) on the education ($p = .000$); monthly income ($p = .001$); occupation ($p = .046$); and marital status ($p = .003$) on the respondents. The study recommended among other things, regulatory policies that are expected to enhance an effective modal regulation that promotes a safe and comfortable use of the mode. Registration and creation of an accurate database of the tricycle operators and operations in order to formalize tricycle operation can enhance the confidence of use and boost comfort levels of passengers.

**Keywords**
Ordinal Regression Modelling, Tricycle, Modal Comfort, Passengers' Perception

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## Introduction

Available literature clearly indicates the absence of an absolute approach in which the quality of service of any facility or service can be measured. However, it is a consensus opinion among scholars that the quality of service is determined by many qualitative variables and as such weighing each of them remains a fundamental technique in measuring quality (Yatskiv, et al., 2008). Many statistical techniques have often been employed by these scholars ranging from correlation and regression analysis, descriptive statistics, or theory of linear composite indicator (Yatskiv et al., 2010; Andronov et al., 2010). According to Tutz (2021) the ordinal models are made up of simpler binary models. Regression methods such as logistic, linear, and ordinal regression have been vigorously employed in analyzing the relationship between multiple explanatory variables such as partial quality attributes and dependent variable such as overall quality of service. This allows researchers to evaluate the extent of relationship between the explanatory variables and the outcome variable. It is based on this premise that Chen & Hughes (2004) concluded that an appropriate choice of an ordinal regression method remains fundamental for evaluating the effect that all-levels explanatory variables will have on the ordered categorical outcome (Chen & Hughes, 2004). The general aim of ordered categorical regression, generally referred to as ordinal regression, is to exploit the ordering of responses usually for the purpose of obtaining simply structured models. Further researches into their widespread applicability was stimulated by the seminal paper of McCullagh in 1980, which helped to avoid the traditional pitfalls associated with the ANOVA-type models on ordered categorical data (McCullagh, 1980). Using ordinary least squares approaches come with limitations which have since been highlighted (Agresti, 2010, 2003; Tutz, 2012; Long & Freese, 2006; Williams & Quiroz, 2020). Several models and corresponding software available today enhance different levels of application of ordered regression especially in the social and environmental sciences. Their relevance in transport studies stem from the realisation that one of the most fundamental problems in cities especially in developing countries is access to the mobility that meets the broad scope of economic and social needs. The satisfaction from modal use varies across these economic and social characteristics of users. Mobility within cities is literally the way to economic growth in the developing world. There was a concentration of urban mobility, where urban mobility tool was concentrated development, before invention of the automobile. This helped to shorten trip lengths to enhance non-motorised transport modes such as walking and cycling. However, the growth of the automobile in the 20th Century helped to stimulate multifarious functions within cities, as this enhanced the ease of intra-city movement. Reliance on public transport system within cities is becoming increasingly high. This can be due to transport policies initiated by metropolitan authorities to reduce congestion and the impacts of climate change, or tough economic realities that has constrained private automobile ownership. The challenge therefore becomes the ability of the public transport to meet the growing demand for services, and most often, leaves residents with the option of informal public transport Cervero, 2000; Kumar, 2011; McCormick et al., 2013; Guillen et al., 2013; Kassa, 2014; Ehebrecht, 2018; Chowdhury et. Al., 2018; Goletz & Ehebrecht, 2020). The informal public transport (IPT) is a widespread means of moving people, goods and services in developing countries. For example, the last three decades had shown how IPT became an integral part of the intra-urban transport system in many developing countries (Shimazaki & Rahman, 1996). First, transport planners attributed this development to the existing gaps in transport needs of the urban population. Second, is the increasing per capita income of the increasing urban population with attendant needs for transport which traditional public transport cannot offer (Hilling, 1996). Third, is the poor management and funding system of most public transport systems leading to overcrowding, and other safety issues (Shimazaki & Rahman, 1996). Few available studies on tricycle operations in Nigeria were conducted within the city center (Nwaogbe, Ibe & Ukaegbu, 2012; Raji, 2012; Barau, 2003; Ubani & Ugwu, 2015; Afolabi & Akibo, 2020). Because tricycle is relatively new in many Nigerian cities, not much has been reported about its operations and the level of reliability as perceived by users The durability and flexibility of this mode has been taken advantage of, in the art of stealing, robbery and molestation of unsuspecting citizens of Calabar. This phenomenon is more common along Atimbo, Edim Otop, Nyanasang, Anantigha, Satellite Town, New Airport, and Ekpo Abasi neighbourhoods. It is obvious that uncertainties attributed to tricycle operations can be traced to no background checks or experience of operating personnel. For example, no driver or rider's licenses are required to facilitate background checks, occupation, residences and psychiatric evaluation, unlike car drivers. This could be one of the reasons they are frequently involved in criminal behaviour. The

use of this mode of transport is a reflection of economic position of the society where it is being used, however, shameful and a parody to urban living. Calabar metropolis is mostly serviced by road transport system dominated by private automobiles, privately operated taxis, mini buses and tricycles, and a few government-operated public buses. Operational regulation such as route restriction apply only to tricycles on major and minor roads (excluding highways), buses only on highway and other major roads, while both private and public automobile operates in all roads within the metropolis. This study seeks to assess the socioeconomic impact of tricycles in Calabar. The study modelled different levels of satisfaction that residents derive from the use of the mode in Calabar metropolis. This is with a view to adding to the available literature on the operations of tricycles in the country particularly in the urban areas.

## Literature Review

Existing literature in motorized paratransit modes has identified different aspects of this transport area across different cities, countries, regions (Harkey & Stewart, 1997; Landis et al., 2003; Klobucar & Fricker, 2007; Parkin et al., 2007; Møller & Hels, 2008). Variables of interest often range from (but not limited to) land use characteristics, road characteristics like pavement quality and traffic signals, outside lane width, weather conditions, experience and confidence of drivers, speed and size of vehicles, trip generation and distribution potential in the surroundings, and so on (Parkin et al., 2007; Sallis et al., 2006; Bopp et al., 2012; Lawson et al., 2013; Nikitas, 2018; Giglio yet al., 2021). The dominance of informal public transport has been reported by researchers especially in developing countries which are characterized by fast-growing population, low per capita income, deficient and poorly managed transport infrastructure (Shimazaki & Rahman, 1996). This informal motorized paratransit is reported to have met 20-50 per cent public transport demand in some of these developing countries such as in Asia and Africa, due largely to their flexibility, frequent and reliable service delivery, feeder connections and low cost of service (Cervero, 1998; Phun et al., 2015) The level of service which primarily defines the quality of satisfaction from use of transport service has remained a dominant concept in public transport evaluation, often considering safety, comfort, aesthetics, reliability, fare, behaviour, operating speed and so on, in their estimations (Landis, 1994; Zhang & Prevedouros, 2003; Jensen, 2007; Liang et al., 2017; Okon et al., 2017; Okon & Moreno, 2019; Okon, 2021). Logistic regression models such as ordinal, binomial and multinomial, are variously used for measuring user's satisfaction of any particular service (Rahman et al., 2017; Josephat & Ismail, 2012; Eboli & Mazzulla, 2007; Okon, 2018; Halim et al., 2018; Okon & Ekwok, 2020). Furthermore, Nwaogbe et al., (2012) demonstrated the imperative of user's perception of the quality of service delivered by tricycle operators in Nigeria which suggested no particular difference in comfort, regularity, affordability, and safety of this mode. They emphasized the importance of road network quality on the quality of service. Nwaogbe, Ibe and Ukaegbu (2012) investigated customers' opinions of the quality of tricycle service and its operation in terms of affordability, regularity, comfort and safety in Aba, Nigeria and found no significant difference across various categories of respondents. There has been widespread literature on extensions of the cumulative logistic model having category-specific effects, including the resulting partial proportional odds model and the nonproportional odds model (see, Brant, 1990; Peterson & Harrell, 1990; Bender & Grouven, 1998; Cox, 1995; Kim, 2003; Liu et al., 2009). While, Peterson and Harrell (1990) have submitted how different variables of category-specific or global effects can be investigated, the interpretation of the effects in the generalized ordered logit models in the social sciences have been offered by Williams (2016) and, Hedeker and Mermelstein (1998). In terms of symmetric binary split models, item response theory (response trees) whose focus is on measuring latent traits, rather than the impact of explanatory variables nor inclusion of covariates as several considerations have been suggested (Plieninger & Meiser, 2014; Khorramdel & von Davier, 2014; De Boeck & Partchev, 2012; Böckenholt & Meiser, 2017; Böckenholt, 2017; Meiser et al., 2019). Furthermore, in each split in item response trees there is specification of new person and trait parameters, the consequence of which is that most response styles are modelled while higher categories tendency gets lost. The parameterization by Meiser et al. (2019) remains an exception which include content related parameters in all steps of item response models. Kulas et al. (2008) had earlier likened odd number of categories in a Likert scale as a neutral middle category usually considered as a dumping ground for unsure or non-applicable response with the tendency for distorted estimates. In Indonesia, Joewono and Kubota (2007) used ordinal, probit and binary logit regression to analyze 54 paratransit factors to measure

user satisfaction and future choice whose finding indicated the importance of financial factors in choosing a particular mode of paratransit in the study area. Although, their study revealed a corresponding dissatisfaction of users on the quality of paratransit services, Tangphaisankun et al., (2009) demonstrated the possibility of the use of paratransit as a successful feeder mode. This informed the popularity of the mode among the public and particularly private users alike in Indonesia. The ordered logit regression result of Yuan, Li, and Li (2018) electric-tricycle (ETCs) crashes and manpower-tricycle (MPTCs) crashes illustrate that they both may share some of the same characteristics. He attributed the severity of such crashes to ramming into trucks, high speed limit, nature of intersections, and night. However, they found out that it was possible to see that the 'rate of fatalities and injuries of ETCs is around 8 per cent higher than that of MPTCs'. Based on 1028 survey points carried out on Benin metropolitan region, Nkeki and Asikhia (2019) applied explored the spatial variability in travel behaviour and built environment interactions using geographically weighted logistic regression method. Unlike global statistics, their result indicated that there is a significant spatial variation in the association between travel mode choice (as the local model revealed) and the factor scores of demographic and socioeconomic variables across sampled neighbourhoods. Accordingly, the GWLR model further revealed demographic and socioeconomic characteristic spatial mismatch, which formed two distinctive neighbourhoods of different influence levels. The study however observed the weakness of built environment variables in predicting mode choices in the study area and therefore concluded that the local model remained most suitable in exploring this relationship as it accounted for local variation often lost in global models (Nkeki & Asikhia, 2019). Major Nigerian towns are faced with the challenges of accommodating the informal transport including the tricycle into their intra-urban transport system. This research, leading to the model estimation for the different levels of comfort and satisfaction from the use of these tricycle form a major contribution to the literature of urban transport in Nigerian cities and beyond. This gap in literature has been responsible for the lack of a workable and realistic policy direction for urban transport in Calabar and Nigeria in general. The paper establishes itself as a response to addressing this often-complicated passenger perception of their comfort level from tricycle mode in Calabar. This is with a view to stimulating reasonable action towards an active urban transport policy and indeed further research in the subject matter.

## Methods

A multi-cluster sampling technique was adopted for this study where initial sub-division of the study area into Calabar Municipality and Calabar South was undertaken. Stratified random sampling was then used to identify users who were then served instruments. Since it is not possible (in the context of this research) to interview every user, the purposive sampling technique was adopted to identify locations where users can be interviewed. Preliminary investigation showed that many terminals have different characteristics in terms of passenger volume and land use characteristics. In the light of this therefore, a total of twelve (12) tricycle terminals, six (6) from each of the Local Government Areas were identified for passenger survey. In Calabar Municipality, sampled terminals include, Essien Town (off Murtala Mohammed Highway), Abang Asang off Eta Agbor, Eta Agbor Layout/Hall-2 off Eta Agbor, Ujimco Filling Station off Eta Agbor, Airport Roundabout, and Ekorinim off Murtala Mohammed Highway. In Calabar South, terminals include, CRUTECH Gate, Calabar South Gate, Bedwell by Nelson Mandela, Watt Market Roundabout by Lagos Street, Etim Edem Park, and Goldie by Mt. Zion (figure 1). A sample size of 384 questionnaire was administered purposively to all 12 terminals based on a Likert scale (1 to 4 with 1 = not very satisfied and 4 = very satisfied) to either waiting passengers or passengers on-board the tricycle, using:

$$\text{Necessary sample size} = (\text{Z-score})^2 * \text{StdDev}*(1-\text{StdDev}) / (\text{margin of error})^2 \quad \text{(i)}$$

Additional instruments used for this study were the coordinate points of major tricycles terminal across Calabar Metropolis obtained from hand-held GPS. Geographic information system (GIS) was used to examine the characteristics of each point in terms of number of tricycles on a particular loading point in peak and non-peak periods, the length of the route, and the nature of land use. Open street map of the study area in addition to field ground-trothing was used to map out the current location of tricycle terminals and their respective routes in the study area, while recording certain characteristics like neighborhood characteristics, nature of route, volume of tricycles, and so on. Data was analyzed using descriptive and inferential statistic. Descriptive

statistical tools such as frequencies, deviations were used in the analysis of data to show different outcomes. Tables, maps, graphs and charts were used to depict results of analyzed data in their various categories. Inferential statistics such as ordinal regression analysis was used to predict an ordinal dependent variable, modal comfort and independent socioeconomic characteristics of users such as, monthly income, employment type, marital status, occupation and age, using the PLUM method in SPSS. If the possible outcomes for the dependent variable in this case (perception rating of comfort) are 1, …, r. Let $p_{ih} = P(y_i \leq h)$, that is, the cumulative probabilities. Then $0 = p_{i0} < p_{i1} \cdots < p_{ir} = 1$ (so that outcomes order is captured), where $p_{i0} = 0$ for notational convenience. Then, for h = 1, …, r

$P(y_i = h) = P(y_i \leq h) - P(y_i \leq h-1) = p_{ih} - p_{ih-1}$ (ii)

Therefore, the model is regarded as binary models with events y ≤ h vs. h < y. The logit models for h = 1, …, r-1 will be:

$$\text{logit}(p_{ih}) = \ln \frac{p_{ih}}{1 - p_{ih}} = b_{0h} + b_{1h}x_{i1} + b_{2h}x_{i2} + \cdots + b_{kh}x_{ik} = \sum_{j=0}^{k} b_{jh}x_{ij} \quad \text{(iii)}$$

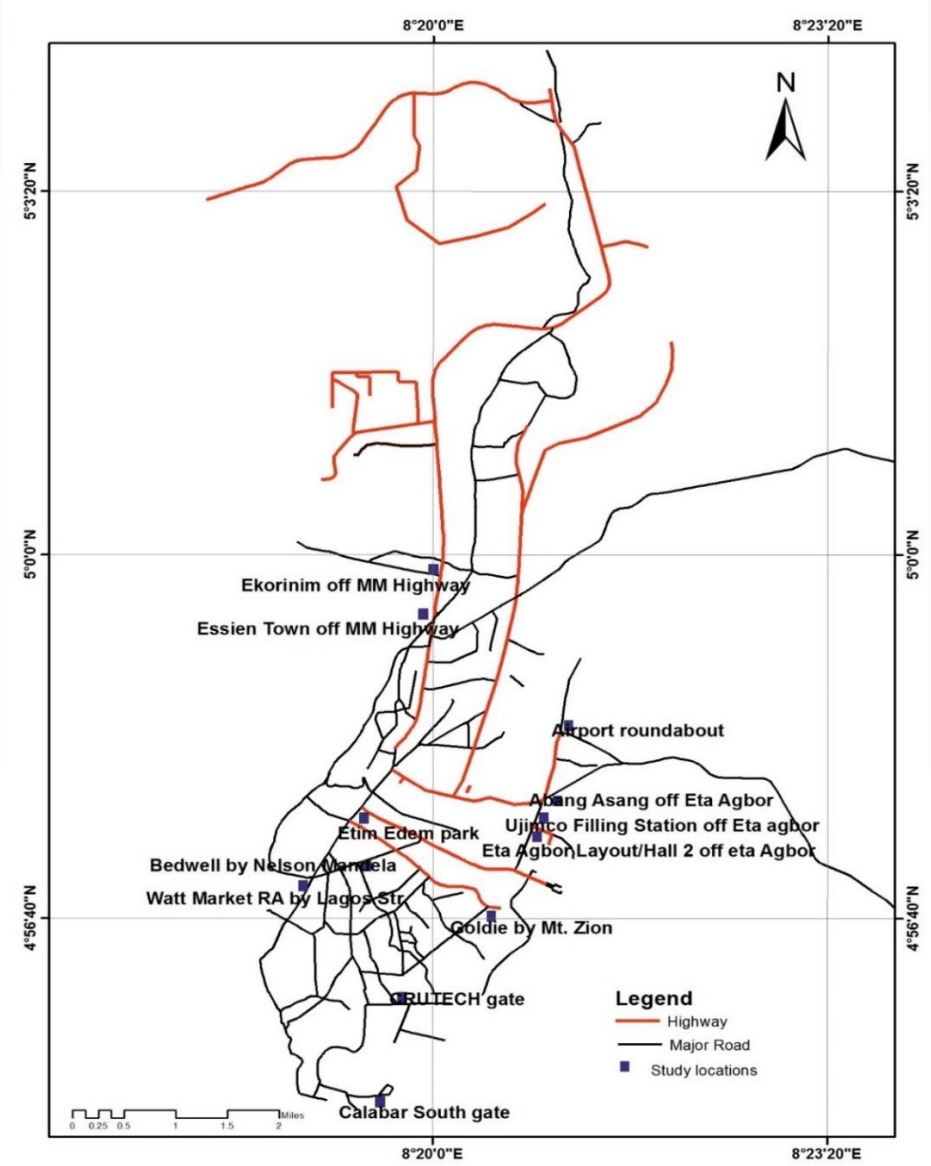


**Figure 1.** Calabar metropolis showing sampling locations (GIS Unit, Geography and Environmental Science, University of Calabar, 2021)

where $x_{i0} = 1$, for convenience, thus:

$$p_{ih} = \frac{e^{\sum_{j=0}^{k} b_{jh} x_{ij}}}{1 + e^{\sum_{j=0}^{k} b_{jh} x_{ij}}} \quad \text{(iv)}$$

The likelihood and log-likelihood statistics are given as follow:

$$L = \prod_{i=1}^{n} \prod_{h=1}^{r} (p_{ih} - p_{ih-1})^{y_{ih}} \quad \text{(v)}$$

$$LL = \ln L = \sum_{i=1}^{n} \sum_{h=1}^{r} y_{ih} \ln (p_{ih} - p_{ih-1}) \quad \text{(vi)}$$

The perception of comfort derived from the use of this mode was also examined across different demographic characteristics including education, income, occupation., marital status, age and gender. The application of this analytic technique is motivated by earlier studies. For example, Yuan, Li, and Li (2018) used ordered logit model.to analyze the significance of the main contributing crash factors between electric-tricycle crashes (ETCs) and manpower-tricycle crashes (MPTCs) in China. Nkeki and Asikhia (2019) applied geographically weighted logistic regression method to examine travel behaviour and built environment interactions, while, accounting for the individual demographic and socioeconomic characteristics. In Indonesia, Joewono and Kubota (2007) employed ordinal, probit and binary logit regression to analyze 54 paratransit factors which they used to measure the user satisfaction and future choice (Joewono & Kubota, 2007).

## Results/Discussions

This section addressed the travel behaviour of the mode users. Ordinal regression analysis of satisfaction from the use of this mode using different socioeconomic parameters were estimated. This also include the demographic parameters of tricycle passengers in the study area. This was realized by making deductions from administered questionnaires which was administered and retrieved at an overall success rate of 94.25 per cent.

### Travel behavior and pattern of the mode users

More work-based trips (31.6 per cent) were undertaken by these mode users in the study area. School-based trips account for the second highest number of trips by tricycle passengers (29.4 per cent). Shopping-based trips also account for a significant volume of trips by users (17 per cent). Recreation-based trips on the other hand accounts for 6.9 per cent of all trips by these users. Other categories not specified accounts for 15.1 per cent of all trips (Table 1). While this distribution of trips may not reflect the overall trip purposes of residents of Calabar, there certainly reflect specific trip purposes executed by residents using the tricycle in the study area. A Chi-Square Test of independence was performed to examine the relation between start and end location of tricycle users. Cross tabulation table between these two variables revealed that most trips are school-based trips (29.4 per cent). Home-based and market trips both accounts for 20.7 per cent while work and hospital respectively accounts for 9.5 per cent and 5.8 per cent respectively. Others, not specified, accounts for 13.8 per cent. The relation between these variables was significant, $X^2$ (5, N = 377) = 43.3, p < .01 (Table 2). There is a significant relationship between the two variables, as it is revealed that most trips irrespective of their origin are home-based trips and therefore significant for peak hour traffic planning. In terms of end-trips location and arrival time, it is also revealed that 59.2 per cent of all trips undertaken by respondents took between 10-20 minutes. This is not unexpected as the mode exhibits some level of flexibility to enhance neighborhood trips. This is also added to the restriction of operations to secondary and arterial roads in the metropolis. Furthermore, 18.6 per cent of all trips takes less than 10minutes, 15.9 per cent takes about 21-30 minutes while 6.4 per cent of trips takes more than 30 minutes. A chi-Square Test of independence was also performed to examine the relationship between end-trip location and arrival time of tricycle users in Calabar. The data used was as obtained from the questionnaire survey on respondents' 'end-trips' and their 'arrival time'. It was revealed that the relationship between these variables was not significant, $X^2$ (3, N = 377) = 3.33, p = .33 (Table 3). Therefore, there is no significant relationship between the two variables. Under

**Table 1**
Main trip purpose (Author's field survey, 2021)

| Variable | Frequency | Percentage |
|---|---|---|
| Main trip purpose | | |
| Work | 119 | 31.6 |
| School | 111 | 29.4 |
| Shopping | 64 | 17.0 |
| Recreation | 26 | 6.9 |
| Other | 57 | 15.1 |

**Table 2**
Chi-Square Tests of start and end location of trips (Author's field survey, 2021)

| Variable | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 43.331a | 5 | .000 |
| Likelihood Ratio | 42.326 | 5 | .000 |
| Linear-by-Linear Association | 5.219 | 1 | .022 |
| N of Valid Cases | 377 | | |

**Table 3**
Chi-Square Tests of end trip location and arrival time (Author's field survey, 2021)

| Variable | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 3.330a | 3 | .344 |
| Likelihood Ratio | 3.741 | 3 | .291 |
| Linear-by-Linear Association | 1.692 | 1 | .193 |
| N of Valid Cases | 377 | | |

the use of this mode, arrival time is not related with end-trip location as expected since these are generally short neighborhood trips of usually 5-10 minutes. Respondents were requested to provide the dominant mode of their trips in the study area, majority of which indicated that they undertake their intra-urban trips using the tricycle (55.2 per cent). Others including private car (12.7 per cent), public taxi (27.3 per cent) and the use of bicycle (3.7 per cent) also exist (Table 4). It is instructive to note that the volume of trips using the tricycle may not necessarily reflect city-wide averages as the administration of the instruments favored loading points. However, the popularity of this mode due to its flexibility and a valuable replacement of the motorcycle in the study area and elsewhere in the county cannot be overemphasized. In terms of number of trips per day, 76.1 per cent of the respondents revealed that they undertake 1-3 trips per day. About 18% accounted for 4-6 trips while only 5.8% responded to doing over 7 trips per day (figure 2). When asked if respondents walk some distance to join the tricycle to their respective destination, only 41.1% responded 'yes'. Of this 'Yes" respondents, 83.2% admitted walking a distance of 50-100m to access the nearest tricycle, 7.7% both walk distances of 101-200m and 201-300m, while 1.3% accounted for distances above 300m (Table 5).

**Table 4**
Dominant mode of travel by respondents (Author's field survey, 2021)

| Variable | Frequency | Percentage |
|---|---|---|
| Private car | 48 | 12.7 |
| Public taxi | 103 | 27.3 |
| Keke | 208 | 55.2 |
| Bicycle | 14 | 3.7 |
| Other | 4 | 1.1 |

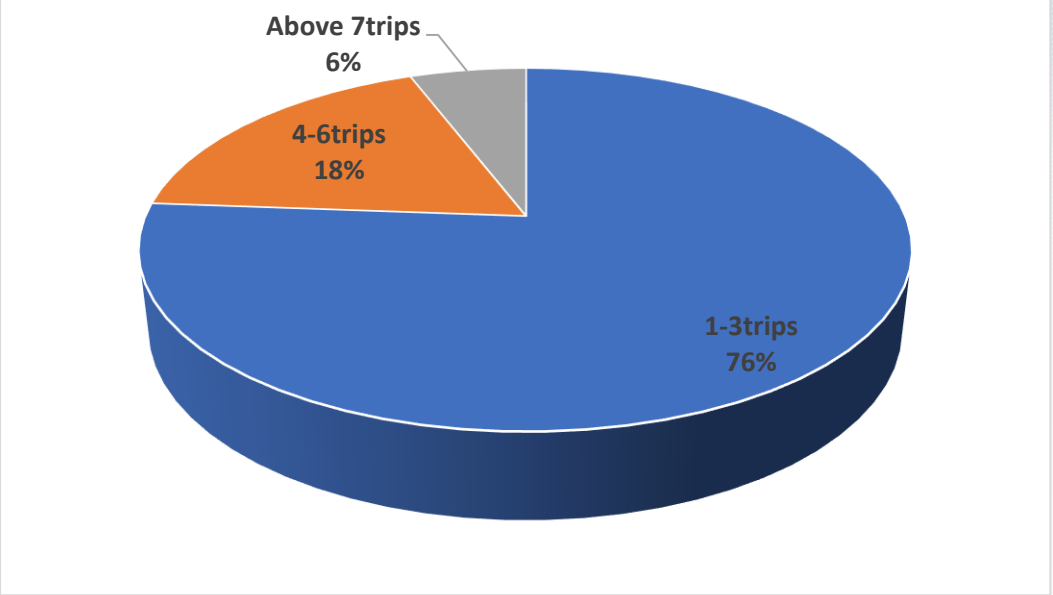


**Figure 4.** Daily trips by respondents (Author's field survey, 2021)

**Table 5**
Mode of trip before undertaking tricycle trip (Author's field survey, 2021)

| Variable | Frequency | Percentage |
|---|---|---|
| Walk to particular junction | | |
| Yes | 155 | 41.1 |
| No | 222 | 58.9 |
| If yes, walk for how long | | |
| 50-100m | 129 | 83.2 |
| 101-200m | 12 | 7.7 |
| 201-300m | 12 | 7.7 |
| 300m> | 2 | 1.3 |

## Ordinal Regression Model

An ordinal regression analysis (PLUM) was used to determine if there was statistical significance between passengers' perception of comfort from tricycle mode and socio-economic status of tricycle passengers in Calabar metropolis. There were no outliers in the data as assessed by inspection of boxplot. The tolerance value (Menard, 1995, 2000) and VIF (Myers, 1990) were used as criteria for assessing collinearity in the data set. A tolerance > 0.1 for all factors and covariates indicated no multicollinearity while VIF > 10 formed no cause to worry about the data. How much new variance has been explained by the model is indicated by the log-likelihood while the Chi-Square Test indicates a decrease in the unexplained variance from the baseline model (596.95) to the final model (559.58). This means that there is a difference of 37.37 (596.95 - 559.58) (see Table 6). This is a significant change which shows how the final model is more important in explaining the original variability and therefore a better fit than the original model. The fit of the model to the data is shown in Goodness-of-fit table (Table 7). Pearson and Deviance statistics test helped to determine whether the predicted values from the model differ significantly from the observed values. While Pearson Statistic, $p < .001$ fails to reject the null hypothesis (that socioeconomic parameters are not the same across response categories), the reverse is the case with Deviance Test $p > .05$. This contrasting result can be explained by overdispersion which is further investigated thus:

$\varphi Pearson = \chi 2\ Pearson/df = 699.964/530 = 1.32$ (vii)
$\varphi Deviance = \chi 2\ Deviance/df = 489.111/530 = 0.92$ (viii)

None of these results warn against over dispersed data since there are both within the range of 1. In Table 8, two other measures of $R^2$ such as the Cox and Snell's Measure are reported as .29, second is Nagelkerke's adjusted value reported as .11. These are reasonably similar values and

represent relatively decent-sized effects. Table 9 tests the assumption of proportional odds expected to be greater than 0.05. This is the case here (p-value = .39). The main assumption of the ordinal regression is checked. The null hypothesis which states that the location parameters (slope coefficients) are not the same across response categories is upheld. In other words, there is no significant difference in the perception of tricycle passengers' comfort across different socio-economic characteristics. This means that different education, income, occupation and marital characteristics accounts for varying degrees of comfort perception from the use of this mode. The last part of the ordinal regression result is contained in the Table 10 (parameter estimates). The most interesting aspect is the locations. We have a statistically significant result, ($p < .05$) for education ($p = .000$); monthly income ($p = .001$); occupation ($p = .046$); and marital status ($p = .003$). Therefore, the null hypothesis that the feeling of comfort while using the tricycle mode is independent of socio-economic characteristics of the passenger is rejected. The comfort of the tricycle mode users is observed to be dependent ($p < .05$) on the education ($p = .000$); monthly increases, the likelihood of rating the mode as comfortable to use will also increase. Income ($p = .001$); occupation ($p = .046$); and marital status ($p = .003$). Only age ($p = .164$) and gender ($p = .875$) were statistically independent, $p > .05$, not enough to reject the hypothesis. This means that socio-economic (marital status, occupation, monthly income, education or employment) characteristics of tricycle passengers does have statistically significant impact on the dependent variable, the perception of "comfort". However, the value of the 'age' (-.185), marital status (-.185) and education (-2.188) suggest that the perception of comfort from use of the tricycle decreases with increasing age, marital status or higher education. Whereas, occupation (2.567), gender (.035) and monthly income (1.087) suggest that as there increased, the likelihood of rating the mode as comfortable to use will also increase.

**Table 6**
Model Fitting Information (Author's field survey, 2021)

| Model | -2 Log Likelihood | Chi-Square | df | Sig. |
|---|---|---|---|---|
| Intercept Only | 596.952 | | | |
| Final | 559.577 | 37.375 | 16 | .002 |

**Table 7:**
Goodness-of-Fit (Author's field survey, 2021)

| | Chi-Square | df | Sig. |
|---|---|---|---|
| Pearson | 699.964 | 530 | .000 |
| Deviance | 489.111 | 530 | .898 |

**Table 8**
Pseudo R-Square

| | Chi-Square |
|---|---|
| Cox and Snell | .294 |
| Nagelkerke | .109 |
| McFadden | .049 |

**Table 9**
Test of Parallel Lines[a] (Author's field survey, 2021)

| Model | -2 Log Likelihood | Chi-Square | df | Sig. |
|---|---|---|---|---|
| Null Hypothesis | 559.577 | | | |
| General | 525.963[b] | 33.614[c] | 32 | .389 |

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a. Link function: Logit.
b. The log-likelihood value cannot be further increased after maximum number of step-halving.
c. The Chi-Square statistic is computed based on the log-likelihood value of the last iteration of the general model. Validity of the test is uncertain.

## Conclusion and Recommendations

Over the years, public transportation in Nigerian cities had faced enormous challenges of sustainability which has led to the introduction of different transport modes such as the tricycle. However, research findings have shown a significant acceptance of the mode in most urban centres in Nigeria. The setbacks notwithstanding, the major problems center on lack of

**Table 10**
Parameter Estimates (Author's field survey, 2021)

| | | Estimate | Std. Error | Wald | df | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower Bound | Upper Bound |
| Threshold | [Comfort = 1] | -1.015 | 1.460 | .483 | 1 | .487 | -3.877 | 1.847 |
| | [Comfort = 2] | 2.134 | 1.458 | 2.142 | 1 | .143 | -.724 | 4.993 |
| | [Comfort = 3] | 3.349 | 1.468 | 5.205 | 1 | .023 | .472 | 6.226 |
| Location | Age | -.185 | .133 | 1.940 | 1 | .164 | -.445 | .075 |
| | [Gender=1] | .035 | .221 | .025 | 1 | .875 | -.398 | .467 |
| | [Gender=2] | 0[a] | . | . | 0 | . | . | . |
| | [Education=1] | -2.188 | .569 | 14.765 | 1 | .000 | -3.304 | -1.072 |
| | [Education=2] | -1.804 | .564 | 10.240 | 1 | .001 | -2.909 | -.699 |
| | [Education=3] | -1.227 | .449 | 7.477 | 1 | .006 | -2.107 | -.348 |
| | [Education=4] | -.165 | .420 | .155 | 1 | .694 | -.988 | .657 |
| | [Education=5] | 0[a] | . | . | 0 | . | . | . |
| | [Monthly_income=1] | 1.087 | .325 | 11.220 | 1 | .001 | .451 | 1.723 |
| | [Monthly_income=2] | 0[a] | . | . | 0 | . | . | . |
| | [Occupation=1] | 2.567 | 1.284 | 3.996 | 1 | .046 | .050 | 5.085 |
| | [Occupation=2] | 2.121 | 1.308 | 2.630 | 1 | .105 | -.442 | 4.683 |
| | [Occupation=3] | 2.039 | 1.282 | 2.531 | 1 | .112 | -.473 | 4.551 |
| | [Occupation=4] | 2.382 | 1.327 | 3.220 | 1 | .073 | -.220 | 4.984 |
| | [Occupation=5] | 2.338 | 1.304 | 3.214 | 1 | .073 | -.218 | 4.895 |
| | [Occupation=6] | 2.260 | 1.298 | 3.033 | 1 | .082 | -.284 | 4.803 |
| | [Occupation=7] | 0[a] | . | . | 0 | . | . | . |
| | [Marital_status=1] | -1.757 | .596 | 8.707 | 1 | .003 | -2.924 | -.590 |
| | [Marital_status=2] | -1.274 | .528 | 5.826 | 1 | .016 | -2.309 | -.240 |
| | [Marital_status=3] | -.768 | .615 | 1.562 | 1 | .211 | -1.973 | .436 |
| | [Marital_status=4] | 0[a] | . | . | 0 | . | . | . |

appropriate training, regulation and control of the operators. It is recommended that the appropriate agencies of government should mount a suitable training program for the operators to enhance efficiency. Such training would lead to the production of licensed operators with the requisite skills and attitude which has been the bane of the system. Based on research findings and extensive background to the study, it is observed that socio-demographic parameters can be used to model the perception of 'comfort' derivable from the use of tricycle mode of transport. Therefore, socio-demographic factors remain an important consideration in the planning and effective operation of this mode of transport for intra-city mobility. From the findings, it is observed that different trip purposes account for the patronage of the tricycle mode of

transport in Calabar. These purposes range from home-based, school, hospital, recreation to shopping trips. While passengers also use other modes, it was observed that in most of these routes, multi-modal split is not common. This is expected as some of these operation routes are narrow collector streets. Therefore, aside from the motorcycle that operates sparingly due to their outright ban, residents are often left with no choice of mode except for the tricycle. The trips associated with this mode are observed to be short, usually, under 10 minutes in most cases. The tricycle transport enhances socio-economic development in Calabar through enhanced mobility for residents and employment opportunity for operators. However, the following recommendations based on the findings of this study are for the enhancement of the smooth operation of commercial tricycles and effective road transport. Specific recommendations include the following:

a. Government investment in commercial tricycle operation as a complementary mode of urban public transportation to reduce unemployment and increase revenue.
b. Designation of more routes and adequate terminal facilities for tricycle operators and users.
c. Regular training of tricycle operators on courtesy since it is not a 'goods only' mode, the right use of roads and safety measures by the Federal Road Safety Corps (FRSC) to enhance an efficient urban transportation system in Calabar.
d. Registration and creation of an accurate database of the tricycle operators and operations in order to formalize tricycle operation and enhance the confidence of use from passengers in Calabar.

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