ASSESSING APP-BASED TAXI SERVICES AND SECURITY CHALLENGES IN NIGERIA URBAN CENTRES

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ABSTRACT

This study assessed app-based taxi services and security concerns in particular urban regions of Nigeria, focusing on the influence of security on the operation of these services. The research employed a descriptive methodology, distributing 400 questionnaires through a cross-sectional design. The study results indicated an increase in insecure tendencies, leading to significant issues. The safety, convenience of rides, customers' trust, market reach, and corporate reputation were all affected by the value of 3.26. At a significance level of 0.000, the hypothesis of this research produced a Multiple Linear Regression result that had an F-value of 694.450. Insufficient background checks on the riders, inappropriate conduct by the riders (harassment and violence), as well as inadequate lighting at points of pick-up and drop-off are some of the reasons why online taxi operators in Nigeria are not safe. The data indicated that violent crimes such as robbery, kidnapping, and auto theft are prevalent, complicating ride availability in high-risk areas. Concerns around security have escalated costs, impeded growth, and adversely affected the brand of the burgeoning enterprise. In conclusion, security concerns have significantly affected app-based taxi services in Nigeria. These measures have resulted in a degradation of trust between customers and businesses, an acceleration of the growth of the industry, as well as a complexity of job opportunities for transporters. To improve the flow of information, this study recommends that the police authority establishes a secure communication network. This report recommends the adoption of cashless transactions and an improvement in the online identification of taxi drivers._driver Availability as well as access to transport is greatly threatened by the issue of insecurity, thus posing a negative impact on online taxi operations. Insecurity results in increased operating costs, slowed growth, as well as damaging the image of this sector.

Keywords: App-Based, Challenges, Nigeria, Security, Taxi Services, Urban Centres.

1. Introduction

The taxi sector in Nigeria is witnessing a shift in structure and operations with the advancement of technology-based applications, such as in the urban areas. The taxi application-based business has recently emerged into the limelight as one of the driving forces in the sustainability of cities. From 1900 to 2020, public transportation in Nigerian cities experienced substantial transformation. The predominant modes of public transportation in Nigerian cities included the deteriorated molue and various commercial buses (danfo) and taxis, characterized by their distinctive yellow and sky-blue hues (Ojekere et al., 2022). Oseni (2021) asserts that app-based taxi services have commenced playing a crucial role in the transportation of individuals and commodities in most Nigerian cities.

Public transport improvements in this spectrum have increased economic and social productivity, by enabling efficient and seamless mobility of human activities, growth and densification of cities, downtowns, or industrial clusters (Aiyegbajeje, 2019). According to Ozoemenam (2021, 2024), the movement of people, goods and logistics services between originating zones and destinations across cities in Nigeria, has always been a growing challenge over the years. This is because of some growing challenges of inadequate taxis and buses to meet transport demands, growing rate of vehicular traffic congestions resulting in the loss of man hour and poor condition of existing transport infrastructure leading to inefficiency of the public transport sector.

The app-based model offers numerous benefits to the Nigerian populace, including increased accessibility, improved safety, and enhanced reliability. Riders can book a taxi from the comfort of their homes, track their rides in real-time, and have a digital record of their trips. However, this innovative transport solution is faced with operational challenges threatening its operation and sustainability. Infact, there is a growing concern across the nation on the heightened rate of security incidences and violent behaviour of miscreant on and by app-based taxi drivers. Pretorius (2022), Roughton, (2020), and Sulaimon et al. (2021), noted that there has been a steady increase to new trend of crime rate over time affecting the traditional taxis and now the app-based taxi system.

Reports have it that some criminal minded drivers readily hide guns, among other dangerous weapons while transporting clients with intention of attacking their passenger (Roughton, 2020). Malin and Chandler (2017) further assert that, women who travel late at night with male drivers especially those under the influence of alcohol face a real and frightening risk of sexual assault. App-based taxi service providers especially the major players have witnessed poor track record to react to these complaints (Malin & Chandler, 2017).

There have been reported cases of threats of physical harm, theft, fare evasion, credit card fraud, stolen or damaged vehicles and other related criminal activities to operators of app-based taxi services. Equally of concern is the case of fake passengers, who engage in negative activities, ranging from wasting a driver's time to more serious safety and security concerns of car snatching. People often ask for trips with the intention of tricking the drivers or taking advantage of the various promotions and other incentives that the platform usually offers. Sometimes, they expose drivers to dangerous situations, which may culminate in attacks and theft. Safety and security concerns are likely to increase in case of malfunctioning emergency management and safety systems or where app-based taxi drivers fail to get assistance as quickly as possible. Along the same line, Ojekere et al. (2022) indicate the mounting concerns attributed to these issues in the app-based taxi industry. The research is important because it seeks to generate findings that surpass specific challenges and provide a holistic understanding of the multifaceted elements influencing the operational environment for app-based taxi services in Nigeria.

The findings are, thus likely to inform evidence-based policies, changes in legislation, as well as technological advances that can improve the robustness and efficiency and, generally stimulate the growth of the country's app-based taxi industry. It is because of this reason that this research is of importance. This research explores how insecurity impacts operations at app-based taxi services operating in selected cities in Nigeria. Based on the assumption, the use of cash transactions, drivers' misbehavior, including harassment and assault, reliance on third-party drivers, including vehicle transfers, defectively designed apps with security loopholes, deficiency in dashboard or body cameras, inadequate law enforcement personnel, poor lighting at pickup and

drop-off points, and deficiency in emergency response measures do not significantly affect the operations of the app-based taxi service in Nigeria..

2. Material and Methods

The study is centred in selected urban centres of Nigeria. Nigeria lies between the geographic coordinates of Latitude: 4°N to 14°N, Longitude: 3°E to 15°E. At 923,768 sq. km.
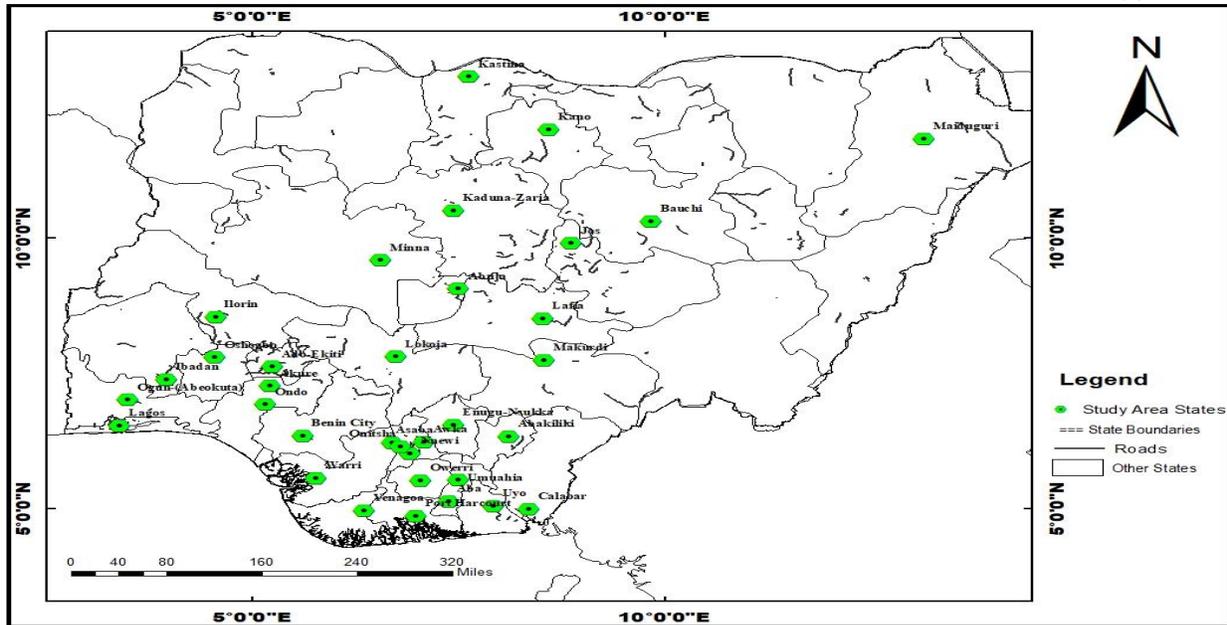
2.1. Study Area

Figure 1: Study Area Map of Nigeria Showing Urban Centres with App-based Taxi Services.

2.2 Methods

The study adopted a cross-sectional research design. This research design was utilized because it supports a descriptive study. The study population is centred on the Nigeria populace, 211,400,704 persons make up the population of Nigeria as projected (World Bank Group, 2021). The target population of interest is the population of Nigerians across the 34 operational locations where app-based taxi operators exist as at 2021-2022 (see appendix I). Note that the study population of 131,031,209 is a large one, thus; the Taro Yamane formula was applied to the targeted population to determine the manageable population size.

2.3 Determination of Sample Size:

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

$$n = \frac{131,031,209}{1 + 131,031,209(0.05)^2}$$

n   =   399.9 Approximated to = 400 (sample size)

The study instrument was correctly distributed to each demographic stratum using a proportional allocation method derived from Amamilo (2021) and Oyegun (2003). [see appendix II].

Proportionate formula: $n = \dfrac{Np \times n}{N}$

Where; Np = number of persons per strata, n = sample size of the study, and N = total population of the study.

The study made use of the two major types of data sources in carrying out this study, which include primary and secondary data. The primary sources of data were incorporated to achieve this study; As part of primary data gathering, reconnaissance survey was employed to obtain information about the operators and their indices of interest across the study area. Oral interview was conducted with app-based taxi companies and randomly selected drivers. 400 copies of the survey questionnaire were administered to users of app-based taxis through physical survey method to obtain valuable responses of interest. On the other hand, the study relied on documented information from operators of app-based taxis in Nigeria, other forms of secondary data were obtained from existing literature, published and unpublished research materials and other internet resources. The nature of data collected from the field were analysed with descriptive (mean and standard deviation) and inferential statistics such as multiple linear regression, which was adopted because it has the ability to tell relationship between dependent and independent variable. The hypothesis was tested with a computer in the environment of statistical package for social science (SPSS version 23.2).

3. Results and Discussion

Table 1: Perceptions of Respondents Regarding the Impact of Security on App-Based Taxi Services in Nigeria

S/N	Insecurity makes it harder for app-based taxis to work by	SA (4)	A (3)	D (2)	SD (1)	Mean	Std. Dev.	Remarks
a.	Reducing ride availability in perceived unsafe areas	244	114	21	21	3.5	3.0	Accepted
b.	Limiting expansion and market penetration	188	201	11	0	3.4	3.0	Accepted
c.	Reduce patronage	137	231	32	0	3.3	2.8	Accepted
d.	Increasing operational cost of implementing security measures	160	164	55	11	3.1	2.7	Accepted
e.	Creates negative publicity and reputational damage	122	202	55	11	3.0	2.6	Accepted
	Cumulative Mean					3.3		

Source: Author's Computation, 2024.

The perception of respondent as displayed in table 1 examined the effect of security on app-based taxi service operations in Nigeria. The major finding from this objective, shows that

security incidences have hugely and negatively affected the operations of app-based taxi service in Nigeria. It is buttressed by the cumulative mean score of 3.3 obtained in the study. Drivers of major service providers such as Bolt, Uber among others are lamenting on the consistent attacks and killing of their colleagues (drivers) by criminal elements in the society.

The availability of app-based taxi services, or ride availability around unsafe locations has been reduced by the growing records of security incidents in Nigeria. The security situation in the country, which includes violent crime, kidnapping, ritual killings and terrorism, has resulted to decrease in drivers' willingness to work in certain areas and time. Drivers avoid certain areas in a bid to avoid potential security flash points, with previous records of frequent attacks, kidnapping, or robbery especially during night hours. These attacks are not only on the drivers as the passengers are often victims of attacks by their drivers. The findings are substantiated in Alade (2020) and Oseni, (2021), on the increasing reports of unwholesome practices, including sexual molestation, kidnapping, due to the steady infiltration of unsuspected drivers into the system as there is inadequate background check mechanism by the app-based taxi companies. Again, according to the report of the Nigeria Bureau of Statistics(date??), incidents of kidnapping, armed robbery and other violent crimes had substantially increased throughout the country in recent years. Safety for both drivers and riders are not fully resolved, as many drivers are regularly killed, and their vehicles stolen.

Security has also threatened the services of app-based taxi operation by limiting expansion and market penetration. This study assertion recorded a significant mean score of 3.4, thus the rate of security incidents and casualties record, scare app-based taxi companies, and limits drivers' willingness to operate in some locations. There are no adequate security measures in the country to manage the issues of security ranging from kidnapping, murder, car theft, robbery, and property theft. These circumstances have not only threatened the services of app-based taxi services but limits both their expansion strategy and market penetration. Some of the security flash points in Nigeria where drivers of app-based taxis deliberately avoid due to security concerns, include; Rivers State (Ogbogoro, Ozuoba, Choba, Aluu, Mile 1, Diobu, D-Line, Rumuibiakani, Elelenwo, Rumukrushi, Woji, and under-bridge of flyovers at Eleme Junction interjection and Mile 1 axis), Benue State (North Bank, Nyima, Agan), Lagos State (Ijegun, Ikotun, Igundo, Oshodi, Ikorodu, VGC (Victoria Garden City), Ajah, Berger, Mile 2), Abuja (Airport road, Kubwa bridge, Dei-Dei, Galadimawa roundabout, Federal Housing Junction, Lugbe, Area 1, and Utako), Benin city, and Imo State (Emekuku, Control Axis, Akwakuma).

The lingering security issue in the northern part of Nigeria over the past 10 years arising from the act of boko haram terrorists and bandits have constrained the expansion and penetration strategies of app-based taxi companies in the region. This position was also corroborated in the work of Osimen, et al. (2017), as they attributed the persisting security problem in the north to the borderless borders in Nigeria and affirmed its increase in recent years. This has become one of the most perverse challenges facing the country today and indirectly affecting the economy, job creation, e-transport development, and app-based taxi services. App-based taxi operations and expansion is not left out.

Security also contributes to a reduction in patronage with a mean score of 3.3; drivers are normally scared and unwilling to operate in flash point areas; hence genuine riders are not only deprived of such services. This practically reduces the level of patronage originally and supposedly enjoyed from these areas. Some of the drivers interviewed revealed that increase in security

incidences has affected their operations drastically and affecting demand and supply of app-based taxis services. Considering the ample record of attacks on drivers and users, operating companies have initiated new measures especially on users' app to help mitigate against this ugly trend. Unfortunately, limited or no reasonable level of success has been recorded so far. The study affirmed at a mean score of 3.1 that security incidences increase operational cost, as TNCs deploy additional security measures at a cost. Bolt and Uber have introduced additional safety features in their apps, which include an SOS push button for emergency situations. These features allow riders not only to share their trip with friends and family members but provide feedbacks on the trips via the driver rating system for accountability.

At significant mean of 3.0, the study revealed that the heightened level of security incidences in the app-based taxi operation, creates negative publicity and reputational damage to the e-transport sector. Note that security trend breeds fear amongst users and drivers, a significant (81%) proportion of users as ascertain from the study survey are a bit scared of ordering app-based taxis at night while drivers often bluntly decline suspicious ride requests (to or from perceived high-risk areas). The consistent reoccurrence of security incidences portrays app-based taxi service as less attractive choice to fulfil one's transportation needs. The reputation of the sector is being dragged down by criminal elements, masking as app-based taxi drivers and/or passengers.

The app-based taxi services have also faced consistent attacks on their drivers and users in some cities, majorly Port Harcourt metropolis, Lagos metropolis, selected areas in Abuja FCT and other growing flash points in Northern and South-Eastern Nigeria. This has invariably affected the wide range of services rendered across the geographical space of Nigeria, distorting income flow on the side of app-based taxi companies and denying Nigeria their right to access e-propelled transport services within and across cities.

The findings emanating from this study are killer issues gradually destroying the operational system of the app-based taxi services in Nigeria. They are novel and apt, and as Nwagboso (2018) corroborated, major internal security challenges like Niger Delta crises, agitations and kidnapping in south-east geo-political zone, Jos crises, Boko Haram crises and disasters by Fulani herdsmen in northern and central parts of Nigeria, have contributed hugely to the worsening security challenges facing the operation of app-based taxis in Nigeria.

The task of addressing this deteriorating security trends in the country, would be a very demanding one as the current security architecture cannot close this obvious gap. Hence, Ugwuishiwu, et al. (2019) affirmed that the standalone operating systems of Nigerian Law Enforcement Agencies, does not propel for adequate collaboration for effective crime management. They recommended that a security architecture or strategy is needed to develop a Model of Real-Time Integrated Crime Information System (ICIS) that will improve the Law Enforcement Agencies (LEA) capability on crime management.

In addition to the findings in this study on internal and external security issues, Feeney (2019) posits that passenger privacy constitutes one greatest security concerns for app-based taxi passengers. Passengers registered personal data stored in the platform apps and visible to app-based companies and their taxi drivers, is identified as a massive privacy concern. There are fears that this could be a source of information for hackers, through which passengers can be defrauded. For instance, some passengers from Kano metropolis, FCT Abuja, Lagos, and Port Harcourt revealed through interview that some drivers have used such information to trace specific passengers on social media. This results in harassment, life-threatening messages and general

threat to lives, especially as some app-based taxi drivers have picked or dropped-off passengers at their place of abode.

It is to address such scaring security concerns on app-based taxi services in Nigeria, that Deighton-Smith (2021) noted that some of the implemented taxi regulations are targeted at ensuring the security and safety of drivers and passengers. Bolt, Uber, and other companies' apps were updated to handle potential concerns, such as assault, robbery, and injuries from accidents caused by careless drivers or cars that aren't well-maintained. Some further solutions from regulators include driver "fit and proper person" checks, mandates for in-vehicle CCTV, age restrictions on cars, maintenance schedules, and mechanical inspections. The impact of these recent security and safety updates in apps didn't reflect in the outcome of this study. This could be as a result of the increasing number of drivers and worsening security situation in the country.

Restricting booking, drivers and passengers may be easily identifiable via the use of GPS monitoring and app-based payment, leading to a high level of responsibility. Additional safety features will include in-app "panic buttons" and real-time ride-tracking. Cars don't need cash when paying with credit cards (again via the app), and because cards can't be readily used fraudulently, the likelihood of fraud and robbery is significantly reduced. High degrees of transparency and accountability are provided by the consensus grading system, which encourages appropriate conduct (MacEachen, 2018). It provides feedback for further upgrade of the apps security, capabilities and operations model.

It is obvious that, the keen request of app-based taxi drivers for offline trips is to allow them to receive the total trip charge without remitting some percentage to the app-based taxi companies as stipulated. This should be a germane security concerns on the side of the passenger.

The regression results in Table 2 indicate that the model is statistically significant, evidenced by an F-statistic of 694.450 at a significance level of 0.000. The findings reveal that inadequate driver background checks, incidents of driver misconduct such as harassment and assault, reliance on cash transactions, deficient in-app security measures, minimal law enforcement presence, poor lighting at pick-up and drop-off sites, and ineffective emergency response systems substantially affect the security conditions of app-based taxi services in Nigeria. The coefficient of determination ($R^2 = 0.934$) indicates that these parameters collectively explain approximately 87.24% of the variations in the security implications encountered by app-based taxi services in the country. The increasing incidence of security-related cases reported by drivers and users can primarily be attributed to the interplay of these identified elements.

Hypothesis Testing

H_0: Insecurity does not markedly affect the functioning of app-based taxi services in Nigeria, demonstrated by, among others, inadequate background screening and driving vetting, inappropriate conduct by drivers such as harassment and Rape, cash transaction, reliance on freelance drivers, insecurity of the app, absence of body cams or monitors, inadequate policing, poor lighting of pick-up and drop-off points, and poor emergency response mechanisms.

H_1: Insecurity affects app-driven taxi services in Nigeria. Lack of adequate security screening of vehicles and drivers, abuse of drivers (harassment or assault), use of cash payments, use of third-party drivers, security vulnerabilities of the app, a lack of camera security on the dashboard or in the body of the vehicle, a lack of security personnel from the police, poor lighting of pick-up and drop-off points, and inadequate plans to address emergencies can be perceived as some of the reasons.

Table 2. Regression analysis of variation on security in Nigerian app-based taxi services

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	157.174	8	19.647	694.450	.000b
Residual	11.062	391	.028		
Total	**168.236**	**399**			

a. Dependent Variable: Security
b. Predictors: (Constant), *inadequate immediate action procedures, drivers' misbehavior (harassment, assault), cash transactions, insufficient app security, not enough checks on records and driver vetting, insufficient policing, failure to use dashboard or body cam, and poor illumination at both pickup and drop-off locations are all predictors*.
Source: Author's computation, 2024.

Table 2 the findings indicate that the F-value of 694.450 is significant at 0.000. Factors such as inadequate verification of drivers' identities, driver misconduct (including harassment and assault), payments in cash, insufficient app security, limited police presence, poor lighting at pick-up and drop-off points, and inadequate evacuation plans significantly affect the safety of smartphone taxi services in Nigeria. Thus, the contrasting hypothesis is supported, whereas the null hypothesis, which claimed there is no significant linear relationship between privacy and app-based taxi businesses in Nigeria, is rejected.

Table 3: t-values of regression of security on app-based taxi service operations in Nigeria

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.120	.492		.244	.807
	Inadequate driver vetting and background checks	.024	.046	.019	.533	.594
	Drivers' misconduct (harassment, assault)	.014	.140	.003	.103	.918
	Cash transaction	.265	.037	.295	7.250	.000
	Insufficient app-security	.050	.041	.046	1.214	.225
	Non-use of dashboard or body cam	-.072	.042	-.070	-1.722	.086
	Inadequate policing	.336	.039	.356	8.534	.000
	Inadequate lighting at pickup and drop-off locations	.147	.035	.214	4.193	.000
	Insufficient emergency response protocol	.172	.043	.167	3.974	.000

a. Dependent Variable: Security on app-based taxi service operations

Source: Author's computation, 2024.

Table 3 shows the contributions of the individual predictor. Ther result shows that the inadequate drivers vetting and background checks (β=.019, t=.533, P=.594), drivers' misconduct (harassment, assault) (β=.003, t=.103, P=.918), cash transaction (β=.295, t=7.250, P=.000), insufficient app-security (β=.046, t=1.214, P=.225), inadequate policing (β=.356, t=8.534, P=.000), inadequate lighting at pickup and drop-off locations (β=.214, t=4.193, P=.000), and insufficient emergency response protocol (β=.167, t=3.974, P=.000) positively predict the effect of security on app-based taxi service operations in Nigeria.

Table 4: Model Summary on the effect of security on app-based taxi service operations in Nigeria.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.967ᵃ	.934	.933	.16820

a. Predictors: (Continuous), *inadequate emergency response procedures, drivers' misbehavior (violence, harassment), cash transactions, inadequate app security, insufficient background checks and driver vetting, insufficient policing, failure to deploy dashboard or body cam, and inadequate lighting at pickup and drop-off locations.*

Source: Author's computation, 2024.

Table 4 demonstrates that the coefficient of assurance (RÂ²) is 0.934. 87.24% of the variation in security outcomes can be explained by the variation in the set of indicators, including a lack of foundation checks, driver checks, driver misconduct (badgering or attack), money exchange, insufficiency of app security, a lack of proximity of the police, insufficient lighting at pickup/drop-off areas, and ineffective crisis response agreements, that security has on app-based taxi companies in Nigeria. All the aforementioned issues have an influence of 87.24% on security.
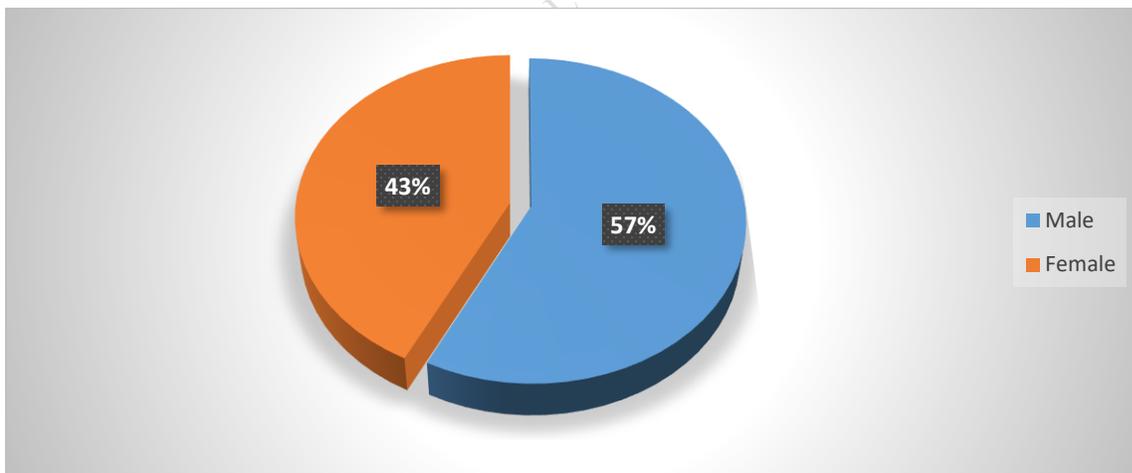

Figure 2: Gender of Respondents

Source: Author's Analysis, 2023.

Figure 2 indicates that 57% of participants are male, whereas 43% are female. However, it is likely that male involvement in taxi services offered through mobile applications is prevalent, including as a driver. This is consistent with research indicating that men and women differ in their use of public transport, where women use it less often due to safety, preconceptions, and social norms. However, since the application enables women to move around more freely while also

allowing them to make money, some of them still use it. Female users of the application express a need for more safety measures. Gender disparities affect the decisions of the transport providers, frequency of safety risk, and services received. Gender disparities need to be corrected to ensure safety, accessibility, and equity in the transport system.
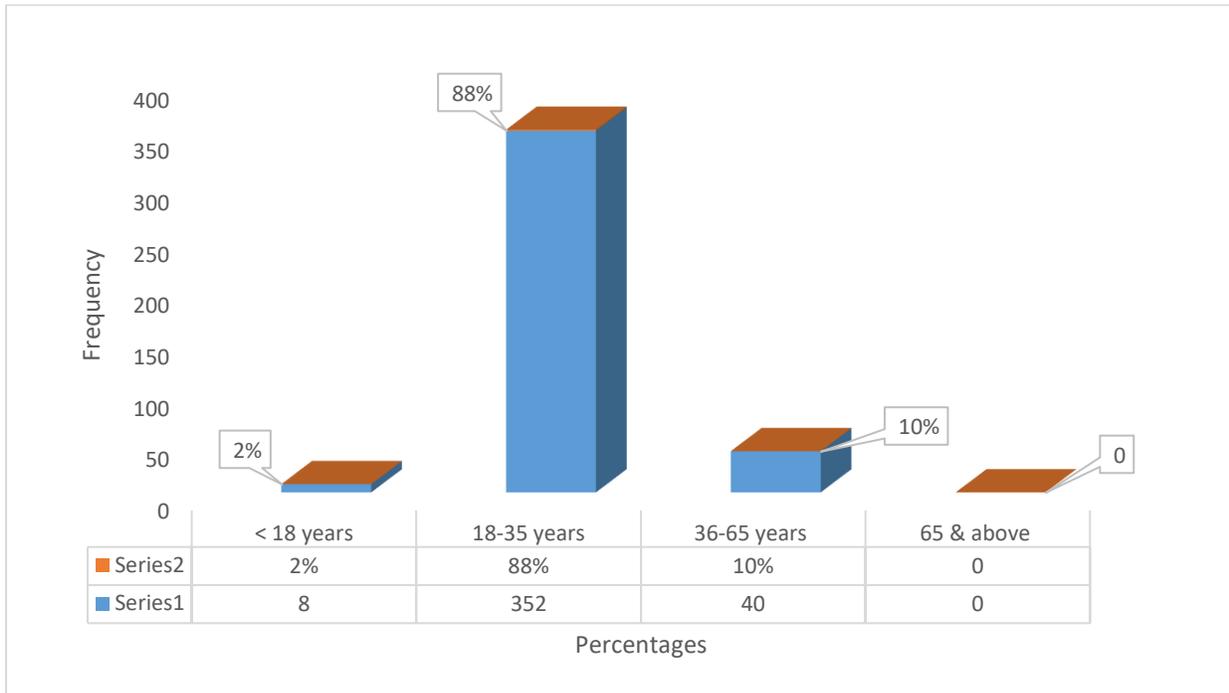

Figure 3: Respondents Age Brackets

Source: Author's Analysis, 2023.

The age distribution of the people who took the survey is shown in Figure 3. Data shows that the primary users of application-supported taxi services are people aged between 18 and 35 years, representing 88%. Few people fell within the bracket of less than 18 and above 65 years, while 10% fell between the ages of 36 and 65 years. The elderly rarely use e-hailing services due to their limited technology knowhow and susceptibility to fraud, as revealed in the interviews. Since they are used to technology and products and learn new technologies quickly, millennials and Generation Z are the most frequent users of technology and products. The design and implementation of transport policy are greatly affected by the consumption trend by ages.
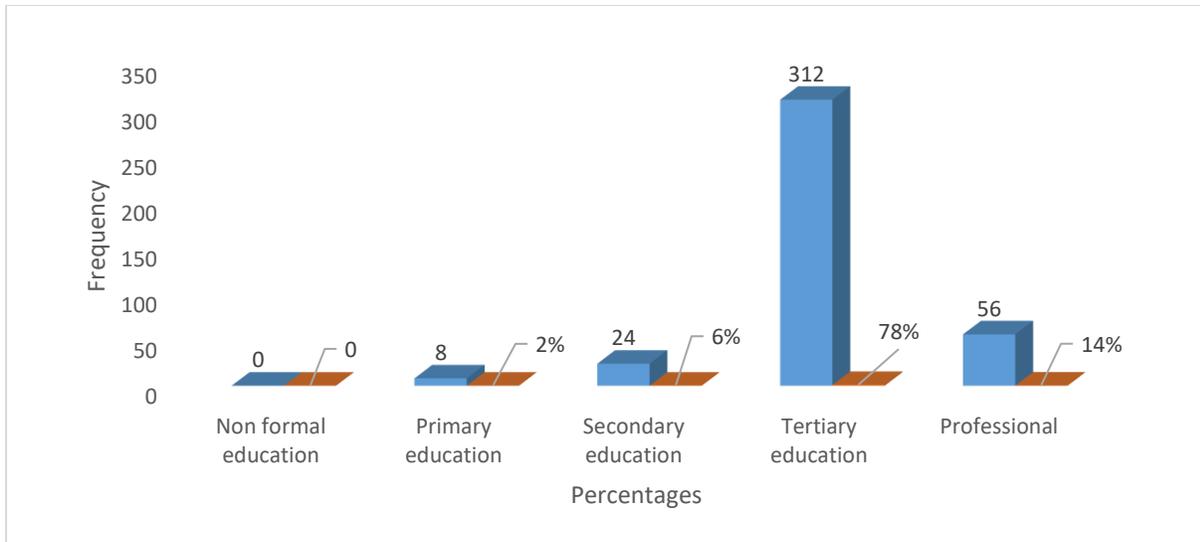
Figure 4. Education Status of Respondents

Source: Author's Analysis, 2023.

Figure 4 shows the level of education of the people who answered. This proves that 78% of them possess a college-level education. Professionals (14%), Secondary (6%), and Primary (2%) follow. Based on the research discussions, individuals with higher educational levels are more technology-savvy and are more likely to use app-based taxi services, especially when they travel to and from their offices. While individuals with lower levels of education think more about prices, individuals with higher educational levels are more likely to pay extra for surge pricing. The group was informed that individuals will be more likely to use services around colleges and business areas. Those with a higher educational level provide more effective and helpful information. These factors are critical when developing services that can be effective and beneficial.

Table 5: Annual Income Bracket/Level of Respondents

Income Bracket	Annual Income Range
Low-income earner	₦0 - ₦600,000
Medium income earner	₦600,000 - ₦5,000,000
High income earner	₦5,000,000 and above

Source: Author's Analysis, 2023.

Table 5 sorts the people who answered into groups based on their income levels: low, middle, and high. The interviews carried out among participants indicated that many people from low-income households generally avoided using the app-based taxis due to lack of affordance to utilize payments through apps or lack of access to mobile phones. For middle-class respondents who had to find a balance between affordability and convenience to meet their mobility needs, they said they used them more often. For those from higher-income households who used them

more often due to convenience, punctuality, and not having to use their personal cars, they said they used them frequently. The amount people buy is highly dependent on income. It is very difficult for Nigerians to get the products they desire due to the state of the economy.
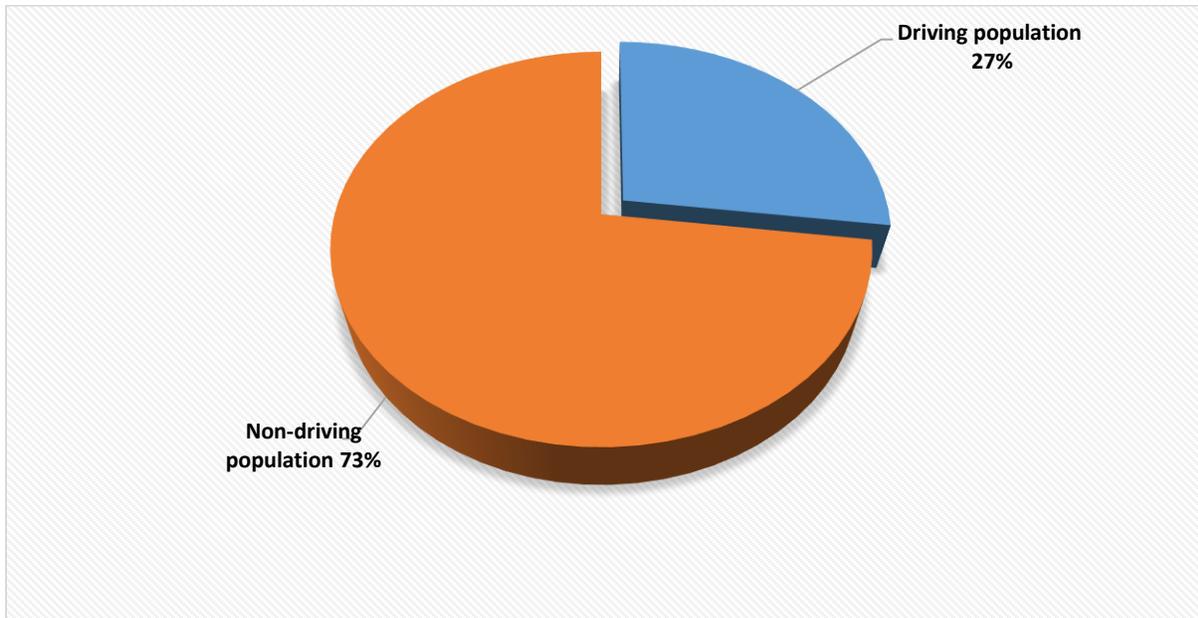

Figure 5: Respondents Involvement in App-based Taxi Drivers

Source: Author's Analysis, 2023.

Figure 5 shows that 73% of the people who answered the survey use app-based taxi services regularly, and 27% said they are both drivers and users. This gap clearly shows that the market is yet to be fully saturated. The number of drivers is also increasing, which clearly shows that people are trying to maximize their earnings by looking for ways to optimize their route to their destination. The e-hailing is most prevalent in major towns such as Abuja, Lagos, Port Harcourt, Enugu, Asaba, Makurdi, and Ibadan, as shown by the number of users. However, there are more drivers in urban areas, and in some cases, services are not readily available. In fact, 68% of the drivers interviewed anonymously and requested not to disclose their identities revealed that their businesses have been severely affected by the new regulation introduced by the Lagos State government due to the extra cost represented by registration and obtaining a license. Despite this increasing number of suppliers in the market, application-enabled taxi businesses are yet to gain popularity.

5. Conclusion and Recommendations

The research explores the use of application-based taxi companies in different cities in Nigeria and reveals how insecurity affects the sector significantly. Insecurity has thus led to low demand usage, higher costs of operations, and made business operations even more difficult for these companies. Insecurity also led to low consumer confidence and trust, stalled business growth, and financial losses for users and companies alike. From the research data, violent offenses such as car theft, kidnapping, and robbery are prevalent and thereby limit access to these services in high-risk regions. The issue of security has thus marred the reputation of this nascent sector and made business operations even more expensive for these companies. Even though various

measures have been taken with regard to security, these seem inefficient within the particular research context. It is thus important for these companies to make profound changes in the sector of security and crime prevention measures to win back the community's confidence. Based on what we found, we suggest the following:

i. The report mainly recommends cooperation and tough, coordinated measures in finding the solutions to security matters; for instance, using technology in data management and ensuring easy knowledge sharing. In addition, the report urges a centralized and secure communication system that will facilitate easy document sharing among different organizations in law enforcement.

ii. A police character certificate and official clearance from statutory regulatory bodies should be part of the driver verification procedure. Currently, it comprises document verification, car inspections, and background checks.

iii. It is important to encourage and reward cashless transactions. Businesses could also think about biometric certification or facial recognition. Other SOS capabilities, such as the option to record voice on the app, and panic button functionality ought to be included.

iv. App-based taxi businesses should use end-to-end encryption for all data sent within the app and georeferenced secure operating areas.

v. In order to make well-informed choices and modifications, the study promotes the gathering and examination of data pertaining to app-based taxi services security exposure. This information can be utilized to pinpoint trouble spots and create a geo-refenced region.

vi. To app-based taxi users: the study recommends abolition of off-line trips. Users should reject the temptation of requesting or accepting off-line trips and operators should carry out intermittent campaigns on the dangers of off-line trips to reduce security incidences.

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Appendix I

Table 3.1. Target Population of the Study

S/N	City	Population*	Operators (app-based taxi companies codes)**
1	Aba	2,845,380	1
2	Abakiliki	2,176,947	1
3	Abuja	1,406,239	1, 2, 5, 6, 7
4	Ado-Ekiti	2,398,957	1
5	Akure	3,460,877	1, 2
6	Asaba	407 198	1, 27, 39
7	Awka	4,177,828	1, 32
8	Bauchi	8,308,800	1,
9	Benin	3,233,366	1, 5, 15, 28
10	Calabar	2,892,988	1, 14,
11	Enugu – Nsukka	3,267,837	1, 2, 14, 19, 29, 39
12	Ibadan	5,580,894	1, 2, 16, 20, 21
13	Ilorin	2,365,353	1
14	Jos	3,206,531	1
15	Kaduna-Zaria	6,113,503	1
16	Kano	9,401,288	1
17	Katsina	10,368,500	1
18	Lafia	1,869,377	1
19	Lagos	9,113,605	1, 2, 3, 5, 6, 7, 8, 18, 22, 23, 24, 26, 30, 33, 34, 35, 36, 37, 38, 40
20	Lokoja	3,314,043	1
21	Maiduguri	1,112,449	9
22	Makurdi	4,253,641	9
23	Minna	513,491	1
24	Nnewi	1,239,186	1
25	Ogun (Abeokuta)	6,379,500	1
26	Ondo	5,300,000	1
27	Onitsha	1,623,000	1
28	Oshogbo	3,416,959	1
29	Owerri	3,927,563	1
30	Port Harcourt	5,198,716	1,2, 3
31	Umuahia	2,845,380	1, 2, 3, 4, 10, 11, 12, 13, 17, 39
32	Uyo	3,902,051	1, 2
33	Warri	4,112,445	1, 2
34	Yenagoa	1,704,515	1, 2

Legend for Table 3.1. Target Population of Study

Code	Names of App-based Taxi Services	Code	Names of App-based Taxi Services	Code	Names of App-based Taxi Services	Code	Names of App-based Taxi Services
1	Bolt	11	Alpha Ride	21	13Cabs	31	Boo Boo cabs
2	Uber	12	Opay	22	Afro	32	Cabmen
3	Pamdrive	13	Ceety Taxi	23	Gaabia	33	Smoothride
4	In Drive	14	My Cabman	24	Gidi	34	Gomyway

5	Smart cabs	15	Fast Taxi	25	Liftme up	35	Holycab
6	Rida	16	Zrideng	26	Safeboda	36	Hitch Africa
7	Oga taxi	17	CabbyNg	27	Pickme up	37	Plentywaka
8	Oride	18	Max	28	Naijacab	38	Eekocab
9	Eryde	19	RideOnTaxi	29	IVMCruise App	39	Enviable transport
10	Easy Ride	20	Tusla Yellow Cab	30	Carxie	40	Jekalo

Sources: Author's computation, 2024., National Bureau of Statistics*, PEDPAN**

*Appendix II

Table B: Determination of Sample Size

S/N	Urban Centres**	Population of City**	Proportionate method of allocation* $\frac{Np \times n}{N}$
1	Aba	2,845,380	9
2	Abakiliki	2,176,947	7
3	Abuja	1,406,239	4
4	Ado-Ekiti	2,398,957	7
5	Akure	3,460,877	11
6	Asaba	407,198	1
7	Awka	4,177,828	13
8	Bauchi	8,308,800	25
9	Benin	3,233,366	10
10	Calabar	2,892,988	9
11	Enugu – Nsukka	3,267,837	10
12	Ibadan	5,580,894	17
13	Ilorin	2,365,353	7
14	Jos	3,206,531	10
15	Kaduna-Zaria	6,113,503	19
16	Kano	9,401,288	28
17	Katsina	10,368,500	32
18	Lafia	1,869,377	6
19	Lagos	9,113,605	28
20	Lokoja	3,314,043	10
21	Maiduguri	1,112,449	3
*22	Makurdi	4,253,641	13
23	Minna	513,491	1
24	Nnewi	1,239,186	3
25	Ogun (Abeokuta)	6,379,500	19
26	Ondo	5,300,000	16
27	Onitsha	1,623,000	5
28	Oshogbo	3,416,959	10
29	Owerri	3,927,563	12
30	Port Harcourt	5,198,716	16
31	Umuahia	2,845,380	9
32	Uyo	3,902,051	12
33	Warri	4,112,445	13
34	Yenagoa	1,704,515	5
**	**Total**	**131,031,209**	**400**

Sources: *Researcher's computation, 2024,
         **National Bureau of Statistics & PEDPAN.