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App-Based Taxi Service Operations and Insecurity Challenges in Nigeria

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ABSTRACT: With an emphasis on the escalating problem of insecurity, this study examines the difficulties encountered by Nigerian app-based taxi service providers. The rise in popularity of ride-hailing services in urban and peri-urban regions, such as Uber, Bolt, and others, presents a distinct set of security-related obstacles to their expansion and long-term viability. These include assaults on drivers and passengers, car-hijacking, and violent crimes, all of which have sparked worries about the security of app-based transportation services. The study also looks into how these security issues affect the operational strategies of taxi service providers, driver recruitment and retention, and user trust. The report also looks at how government regulations, technical advancements, and regulatory frameworks might enhance security in the ride-hailing sector. Results show that the operational effectiveness of taxi services is severely harmed by insecurity, insufficient law enforcement, and a lack of strong safety features in apps. In order to allay these security worries and guarantee the long-term sustainability of app-based taxi services in Nigeria, the paper ends with suggestions for strengthening safety procedures, raising user and driver awareness, and encouraging cooperation between ride-hailing businesses and law enforcement.

KEYWORDS: Insecurity, App-based taxi services, Ride-hailing, Driver safety, Operational challenges

I. INTRODUCTION

Recent years have seen a huge revolution in the taxicab transportation industry: app-based taxi services (also known as ridesharing, ride-hailing, or e-hailing) have drastically changed how people commute, particularly in urban areas. The companies that offer these app-based taxi services, commonly referred to as Transport Network Companies (TNCs), connect available drivers and potential passengers in real-time via a smartphone-based, internet-enabled platform. This makes the process of acquiring a passenger ride service effective, convenient, quick, and transparent (Shaheen et al. 2015; cited in Wadud, 2020). Global and regional TNCs like Bolt, Ola, Opay, Ceetytaxi, Easyride, Grabor Careem, Uber, Lyft, and Didi-Chuxing quickly made these services widely available. They are currently available in almost every major city worldwide, with the exception of those where they do not adhere to local laws and other technical considerations (Wadud, 2020).

Technology like the Global Positioning System (GPS) and real-time tracking are essential to app-based taxi services. Mobility services based on smartphone apps and GPS technology, which take advantage of real-time geographical information and are tailored to customers' demands, have grown and diversified rapidly in the last ten years, according to the International Transport Forum [ITF] (2019). Transportation systems have been significantly impacted by the Global Positioning System (GPS). The advent of app-based applications in the taxi sector is one of the recent technological innovations, and advancements in GPS technology have significantly boosted the expansion of automated transport systems in a number of areas, claim Benson and Jane (2020). All things considered, technology has significantly increased the effectiveness and dependability of app-based taxi services. App-based taxi services provide consumers with a convenient, dependable, and secure mode of transportation by utilizing technology including GPS monitoring, machine learning algorithms, mobile apps, in-app communication, payment processing, and driver rating systems.

Due to a greater supply of cars and drivers in major cities, app-based application services have created intense rivalry in the taxi market. Among others, Bolt, Uber, and Little Cab were created with the vision to distinguish their operations from the traditional taxi business model, which has improved efficiency and profitability. App-based taxi companies are

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made up of an operations management system that makes sure drivers provide excellent customer service and that vehicles are in good working order, as well as a fleet management system that manages pricing, tracking, rewards, and vehicle allocation.

As more people sign up for the programs, these transportation options have expanded quickly. Additionally, the number of operators has increased, and the services are now available in more regions. Between 1900 and 2020, public transportation in Nigerian cities underwent significant reform. The most common forms of public transportation in Nigerian cities were the dilapidated molue and a variety of commercial buses (danfo) and taxis (taxi) with the signature yellow and sky-blue colors (Ojekere et al., 2022). In the majority of Nigerian cities, the rise of app-based taxi services has begun to significantly impact both the movement of people and products (Oseni, 2021).

The app-based services have expanded rapidly from two operators in 2014 to over forty (40) in 2021, many of which have begun operations in Nigeria's major cities, taking advantage of the country's inadequate public transportation system, large population, and fast urbanization. According to Statista (2020) and Johnson et al. (2020), the nation's app-based or digital ride-hailing business is expected to bring in roughly USD 292 million annually and represent 15% of the 48.6 million app-based user records on the African continent. According to Ojekere et al. (2022), ridesharing platforms have improved the comfort and convenience of transportation for Nigerians since its inception in 2014.

Nigeria's economy has benefited from the expansion and operation of app-based taxicab services in a number of areas, including employment development, logistics, door-to-door distribution, and quick transportation options. However, operational issues are compromising the viability and functionality of this creative transportation solution. Concern over the increased frequency of security incidents and violent deviant behavior by and on app-based taxi drivers is spreading throughout the country. According to Sulaimon et al. (2021), the trend of crime rates has been steadily rising over time, impacting both traditional taxis and the more recent app-based taxi system.

Pretorius (2022) and Roughton (2020) claim that the emergence of ridesharing applications has changed the transportation industry while creating new opportunities for criminal conduct. You can use the TNCs' app to offer your driving services if you are at least one year old and meet the country's driving age requirements (Uber, 2020). Sadly, despite insufficient background checks and continuous driver assessments, app-based taxi services have made it possible for certain dishonest drivers to enter the market (Roughton, 2020). Customers are therefore unaware that they may be delivered by people with questionable criminal backgrounds and character traits (Thorebecke, 2019). Crimes include driving under the influence, becoming a victim, harassing someone else, assaulting someone, and stealing (Henama et al., 2017). Despite having obvious gaps in their background checks, the drivers in issue have been employed as independent contractors by businesses such as 247TaxiCabx, Alpha2Rides, Opay, CabbyNG, Bolt, Easyride, and Uber (Dyer, 2017). The ability of drivers to conceal handguns while transporting customers has led to an increase in the use of app-based taxi services (Roughton, 2020).

Moreover, female patrons who accompany male drivers on late-night excursions, particularly when they are intoxicated, are at risk of sexual assault (Malin and Chandler, 2017). The big companies in the app-based taxi industry, in particular, have a poor record of responding to these complaints (Malin and Chandler, 2017). Due to the perception that Uber drivers steal clients from metered taxi drivers and so hurt both parties, there are operational problems linked to the competition between app-based taxi drivers, such as Metered taxi and Uber taxi drivers (Adebayo, 2019).

The rise in these issues suggests that app-based taxi drivers work fewer hours at night and turn down transport requests from locations with high security concerns. It is acknowledged that the nation's rising rate of insecurity has made it more difficult for app-based taxi drivers to operate efficiently because suspected excursions are being canceled and occasionally avoided at the time of pickup according to the customer's circumstances. Given the significant influence these issues have on the efficacy and efficiency of the sector, evaluating the operational difficulties encountered by Nigerian app-based taxi services is crucial. The interconnectedness and complexity of the issues found serve as the foundation for this study, and each one is vital in determining how app-based taxi services operate in the nation. This study was designed with this context in mind.

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II. MATERIAL AND METHOD

Location and extent

Nigeria is located between 3 degrees east and 15 degrees west and 4 degrees north and 14 degrees north in the West African region. It is quite vast at 923,768 square kilometers. It shares borders with the Republic of Benin and Cameroon on the west, the Republic of Niger and Chad on the north, and the Atlantic Ocean, which defines Nigeria's southern border, on the east with the Republic of Cameroon. It is more than 1,050 kilometers long from north to south and almost 1,200 kilometers long from east to west. There are mountains on its eastern border, high plateaus to the north, and the lowlands of the Niger River along its shore. The Nigerian populace serves as the study's population. Nigeria has a population of 211,400,704 (World Bank Group, 2021). Nigerians living in cities with app-based taxi services are the study's target audience of interest.

Table 1. Target Population of the Study

City	Population	Operators (app-based taxi companies codes)
Aba	897,560	1
Abakiliki	662,000	1
Abeokuta	593,100	1
Abuja	3,840,000	1, 2, 5, 6, 7
Ado-Ekiti	536,000	1
Akure	484,798	1, 2
Asaba	407 198	1, 27, 39
Awka	2,560,722	1, 32
Bauchi	670,280	1,
Benin City	1,125,058	1, 5, 15, 28
Calabar	371,022	1, 14,
Enugu	722,664	1, 2, 14, 19, 29, 39
Gulu (Kano)	N/A	2
Ibadan	3,565,108	1, 2, 16, 20, 21
Ilorin	814,192	1
Jos	816,824	1
Kaduna	1,582,102	1
Kano	3,626,068	1
Kastina	523,950.	1
Lafia	374,084	1
Lagos	9,000,000	1, 2, 3, 5, 6, 7, 8, 18, 22, 23, 24, 26, 30, 33, 34, 35, 36, 37, 38, 40
Lokoja	839,046	1
Maiduguri	1,112,449	9
Makurdi	454,419	1
Minna	496,000	1
Nnewi	1,239,186	1
Nsukka	444,100	1
Ogun	6,379,500	1
Ondo	475,286	1
Onitsha	1,623,000	1
Oshogbo	772,000	1
Owerri	401,873	1, 2, 3,
Port Harcourt	1,148,665	1, 2, 3, 4, 10, 11, 12, 13, 17, 39
Umuahia	359,230	1, 2
Uyo	1,329,000	1, 2
Warri	557,398	1, 2, 3
Yenagoa	266,008	1
Zaria	975,153	1

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Legend for Table 2 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	IVM Cruise App	39	Enviable transport
10	Easy rRide	20	Tusla Yellow Cab	30	Carxie	40	Jekalo

Sources: Researcher's computation, 2021. (National Bureau of Statistics & PEDPAN)

Given the size of the study's target population, the Taro Yamane formula must be used to reduce the population to a manageable size. A sample size of 400 was obtained by applying the Taro Yamane formula to the population (129,918,760). Additionally, the study instrument was used to sample the respondents using the basic random sampling technique. The total population of the study was inserted into the Taro Yamane formula as illustrated below:

Table 3 Determination of Sample Size

S/N		Population of City	Proportion of total population $\frac{Np \times n}{N}$
1	Aba	2,845,380	9
2	Abakiliki	2,176,947	7
4	Abuja	1,406,239	4
5	Ado-Ekiti	2,398,957	7
6	Akure	3,460,877	11
7	Asaba	407 198	1
8	Awka	4,177,828	13
9	Bauchi	8,308,800	25
10	Benin	3,233,366	10
11	Calabar	2,892,988	9
12	Enugu – Nsukka	3,267,837	10
13	Ibadan	5,580,894	17
14	Ilorin	2,365,353	7
15	Jos	3,206,531	10
16	Kaduna-Zaria	6,113,503	19
17	Kano	9,401,288	29
18	Katsina	10,368,500	32
19	Lafia	1,869,377	6
20	Lagos	9,113,605	28
21	Lokoja	3,314,043	10
22	Makurdi	4,253,641	13
23	Minna	513,491	1.5
24	Nnewi	1,239,186	3

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25	Ogun (Abeokuta)	6,379,500	20
26	Ondo	5,300,000	16
27	Onitsha	1,623,000	5
28	Oshogbo	3,416,959	11
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
35	**Total**	**129,918,760**	**400**

Sources: Researcher's computation, 2021. (National Bureau of Statistics & PEDPAN).

The total population of the study was inserted into the Taro Yamane formula as illustrated below:
Taro Yamane (1967) provides a simplified formula to determine the sample size.

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

Where: n = the sample size

N = the total population
e = the error of sampling/accepted error limits (0.05)
1 = the constant figure/level of precision

The Taro Yamane formula is applied to the above population to determine the sample size:

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

$$n = \frac{129,918,760}{1 + 129,918,760(0.05)^2}$$

$$n = \frac{129,918,760}{1 + 129,918,760(0.0025)}$$

$$n = \frac{129,918,760}{1 + 324,796.9}$$

$$n = \frac{129,918,760}{324,797.9}$$

$$n = 399.9$$

Approximated to = 400 (sample size)
The study instrument was adequately distributed to each population strata using a proportionate method of allocation derived from Amamilo (2021) and Oyegun (2003).

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

Where Np = number of persons per strata
n = sample size of the study

N = total population of the study.
See table 3. for the calculation of the ratio of questionnaire (instrument) distributed.
400 copies of questionnaires were administered to users of the app-based taxis in Nigeria through physical survey method to obtain valuable resp onses of interest. Oral interview was conducted with the management staff of each of the app-based taxi companies and drivers.

III. RESULTS AND ANALYSIS

The four hundred (400) copies of the questionnaire were all properly completed, yielding a 100.0% response rate. According to Mugenda (2003), data analysis requires a response rate of 50% or above. According to Ilo et al. (2010), this suggests that 100.0% response rates were highly suitable for data processing.

Demographic Implications of Respondents
Gender distribution

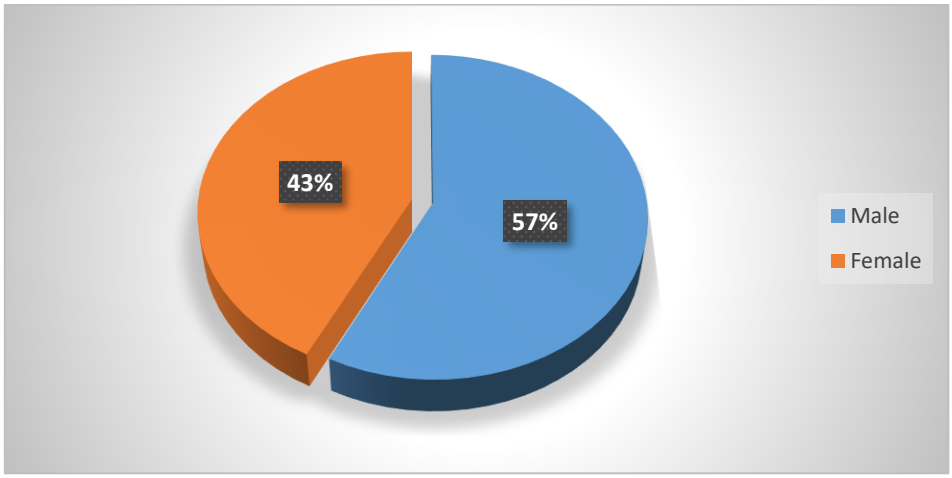

Figure 1 Gender of Respondents

In the research area, 43% of respondents were female and 57% of respondents were male. Males are more likely to use the services; that is, most of them double as drivers of app-based taxis, while some are passengers. This response rate supports the claim that transportation is not gender neutral and supports the finding by Lejsková et al. (2023) that men and women behave significantly differently when it comes to transportation. In the transportation sector, women continue to be underrepresented among operators, drivers, engineers, and industry executives (Carvajal and Alam, 2018). According to the study, women's low engagement in the transportation sector was a result of their fear of harassment in public places. Beyond safety, social conventions and traditional gender roles are major factors in limiting women's participation in several occupations, such as transportation. When working as app-based taxi drivers, some women might not be prepared to deal with social stigma or stereotype. Positively, many Nigerian women continue to use the app-based taxi service in spite of the industry's growing security worries. Women appear to be equally benefiting from app-based taxi services, as seen by the 43 percent response rate for females. As a result, app-based taxi services are assisting in closing the gender gap in financial independence. Women who engage, particularly as drivers, become economically independent and are able to support their families.

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Age Brackets

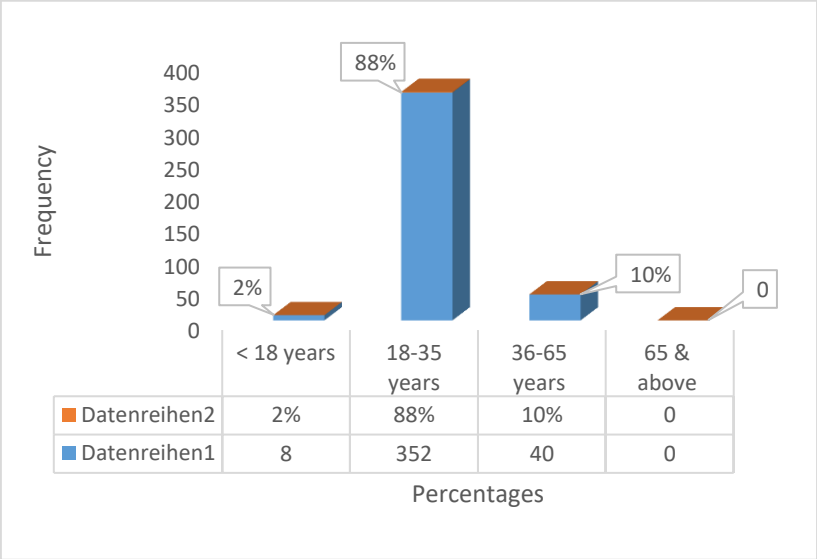

Figure 2 Respondents Age Brackets

The majority of responders were young adults (those between the ages of 18 and 36), as seen in Fig. 2. Individuals in the 65+ age range had a zero response rate, indicating that they use app-based taxi services infrequently or never. The majority of users of this mode of transportation are between the ages of 18 and 35, with those between the ages of 36 and 65 making up the second-highest percentage. For both short- and long-distance travel within and between cities, this age group heavily utilizes app-based taxis. According to the study, elderly Nigerians are less likely to use app-based taxi services. The elderly and those classified as senior citizens are one demographic that is especially vulnerable to e-hailing apps. Their age, low level of mobile literacy, vulnerability to injury, and unfamiliarity with e-hailing technology are the main causes of this. Young and Farber (2019) confirm the claim that elderly people are especially susceptible to e-hailing scams, which are carried out by con artists who deceive their victims into believing they have not made any card payments before requesting money for two different journeys. Elderly persons are also at risk due to a lack of understanding about how e-hailing services or applications operate and the fact that some of them are afflicted with various illnesses, including dementia. Being too elderly to fight or defend oneself in dangerous situations is another. Furthermore, 61% of the app-based taxi drivers surveyed admitted to taking older consumers' transportation requests with a younger person's assistance.

People between the ages of 18 and 35 made up the largest percentage of responders. According to the research, these services are well-liked by smartphone owners who are accustomed to utilizing mobile apps. These young adults, who are in their 20s and 30s, are frequently among the first to use technology, such as app-based taxi services. Younger generations find these services appealing since they are convenient, simple to use, and frequently less expensive than traditional taxis. Popular modes of transportation on social media have a big influence on the travel decisions of these young adults, also known as Generation Z and Millennials.

It is well known that members of this age are highly tech-savvy and frequently use digital gadgets like cellphones. Receptivity, risk-taking, and rational decision-making are traits of Generation Z. They embrace change wholeheartedly. The Z generation also dominates the ride-hailing industry. They are at the forefront of a technology revolution and have a tangible imaginative spirit (Petro, 2020). The study's findings regarding age participation are consistent with a survey by Davis & Neves (2021), which found that, in the US in 2016, Millennials and Generation Z accounted for the majority of ride-hailing service users, as they do in both developed and developing countries where mega applications are most common. Because young adults were more likely to utilize services, age is therefore a crucial component in the

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acceptance and utilization of app-based taxi services, and its operation would be impacted by certain age-specific issues. The study's conclusions are crucial and have ramifications for transportation planning and policy since decision-makers must take mobility into account and close the gap to possible effects.

Marital Status

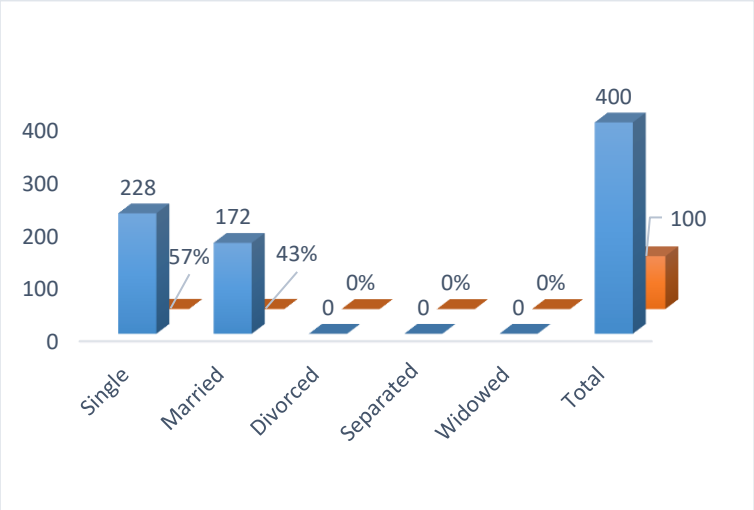

Figure 3 Marital Status of Respondents

In its transportation corridor, the app-based taxi service's implication of marital status is distinct. According to the research, those who are single (57%) travel more and in a variety of ways than people who are married, divorced, or separated. Among family vacations, they typically use the service for social outings. Unmarried people may rely on app-based taxi services, which are a practical and cozy form of transportation, particularly if they live alone or don't have access to a car. The second most popular app-based taxi services in Nigeria are used by married passengers (43%) for family outings, church trips, and other family-related travel needs, particularly by households without individual vehicles. In comparison to those who are single, those who own cars are more likely to have a lower level of risk tolerance, which accounts for the slight decline in the proportion. Depending on their status, passengers have different safety worries. For example, 86% of married people with families are more worried about their loved ones' safety when they are traveling alone.

According to the report, family travel is more prevalent among app-based taxi service users. Operators that typically modify trip prices to correspond with peak, rush, or high demand times receive negative signals from the service demand during these times. Additionally, it has been noted that 64% of consumers complain about app-based operators' fraudulent claims of peak hour fees. They contend that it has a detrimental effect on the entire customer experience and adds to prize uncertainty, consumer discontent, and annoyance. Earnings and demand may decline as a result. The marital status of app-based taxi service customers also affects a number of service-related factors, such as user experience, marketing tactics, safety concerns, and travel habits. App-based taxi companies can better plan to meet the needs of their varied and expanding clientele by being aware of these ramifications.

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Education Status

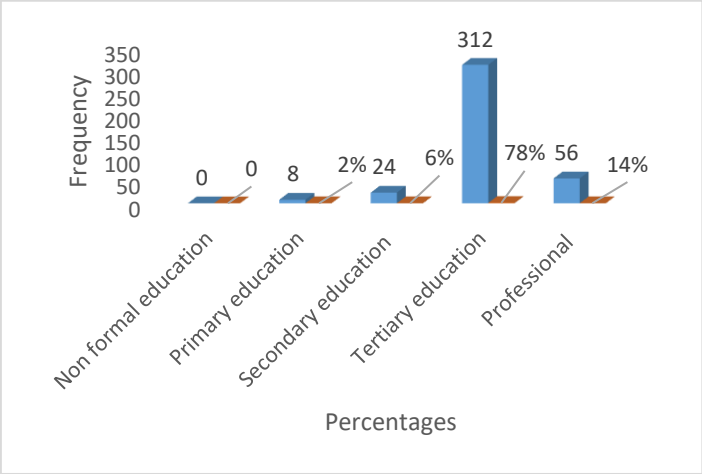

Figure 4 Education Status of Respondents

According to the respondents' educational backgrounds, 78% of them hold a tertiary degree, 14% are professionals in a variety of sectors, and 6% and 2%, respectively, have a secondary education or basic school certificate.

Higher educational attainment is associated with increased tech literacy, according to 74% of respondents in the conducted interview, which considerably increases the adoption and use of app-based taxi services. Passengers' usage habits have been impacted by the respondents' educational backgrounds; users with varying educational backgrounds exhibit unique usage patterns. Higher education users typically utilize the service for personal travel or recreation, while others use it for work.

Pricing sensitivity (surge price) was observed in the field study; a larger proportion of interviewees affirmed their views that users' price sensitivity is influenced by their educational background. Higher educated users value affordability, while less educated users are less happy but more willing to pay for premium services or surge prices. Excessive surge pricing has the potential to change the public's opinion of app-based taxi services and result in negative press. Long-term client loyalty and industry trust may be impacted by this unfavorable opinion.

Additional observations show that more educated customers offer more thorough reviews and feedback, which might be helpful for development. The geographic distribution of users is also influenced by educational attainment; according to 67% of respondents, places close to colleges, universities, or commercial districts may have greater rates of app-based taxi service uptake. When serving a varied user base, service providers should take into account the consequences of the educational background of app-based taxi users, as this information offers useful insights for app-based taxi business strategies.

Annual Income Bracket

Table 4 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: Researcher's Analysis, 2023.

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The respondents' annual income range is displayed in Table 4. According to the data collected, the low-income earners are those who make between ₦0 and ₦600,000 annually, the medium-income earners are those who make between ₦600,000 and ₦5,000,000 annually, and the high-income earners are those who make ₦5,000,000 and more annually. Based on the data collected, it was found that respondents in the low-income group do not frequently use app-based taxi services because of their tight budgets. It is extremely cost-sensitive, looking for less expensive solutions or taking public transportation to cut down on travel expenses. Their financial situation may make it harder for them to consistently use app-based taxi services. For lower-income consumers and some middle-income earners, issues like smartphone ownership, availability of digital payment methods, and the cost of these services can be obstacles.

By striking a balance between affordability and convenience, middle-class individuals are more likely to use app-based taxis. When selecting services, they have a greater selection of options and take comfort and cost into account. For middle-class individuals, app-based taxis provide a practical way to get around for everyday tasks, which may lessen their dependency on private vehicles.

App-based taxi platforms are more likely to be adopted and used consistently by high-income earners. They are accustomed to the comforts of private driving and have a high automobile ownership rate. As a result, when selecting a taxi, they purposefully put efficiency, comfort, and convenience ahead of price. The ease, dependability, and perceived safety of these services make them equally more eager to spend. Among the reasons for this group's increased patronage are the opportunity to lessen reliance on personal automobiles, save money on fuel, and preserve the condition and wear of their vehicles. They make heavy use of app-based taxis, which may lessen the need for personal vehicles at specific periods to meet specific transportation needs.

Additionally, a significant number of high earners generate demand for luxury or premium app-based taxi services, which boosts earnings for both businesses and drivers.

In general, people's use of app-based taxi services in Nigeria is greatly influenced by their income levels. It implies that there is a complicated relationship between income levels and the use of app-based taxi services, one that varies depending on a number of variables such as geographic location, cultural concerns, and market conditions. According to the comments, despite the fact that app-based taxis are safer, more comfortable, and more convenient, the country's economic climate will make their services more accessible to people in a particular income range. It is implied that this has played a role in the nation's rising rates of underemployment or unemployment.

Involvement in App-based Taxi Drivers

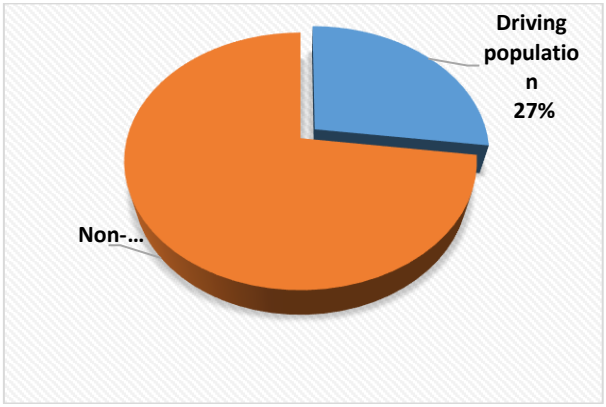

Figure 5 Respondents Involvement in App-based Taxi Drivers

According to Figure 5, 27% of respondents are drivers and consumers of Nigerian app-based taxi services, while 73% of respondents are regular users of the services. An unbalanced business climate is suggested by this variation in the

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percentage of responders. The increasing number of taxi drivers using apps indicates that they have streamlined their routes in order to increase their profits.

The high user percentage suggests that the Nigerian population where app-based taxi services are available uses and accepts them to a considerable extent. Only a few Nigerian cities—Abuja, Port Harcourt, Lagos, Asaba, Enugu, Makurdi, and Ibadan—have access to these services. Therefore, there are geographical differences in the distribution of app-based taxi drivers in Nigeria; a big metropolis may have more drivers than a suburban or rural location. According to the Lagos State government's regulatory strategy, the increased number of drivers would undoubtedly attract attention, which will raise the cost of registration and licensing for app-based taxi operators and businesses.

Given that Nigeria has 774 local government units and more than 45 rapidly emerging cities, the above degree of involvement in app-based taxi business suggests a relatively low penetration throughout the nation. Eight (8) out of ten (10) respondents agree that the number of app-based taxi services is growing, but their geographic distribution is inadequate.

Effect of Insecurity on App-Based Taxi Service Operations in Nigeria

Table 5 Perception of Respondents on the Effect of Insecurity on App-Based Taxi Service Operations in Nigeria

S/N	Insecurity contributes to the challenges of on app-based taxis operations by	SA (4)	A (3)	D (2)	SD (1)	Mean	Std. Dev.	Remarks
a.	Reduces ride availability in perceived unsafe areas	244	114	21	21	**3.45**	**3.02**	**Accepted**
b.	Limiting expansion and market penetration	188	201	11	0	**3.44**	**2.95**	**Accepted**
c.	Reduce patronage	137	231	32	0	**3.26**	**2.78**	**Accepted**
d.	Increase operational cost of implementing security measures	160	164	55	11	**3.13**	**2.74**	**Accepted**
e.	Creates negative publicity and reputational damage	122	202	55	11	**3.03**	**2.63**	**Accepted**
	Cumulative Mean					**3.26**		

Source: Researcher's Analysis, 2023.

Respondents' perceptions of how insecurity affects Nigerian app-based taxi services are displayed in Table 5. The array of data gathered from the returned questionnaire yielded a cumulative mean of 3.26. The respondents' great agreement with the impact of insecurity on app-based taxi services in Nigeria is indicated by the average high mean score of 3.26 compared to the predetermined mean of 2.5. Stated otherwise, the respondents or data points are typically higher than the reference value or scale's midpoint. This usually means that the participants or data points have a higher level of the measured variable, a more favorable emotion, or agreement. According to an analysis of the data collected on the different impacts of insecurity on Nigerian app-based taxi services, insecurity poses a serious risk to the business and lowers the availability of rides in locations that are deemed hazardous, with a noteworthy mean score of 3.45. This mean score suggests that, on average, the respondents' scores are higher than the scale's midpoint (2.5).

With a noteworthy mean score of 3.44 (standard deviation of 2.95), insecurity is also impeding growth and market penetration for transport network companies. The average response from respondents is higher than the scale's midpoint (2.5), as indicated by the mean score of 3.44. This implies that, on the whole, respondents have given answers that tend to be on the higher end of the spectrum, suggesting a generally favorable attitude or level of agreement with the survey questions. Although there is some variation in the replies, as indicated by the standard deviation of 2.95, the mean score nevertheless points to a propensity for agreement or positive attitude.

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Reduced patronage is also a result of insecurity, which explained the mean score of 3.26 (standard deviation of 2.78). According to the above mid-point average of 3.26, respondents generally agreed that insecurity is to blame for the decline in app taxi service usage. This implies that replies from participants have generally tended to be on the higher end of the spectrum. This suggests a generally favorable attitude or level of agreement with the survey's questions. There is some variation in the responses, as indicated by the 2.78 standard deviation.

A positive mean score of 3.13 with a standard deviation of 2.74 was obtained for the increase in operational costs associated with putting security measures in place. The average response from respondents is higher than the scale's midpoint of 2.5, as indicated by the mean score of 3.13. This implies that replies from participants have generally tended to be on the higher end of the spectrum.

Hypothesis

Ho: There is no significant impact of insecurity on app-based taxi service operations in Nigeria measured by inadequate driver vetting and background checks, drivers' misconduct (harassment, assault), cash transactions, Use of third-party drivers (handover of vehicles), Insufficient app-security, Non-use of dashboard or body cam, Inadequate policing, Inadequate lighting at pickup and drop-off locations, and insufficient emergency response protocol.

Table 6 Analysis of variance of regression on insecurity on app-based taxi service operations in Nigeria.

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: Insecurity

b. Predictors: (Constant), *Insufficient emergency response protocol, drivers' misconduct (harassment, assault), Cash transaction, Insufficient app-security, Inadequate drivers vetting and background checks, Inadequate policing, Non-use of dashboard or body cam, Inadequate lighting at pickup and drop-off locations.*

Table 6 shows that the F-value of 694.450 is significant at 0.000. This indicate that insecurity in app-based taxi service operations in Nigeria is significantly influenced by inadequate driver vetting and background checks, drivers' misconduct (harassment, assault), cash transactions, insufficient app security, inadequate policing, inadequate lighting at pickup and drop-off locations, and insufficient emergency response protocol in the study area. therefore, the null hypothesis of no significant linear relationship between the effect of insecurity on app-based taxi service operations in Nigeria was rejected, and alternate hypothesis which state that there is a significant relationship on the impact of insecurity on app-based taxi service operations in Nigeria measured by inadequate driver vetting and background checks, drivers' misconduct (harassment, assault), cash transactions, use of 3rd party drivers (handover of vehicles), insufficient app-security, non-use of dashboard or body cam, inadequate policing, inadequate lighting at pickup and drop-off locations, and insufficient emergency response protocol was upheld.

Table 7 t-values of regression of insecurity 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

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	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: Insecurity on app-based taxi service operations						

Table 7 shows the contributions of the individual predictors, the 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 insecurity on app-based taxi service operations in Nigeria.

Table 8: Model Summary on the effect of insecurity on app-based taxi service operations in Nigeria.

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

a. Predictors: (Constant), *Insufficient emergency response protocol, drivers' misconduct (harassment, assault), Cash transaction, Insufficient app-security, Inadequate drivers vetting and background checks, Inadequate policing, Non-use of dashboard or body cam, Inadequate lighting at pickup and drop-off locations.*

The coefficient of determination (R^2) is 0.934. This indicates that 87.24% of the variance in the insecurity on app-based taxi service operations is caused by variations in the predictor variable (inadequate driver vetting and background checks, drivers' misconduct (harassment, assault), cash transaction, insufficient app security, inadequate policing, inadequate lighting at pickup and drop-off locations and insufficient emergency response protocol). Therefore, 87.24% of the variance in the effect of insecurity on app-based taxi service operations in Nigeria is predicted by the variables (inadequate driver vetting and background checks, drivers' misconduct (harassment, assault), cash transactions, insufficient app security, inadequate policing, inadequate lighting at pickup and drop-off locations and insufficient emergency response protocol).

IV. DISCUSSION OF FINDINGS

The main conclusion drawn from this goal is that security incidents have had a significant and adverse impact on Nigeria's app-based taxi industry. It is supported by the study's cumulative mean score of 3.26. Major service provider drivers, including those employed by Bolt and Uber, are complaining about the frequent assaults and fatalities of their fellow drivers by law enforcement. According to the statistical results of the regression analysis, insufficient driver vetting and background checks, driver misconduct (such as harassment and assault), cash transactions, insufficient app security, inadequate policing, inadequate lighting at pickup and drop-off locations, and inadequate emergency response protocol all have a significant impact on insecurity in app-based taxi service operations in Nigeria (F-value of 694.450 is significant at 0.000). The coefficient of determination (R2) is 0.934, meaning that insufficient background checks and driver vetting, driver misconduct (such as harassment and assault), cash transactions, insufficient app security, insufficient policing, inadequate lighting at pickup and drop-off locations, and inadequate emergency response protocol account for 87.24% of the variance in the impact of insecurity on app-based taxi service operations in Nigeria. The increasing number of insecurity incidents reported by app-based taxi drivers and consumers can be attributed in large part to these factors.

The availability of app-based taxi services and rides in dangerous areas have been impacted by Nigeria's increasing security incident records. Drivers are less eager to operate in some places, particularly at night, as a result of the country's insecurity environment, which includes violent crime, kidnapping, ritual killings, and terrorism.Taxi drivers that use apps steer clear of possible security hotspots with a history of assaults, kidnappings, or robberies. According to Alade (2020)

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and Oseni (2021), the growing number of reports of unethical behavior, such as sexual molestation and kidnapping, is caused by drivers steadily entering the system and by the app-based taxi companies' insufficient background check system. Once more, the Nigeria Bureau of Statistics report from 2021 states that violent crimes such as armed robbery and kidnapping have significantly increased in the nation in recent years. Since many drivers are often killed and their cars are stolen, there are still issues with safety for both drivers and riders.

By restricting growth and market penetration, insecurity has also put the services of app-based taxi companies at risk. The number of documented insecurity events and fatalities deters drivers and app-based taxi services from operating in particular areas. Nigeria's security measures are rarely sufficient to handle the country's insecurity problems, which include robbery, property theft, car theft, murder, and kidnapping. These conditions have restricted the growth strategy and market penetration of app-based taxis in addition to endangering their services. Drivers of app-based taxis in Nigeria purposefully steer clear of the following security hotspots because of security concerns: 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), Benue State (North Bank, Nyima, Agan), Lagos State (Ijegun, Ikotun, Igundo, Oshodi, Ikorodu, VGC, 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).

Over the past ten years, the Northern region has experienced instability due to acts of banditry and boko haram terrorists, which has limited the growth and penetration tactics of app-based taxi services in the area. Osimen et al. (2017) also supported this issue, attributing the security concern to Nigeria's borderless borders and confirming its rise in recent years. This is now one of the most problematic issues the nation is dealing with, and it has an indirect impact on the economy, the development of e-transport, the creation of jobs, and app-based taxi services.

With a mean score of 3.26, insecurity also plays a role in a decline in patronage; since drivers are typically afraid and reluctant to work in high-risk locations, legitimate riders are denied access to these services. This essentially lowers the amount of business that these places used to generate. According to some of the drivers surveyed, a rise in insecurity has had a significant impact on their business operations and the supply and demand for app-based taxi services. Operating firms have implemented new controls, particularly on users' apps, to help combat this unsightly trend in light of the extensive record of attacks on app-based taxi drivers and customers. Regretfully, there has been little to no success reported thus far. The study confirmed that because TNCs must pay to implement extra security measures, instability raises operating costs. An SOS push button for emergency scenarios is one of the safety features that Bolt and Uber have added to their apps. These features include a driver rating system for accountability and the option for passengers to share their adventure with friends and family.

Increased security incidents in app-based taxi services harm the e-transport subsector's reputation and generate bad press. It should be noted that the trend of uncertainty causes anxiety in both drivers and customers. According to the study poll, a sizable portion of users (81%) are somewhat apprehensive about using app-based taxis at night, and drivers frequently politely refuse dubious ride requests (to or from perceived high-risk zones). The frequent recurrence of security incidents makes app-based taxi services seem like a less desirable option for meeting one's transportation needs, and criminal elements are damaging the industry's reputation by disguising themselves as app-based taxi drivers.

Some cities, such as Port Harcourt, Lagos, some parts of Abuja, and other developing hotspots in Northern and South-Eastern Nigeria, have seen a steady assault on the drivers and consumers of app-based taxi services. This has inevitably impacted the vast array of services provided throughout Nigeria's geographic area, skewing revenue flow for app-based taxi businesses and depriving Nigeria of its right to use e-propelled transportation both inside and between cities.

The study's conclusions reveal fatal flaws that are progressively ruining Nigeria's app-based taxis' operating framework. Significant internal security issues, such as the Niger Delta crises, kidnappings in the South-East geopolitical zone, Jos crises, Boko Haram crises, and Fulani Herdsmen disasters in the northern part of Nigeria, have significantly exacerbated the security issues facing the operation of app-based taxis in Nigeria. These issues are new and appropriate, and Nwagboso (2018) confirmed this.

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Since the current security architecture is unable to bridge this glaring gap, resolving the nation's declining insecurity trends would be an extremely difficult challenge. Accordingly, Ugwuishiwu et al. (2019) confirmed that Nigerian law enforcement agencies' independent operating systems do not encourage sufficient cooperation for efficient crime control. They said that in order to create a Model of Real-Time Integrated Crime Information System (ICIS) that will enhance the capacity of Law Enforcement Agencies (LEA) to handle crime, a security architecture or strategy is required.

Along with the study's conclusions about internal and external security risks, Feeney (2019) asserts that one of the biggest security concerns for passengers using app-based taxis is passenger privacy. A major privacy risk is the registered personal information of passengers that is kept in platform apps and accessible by app-based taxi drivers. There are concerns that this would provide hackers with information that could be used to swindle travelers. In an interview, for example, numerous passengers from Kano, Abuja, Lagos, and Port Harcourt disclosed that certain drivers had utilized this information to track down particular passengers on social media. Because some app-based taxi drivers have picked up or dropped off people at their homes, this leads to harassment, life-threatening texts, and general threats to lives. Deighton-Smith (2021) pointed out that some of the cab laws that have been put in place are intended to ensure the security and safety of not just drivers and passengers, but also other people. This is in response to the alarming security concerns regarding app-based taxi services in Nigeria. Apps like Bolt, Uber, and others were upgraded to address possible issues including assault, robbery, and injuries from collisions brought on by irresponsible drivers or poorly maintained vehicles. Additional measures taken by regulators include age restrictions on automobiles, requirements for in-vehicle CCTV, driver "fit and proper person" checks, maintenance plans, and mechanical inspections. The results of this study did not account for the effects of recent app security and safety enhancements. The growing number of drivers and the nation's deteriorating security condition may be the cause of this.

High levels of accountability may result from restricting booking and making drivers and passengers easily traceable through the use of GPS monitoring and app-based payment. Real-time ride-tracking and in-app "panic buttons" will be two further safety measures. Credit cards (again through the app) eliminate the need for cash when paying for cars, and as they are difficult to use fraudulently, there is a far lower chance of fraud and robbery. The consensus grading system promotes appropriate behavior and offers high levels of transparency and accountability (MacEachen, 2018). It offers suggestions for additional improvements to the apps' security, features, and business model. It is clear that app-based taxi drivers express a strong desire to be paid the full trip cost for offline trips rather than having to pay a set percentage to the app-based taxi companies. From the passenger's perspective, this should be a serious security issue.

V. CONCLUSION

Insecurity poses a substantial challenge for app-based taxi services in Nigeria. Safety and security concerns for both drivers and passengers, reduces ride availability and deter potential users (patronage). It equally increases operational cost, limits expansion and market penetration of app-based taxi services in the country. In conclusion, the significant relationship between regulatory policies, road infrastructure, fare structure, internet connectivity, payment modes, and insecurity collectively shapes the operational landscape of app-based taxi services in Nigeria, underscoring the need for a holistic and balanced approach to addressing these impeding factors, to ensure the continued growth and sustainability of this industry.

RECOMMENDATIONS

Study suggests collaboration and stringent integrated measures in addressing security concerns: recommend increased collaborative efforts to address insecurity challenges in the country. Implementation of a centralized and secure communication system for seamless sharing of information among various law enforcement agencies while technology should be adopted for data management and facilitation of seamless information exchange. The driver verification process (background checks, vehicle inspections, and documents verification) should be strengthened to include formal clearance from statutory Law Enforcement Agencies (e.g., Police Character certificate). Cashless transaction should be promoted and incentivise. Facial recognition or biometric authentication validation should also be considered by the companies. Panic button functionality and other SOS features, including voice recording capability on app, to be tested at defined interval via drills and audits. Geo-refencing of secured operational areas and end-to-end encryption for all data transmissions within the app. Data-Driven Decision Making: Encourage the collection and analysis of data related to

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app-based taxi services security exposure, to make informed decisions and adjustments. This data can be used to identify problem areas and form an input into the geo-fenced area.

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