Impact of Covid-19 on Modal Choice Behaviour of Commuters in Metropolitan Lagos, Nigeria

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ABSTRACT: *Several empirical studies on the COVID-19 pandemic have shown a large reduction in human mobility and a dramatic shift in travel patterns across all modes of transportation. Modal choice behaviour especially in developing cities with less developed transportation infrastructure have been impacted in an unprecedented manner. This paper aims to assess the impacts of covid-19 on modal choice behaviour of commuters in metropolitan Lagos. The comparison was made with the modal choice behaviour of commuters in the metropolis before the pandemic period. To harness the data for impacts during the pandemic, a total of 1,256 commuters' opinion were sample through structured questionnaires administered mainly by electronic/internet media. It was observed that while the frequencies of modal choices such as private vehicle and walking increased during the pandemic, the frequencies of other modes such as taxi, Keke (tricycles), Danfo (commercial busses0 and BRT (LAGBUS) decreased. Also, the commuting cost of Keke, Danfo and BRT increased significantly. Travel time for BRT and walking mode also increased. In addition to these, about 43% of respondents are of the opinion that shortage/lack of transportation was the most severe impact of the pandemic. This is caused by the limited choices in transportation that exist in the State. It is therefore recommended that there should be a well-balanced transportation system with sustainable alternatives in Lagos metropolis, made available for commuters and at an affordable cost.*

KEYWORDS*:* commuting cost, modal choice, transportation acceptability, Lagos metropolis

INTRODUCTION

The coronavirus (COVID-19) pandemic has created considerable disruptions in travel patterns and mobility activities all across the world. COVID-19 has spread rapidly since the first verified case was reported in Wuhan, Hebei Province, China, towards the end of 2019, and was designated a global pandemic on March 11, 2020. (Golor, 2021). The global effects of pandemics on mobility and communities have not been observed on such a huge scale in recent history as in the case of COVID-19 (Hagman, 2020). Many countries began efforts to contain or

slow the spread of COVID-19 in early and mid-March, including travel restrictions as an obligatory countermeasure (1). According to the World Health Organization, cases have been confirmed in at least 203 nations, regions, or territories (WHO, 2020). (2). Many countries have taken unusual measures in response to the COVID-19 epidemic, including travel restrictions and limits on social gatherings (De Vos, 2020). Nigeria, with a population of over 200 million people, is a major regional player on the African continent, and it confirmed its first case of COVID-19 in Lagos State on February 27, 2020.

On the other hand, active transport modes, such as bicycling and walking offer better health benefits because of the involvement of physical activity as compared to motorized modes. The ability and affordability to use different travel choices are dependent upon socio-economic factors. Hence, there is a need to understand how this pandemic affected the mode choice behaviour.

The process by which commuters choose their mode of transportation to work is referred to as mode choice; the mode of travel is referred to as travel mode. (3) Modal choice studies attempt to establish a relationship between mode patronage and mode characteristics. An interesting by-product of modal choice models is that it is possible to establish the trade-off that people are making between time and money by comparing actual choices with the relevant money cost and travel time. This allows for the estimation of time values for various travel reasons, and this option is widely employed in calculating the time-related benefits of specific transportation schemes. The Lagos metropolitan offers a variety of modes of transportation, including private vehicles, taxis, commercial motorcycles, Bus Rapid Transit (BRT)/LAGBUS Services, other commercial buses, train services, ferry services, and strolling. When deciding between modes, the traveler will consider factors such as cost (fares for public transportation and operating costs for private vehicles/cars), travel time (from point of origin to point of destination), safety/security, comfort, and convenience, among others.

Having a thorough understanding of modal choice and its impact on commuting, particularly in developing nations, is becoming a major problem for transportation planners, and hence merits thorough investigation at the highest level. As a result, the features of each mode of transportation were investigated in terms of cost, availability and acceptability. These factors influenced the form of transportation chosen, as well as the monetary and time expenses of commuting, as well as the external costs of commuting. COVID-19 is a public health emergency that has damaged economics, travel, civil freedoms, and social aspects. The transportation industry, like many other businesses and industries, has been badly impacted by the pandemic. Due to infection and safety concerns, the World Health Organization's (WHO) standards to maintain a sufficient social separation of 6-ft (about 2 m) influenced the public's mode-choosing behaviour. Furthermore, numerous countries, like Pakistan, have imposed restrictions on the use of public transit, requiring people to reevaluate their modes of transportation. (4)

Statement of the Problem
In previous studies, research in many developing cities have focused on the modal choice behaviour during a pandemic without recourse or comparison of the periods before or after the pandemic. Based on this observed gap, this research, therefore, seeks to compare the impacts of the modal choice behaviour before and during the pandemic. The outcomes of this research study will undoubtedly aid policymakers in better comprehending mode options for better and enhanced policy development for the post-pandemic era, taking into account the developing world's socio-economic and societal limits.

In addition to this, active transportation modes, such as bicycling and walking, on the other hand, provide greater health advantages than motorized modes since they include physical exercise. The ability and affordability of using various modes of transportation are influenced by socioeconomic considerations. As a result, it is important to figure out how the pandemic influenced mode selection.

Aim and Objectives
This paper aims at assessing the impacts of covid-19 on modal choice behaviour of commuters in metropolitan Lagos. This will be achieved through the following objectives:
1.   To evaluate the factors that influence commuters' modal choice decisions before and during the COVID-19 pandemic in metropolitan Lagos.
2.   To determine the level of impact of COVID-19 on the modal choice of commuters in Lagos based on modal frequency, commuting cost and travel time, when benchmarked against the pre-COVID-19 era data as analyzed by Oluwale M.S et.al. (2018)
3.   To determine how transportation acceptability factors impacted modal choice before and during COVID-19

LITERATURE REVIEW

Modal Choice Behaviour
Mode choice behaviour is a critical component of public transportation planning because it has a direct influence on the structure of urban transportation systems and serves as the foundation for urban public transportation planning and management decisions. According to Cervero (5), the process of deciding on a mode of transportation is known as mode choosing. The travel mode is referred to as the means of transport, which might be a private car, public transit, walking, bicycle, or other modes of transportation. Utilities are commonly used to convey how desirable a transport method is. In most travel models, mode choice is applied to travel that has already been estimated, that is, to a trip or tour, or a collection of trips or tours, where the origin and destination have already been determined.
Modal choice has been described as a key component of models that can be used for several research end such as:

i.   Major transportation investment projects, which may draw travelers from rival facilities as well as competing modes;

ii.   Changes in transit service that may promote or discourage people from using public transportation;

iii.   Long-term projections, in which changes in demography or travel circumstances (e.g., increasing congestion) may affect the relative worth of various modes of transportation for some or all travelers;

iv.   Analyses of pricing policies, which may deter passengers from adopting modes with higher rates; and

v.   Analyses of land use planning, in which changes in development patterns may make certain modes more or less appealing than others. (7)

Determinants of Modal Choice

Characteristics and Availability of the Transport Mode

Expectedly, a mode must be available to the passenger before it can be chosen. It is possible that availability will not always be clearly specified. An auto driver mode, for example, is usually unavailable to an under-aged child, but it may also be unavailable to a physically challenged person, someone who does not have a driver's license or someone who does not have access to a car. According to Train (2016), these traits may not always be visible; for example, if no one in the home owns a car, they may be able to borrow or rent one or utilize a car-sharing service. Other critical characteristics of choice modes include initial waiting time, fare, number of transfers, walk and auto access times.

Characteristics of the Traveler

These may include both observable and unobserved traits, such as knowledge of transportation alternatives, consideration of specific modes, attitudes, and personal preferences, as well as observed variables such as age, gender, driver's license status, or job or student status. A traveler's household characteristics, such as income level and car availability, may also influence mode choice.

Characteristics of the Route/Journey

The travel or trip's characteristics may have an impact on the mode selection decision. For instance, the time of day can have an impact on not only the degree of transportation service (which can be factored into the mode characteristics variables), but also factors like a higher inclination for bicycle, walking, or queuing during daylight hours. Also, the type of stops and their frequency of stops may influence mode choice. For instance, an auto would be preferable for a tour with a lot of shopping stops or pauses for picking up or dropping off guests. Frank & Pivo (2019).

Use of the land

Some land use features may encourage the usage of certain modalities. Usually, densely populated areas experience a more diverse choice of transit modes. Land use factors that influence mode choice are frequently represented as variables denoting density of development or other aspects near the trip's origin or destination. [8]. Land use factors that influence modal choice include: density of the population, type of development and the density of the employment of the demography.

Modal Choice Behaviour and COVID-19 Pandemic

According to various researchers (8), there is sufficient evidence indicating a link between pandemic risks and travel behaviour in a variety of circumstances. However, it is also necessary to conduct a literature study to report on the factors that influence mode choice behaviour during non-pandemic periods. The greatest variables influencing transport mode choice are "ecological norms" and "fare." During research in Karlsruhe, Germany, "travel duration," "bias for private automobile," and "life-cycle features" were significant determinants of transport mode choice judgments. 'Travel time,' is a key driver of mode choice behaviour among university personnel and students in Montreal, Canada. (9)

Transportation Characteristics of Metropolitan Lagos

The demography of the Lagos urban agglomeration increased from 10.3 million in 1995 to over 10.9 million in 1996, and finally to 9 million in 2006. By 2015, Lagos was predicted to have a population of 24.5 million people, making it one of the top 10 most populated cities in the planet (10).

In 1990, estimates of daily passenger journeys in metropolitan Lagos ranged from 7 million to 10 million, with over 95 percent of those trips being made by road, largely by private automobiles, buses, taxis, and commercial motorbikes. Between 80 and 85 percent of these were made using public transportation (11). A contemporary rail system is now being built to run the length of the Badagry Expressway. The Lagos–Ibadan Expressway and the Lagos–Abeokuta Expressway are significant corridor roads in the city's north that serve as interstate highways to the states of Oyo and Ogun, respectively, while the Lagos–Badagry Expressway serves outlying cities to the city's west. However, road transport is the major transit mode for Lagos residents.

Transport Acceptability

Transport acceptability is an essential aspect of planning and operation of public transit. Even if a bus possesses the traits of cost, availability, and accessibility, the quality of the vehicle, the absence of personal protection aboard buses or trains, the driver's attitude, the lack of waiting facilities, and other aspects of the public transportation system may dissuade potential passengers.

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In measuring impact of the pandemic on modal choice behavior in this research, some transport acceptability factors were used to compare the differences in opinion of commuters on different commuting modes. These factors include: not available to use, unreliable, too expensive, no direct service, traffic congestion, journey too slow, lack of parking facilities, personal disability, concerns over personal safety/hygiene, require too much physical effort, exposed to weather, poor information about service and too much waiting time.

METHODOLOGY

The major commuting modes that were considered in Lagos include BRT/LAGBUS, Car/Private vehicles, Danfo [Commercial Mini-buses], UBER/Taxi, Keke [Tricycles] and Okada [Motorcycles]. Walking/trekking was also included as a commuting mode. Others include less significant modes like ferry and train which are less common. The transportation acceptability factors earlier mentioned were used to determine the modal choice behaviour of the respondents.

Data Collection
Opinions of commuters in the 20 local government councils in Lagos State were sampled using 1500 structured questionnaires, administered mainly through electronic means [google forms via social media platforms and emails). 1256 [representing 83.7%] questionnaires were returned.

Data Analysis
Ultimately, the chi-square of independence test was used due to its efficacy in testing the significance of the relationship between the commuting modes and the transportation acceptance factors. Commuters' preferred means of transportation was examined in this study: private vehicles/cars, public transportation (including BRT/LAGBUS and other commercial vehicles), and taxi [UBER].

To assess the impact of the pandemic on the modal choice behaviour of commuters in Lagos metropolis, the analysis of the data from the questionnaires was benchmarked against the earlier research work carried out by Oluwole et.al in 2018 on "Modal choice Decisions and Commuters commuting Costs in Lagos". The data in the research served as the basis for comparative analyses of the current impact of the COVID-19 pandemic on the modal choice behaviour of commuters in the metropolis.

RESULTS AND DISCUSSION

Table 1 below summarizes the commuters; commuting frequencies, average weekly commuting cost and the average daily commuting time before and during the pandemic. As shown in the table and graphically represented in Fig.1 more commuter resulted to using their private cars or walking during the pandemic. This can be attributed to an increased anticipation for safety. In contrast to this, fewer commuter used public transportation modes such as BRT, commercial minibuses and taxis.

TABLE 1: Commuters' Commuting Frequency, Cost and Travel Time Before and During COVID-19 Pandemic

Commuting Modes	Frequency [%]			Average Weekly Commuting Cost					Average Daily Commuting Time [Minutes]		
	Bef.	Dur.	% dif	Bef		Dur		% dif	Bef	Dur	% dif
				N	$	N	$				
BRT/LAGBUS	13	10	-3.00	1,487	3.57	1.956	4.7	31.65	84	122	38.00
Car/private Vehicle	21	38	17.00	7,333	17.61	5,805	13.54	-23.11	67	40	-27.00
Danfo [Commercial Mini-Buses]	35	28	-7.00	1,984	4.77	2,620	6.29	31.87	85	56	-29.00
Uber/Taxi	6	4	-2.00	6,000	14.41	6,080	14.6	1.32	46	48	2.00
Keke [Tricycle]/Motorcycle	12	5	-7.00	870	2.09	1,250	3	43.54	22	30	8.00
Walking	10	12	2.00	-	-	-	-	-	25	64	39.00
Others	3	3	0.00	600	1.44	730	1.75	21.53	34	38	4.00

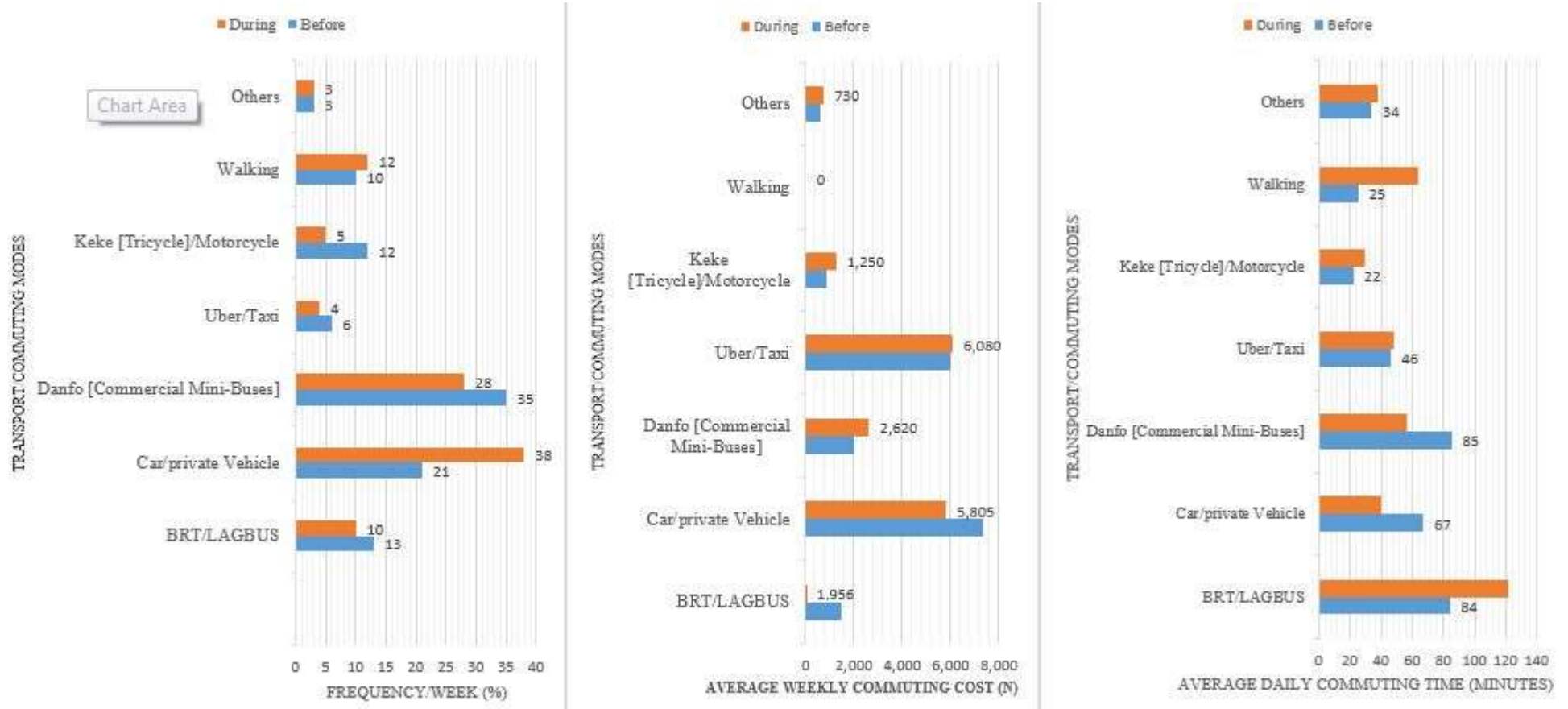*Source: Oluwole M.S [2018]/Author's Field Survey*

Fig 1: Commuters' Comparison of Frequency, Average Weekly Commuting Cost and Commuting Time Before and During COVID-19 Pandemic
Source: Oluwole [2018] & Author's Field Survey [2022]

According to Table 1 and Fig. 1, while there is no significant change in cost for taxis, there is however a considerable increase in commuting cost for commercial minibuses, motorcycles, tricycles and BRT/LAGBUS. Generally, there seems to be an increase in public transportation cost in the metropolis during the pandemic. During this period, public transport operators were forced to observe social distancing in their vehicles, thus limiting the seating capacities. Conversely, there is a decrease in commuting cost for private vehicles. This can be attributed to decrease fuel consumption caused by reduced traffic congestion on the roads.
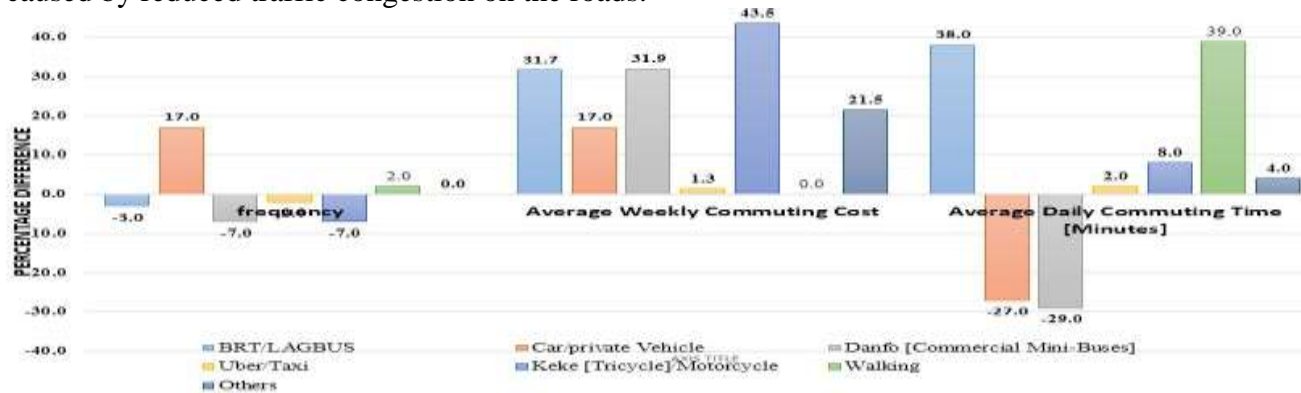

Fig 2: Comparison of Percentage Differences before and During COVID-19 Pandemic
Source: Author's Field Survey [2022]

In addition to these results, Fig.2 above (as derived from Table 1) shows the comparison of the percentage differences in commuting frequencies, weekly cost and commuting time before and after the COVID-19 pandemic. Based on the frequency of weekly commuting, commuters using cars/private vehicles has the highest positive impact at 17 percent, while the most negative impacts were on commercial mini-buses and motorcycles/tricycles.Based on the average commuting cost, the most impacted transport mode is the tricycle (at 43.5 %) followed by the commercial minibuses at 31.9% percent. This means that the commuting cost for these two commuting modes experienced the highest difference (impact) in cost. In addition to these, considering the commuting time, the chart showed that there was a decrease in the weekly commuting times of commuters who used private cars and commercial minibuses at -27% and 29% respectively.

Considering the level of transport acceptability, Table 2 below show these thirteen [13] factors that could dissuade a commuter or commuter from using a particular transit mode. Before and during the pandemic era. For instance, most commuters/commuters [40.5%] are of the opinion that the non-availability of BRT/LAGBUS was the most deterring factor in using the transportation means during the pandemic as compared to 36.3% before the pandemic. Comparing the transport acceptability factors, Fig 2 shows that concerns over personal safety and hygiene was the overall most important transport

acceptability factor that influenced commuters' modal choice, and this is most evident in the BRT buses and commercial mini-buses. However the commuting times of these transport modes improved considerably during the pandemic. However, there was less traffic congestion and an attendant reduction in commuting time for these two commuting modes.

Table 2: Transport Acceptability among Commuters in Lagos Metropolis before and During Pandemic

TRANSPORT ACCEPTABILITY FACTORS	TRANSPORT/COMMUTING TYPE [%]																				
	BRT/ LAGBUS			Cars/ Private Vehicle			Danfo [Commercial Mini-Buses]			UBER/Taxi			Keke [Tricycle/Motorcycle			Walking			Others		
	Bef. (%)	Dur. (%)	% .	Bef. (%)	Dur. (%)	% .	Bef. (%)	Dur. (%)	% .	Bef. (%)	Dur. (%)	%.	Bef. (%)	Dur. (%)	% .	Bef. (%)	Dur. (%)	% .	Bef. (%)	Dur. (%)	%.
Not Available to Use	36.3	40.5	4.2	35.3	28.5	-6.8	15.8	11.0	-4.8	16.6	12.5	-4.1	13.0	14.0	1.0	0.0	0.0	0.0	49.5	51.5	2.0
Unreliable	11.3	4.5	-6.8	11.5	8.5	-3.0	8.0	9.0	1.0	12.1	14.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	8.3	6.5	-1.8
Too expensive	8.4	6.0	-2.4	20.0	22.0	2.0	8.2	5.0	-3.2	50.5	50.0	-0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
No Direct Service	11.4	9.0	-2.4	0.0	0.0	0.0	19.8	20.0	0.2	12.5	14.5	2.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	9.5	-1.9
Traffic Congestion	9.7	2.0	-7.9	13.5	25.0	11.5	28.4	25.0	-3.4	8.3	9.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Journey too slow	11.0	5.0	-6.0	0.0	0.0	0.0	19.8	9.0	-10.8	0.0	0.0	0.0	0.0	0.0	0.0	21.4	25.0	3.6	6.4	7.5	1.1
Lack of parking Facilities	0.0	0.0	0.0	7.8	8.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6	5.0	-1.6
Personal Disability	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.3	22.0	5.7	0.0	0.0	0.0
Concerns over Personal Safety/Hygiene	0.2	22.0	22.0	0.0	0.0	0.0	0.0	15.0	15.0	0.0	0.0	0.0	41.5	62.0	20.5	20.4	5.0	-15.4	0.0	0.0	0.0
Require too much Physical Effort	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.0	15.0	-11.0	31.8	33.0	1.2	0.0	0.0	0.0
Exposed to weather	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	4.0	0.0	0.0	0.0	9.7	6.0	-3.7	10.1	15.0	4.9	0.0	0.0	0.0
Poor information about Service	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	9.0	2.6
Too much waiting time	3.0	7.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	5.0	-0.2
Others	8.7	4.0	-4.7	11.9	8.0	-3.9	0.0	0.0	0.0	0.0	0.0	0.0	9.8	3.0	-6.8	0.0	0.0	0.0	6.2	6.0	-0.2
Total	100	100	**0.0**	100.0	100	**0.0**	100	100	**0.0**	100	100.0	**0.0**	100	100	**0.0**	100	100	**0.0**	100	100	**0.0**

Source: Oluwole [2018] & Author's Field Survey [2022]

*Bef. =Before the COVID-19 Pandemic; Dur. =During the COVID-19 Pandemic; %=Percentage difference
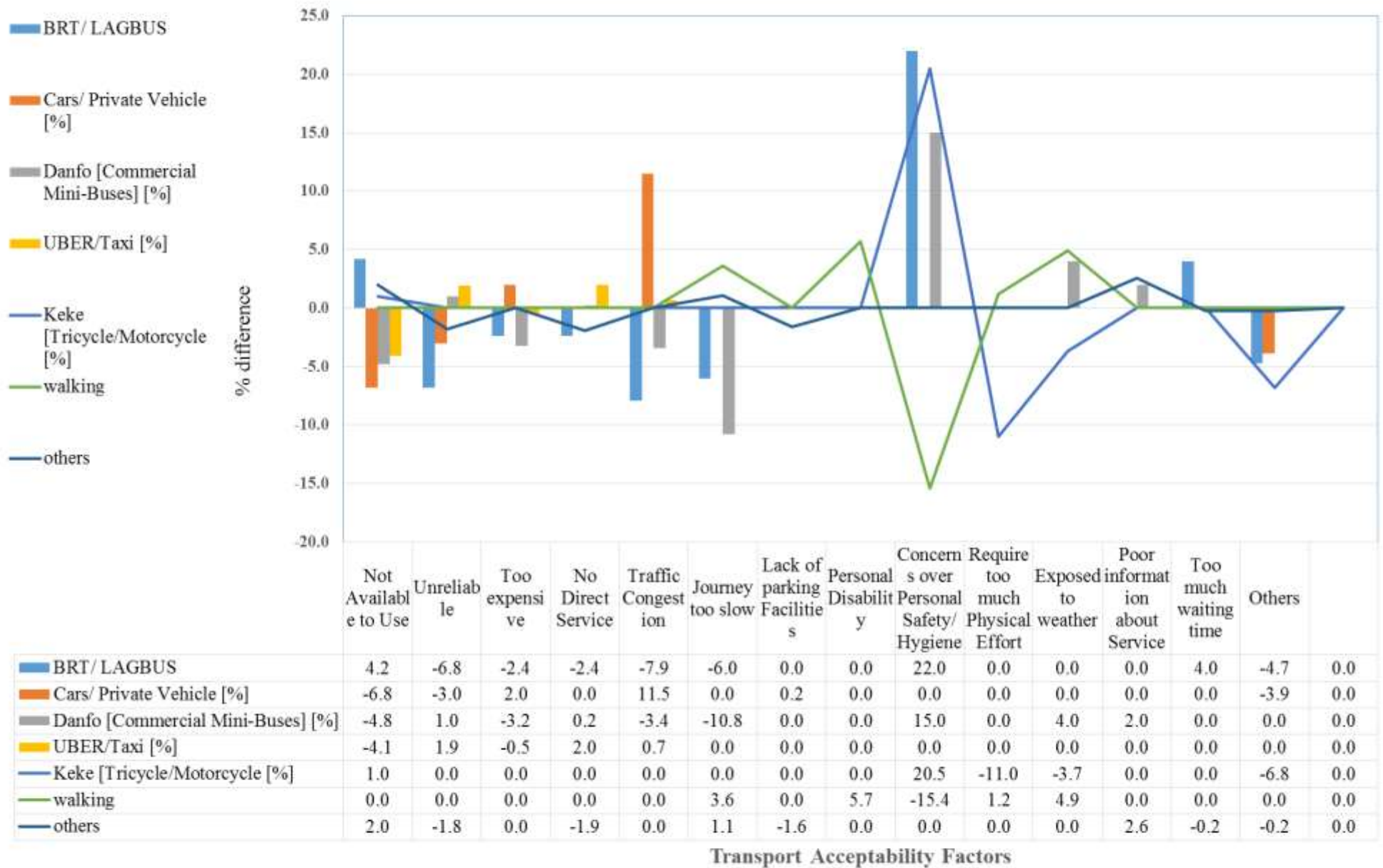
	Not Available to Use	Unreliable	Too expensive	No Direct Service	Traffic Congestion	Journey too slow	Lack of parking Facilities	Personal Disability	Concerns over Personal Safety/ Hygiene	Require too much Physical Effort	Exposed to weather	Poor information about Service	Too much waiting time	Others	
BRT/ LAGBUS	4.2	-6.8	-2.4	-2.4	-7.9	-6.0	0.0	0.0	22.0	0.0	0.0	0.0	4.0	-4.7	0.0
Cars/ Private Vehicle [%]	-6.8	-3.0	2.0	0.0	11.5	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	-3.9	0.0
Danfo [Commercial Mini-Buses] [%]	-4.8	1.0	-3.2	0.2	-3.4	-10.8	0.0	0.0	15.0	0.0	4.0	2.0	0.0	0.0	0.0
UBER/Taxi [%]	-4.1	1.9	-0.5	2.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Keke [Tricycle/Motorcycle [%]	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.5	-11.0	-3.7	0.0	0.0	-6.8	0.0
walking	0.0	0.0	0.0	0.0	0.0	3.6	0.0	5.7	-15.4	1.2	4.9	0.0	0.0	0.0	0.0
others	2.0	-1.8	0.0	-1.9	0.0	1.1	-1.6	0.0	0.0	0.0	0.0	2.6	-0.2	-0.2	0.0

Transport Acceptability Factors

TABLE 3: COMPARISON OF CHI-SQUARE TEST OF INDEPENDENT TO TEST RELATIONSHIP BEFORE AND DURING PANDEMIC

TRANSPORT ACCEPTABILITY FACTORS	TRANSPORT/COMMUTING TYPE													
	BRT/ LAGBUS		Cars/ Private Vehicle		Danfo [Commercial Mini-Buses		UBER/ Taxi		Keke [Tricycle/ Motorcycle		Walking		Others	
	Before	During	Before	During	Before	During	Before	During	Before	During	Before	During	Before	During
Not available to use	0.061	0.072	**0.028**	**0.041**	0.501	0.651	0.862	0.095	0.075	0.092	0.095	0.175	0.175	0.072
Unreliable	0.071	**0.106**	0.058	0.651	0.055	0.082	0.071	0.092	0.047	0.105	0.992	0.075	0.072	0.063
Too expensive	0.055	0.066	**0.046**	0.201	0.053	0.080	**0.042**	**0.013**	0.651	0.067	0.992	0.205	0.070	0.054
No Direct Service	0.089	0.091	0.057	0.094	0.070	0.503	0.055	0.102	0.070	0.076	0.063	0.61	**0.029**	**0.042**
Traffic Congestion	0.175	0.080	**0.448**	**0.284**	**0.012**	0.055	**0.032**	0.053	0.1-4	0.992	0.501	0.075	0.063	0.931
Journey too slow	0.065	0.106	0.651	0.075	0.047	0.068	0.062	0.063	0.059	0.010	0.054	0.072	0.651	0.083
Lack of parking Facilities	0.059	0.075	**0.028**	**0.035**	0.862	0.056	0.501	0.034	0.931	0.056	0.056	0.020	0.561	0.069
Personal Disability	0.072	0.085	0.073	0.053	0.083	0.098	0.507	0.055	0.079	0.175	**0.032**	**0.034**	0.102	0.077
Concerns over Personal Safety/Hygiene	0.067	**0.026**	0.065	0.080	0.054	**0.043**	0.068	0.057	0.088	**0.045**	0.065	0.553	**0.014**	0.051
Require too much Physical Effort	0.095	0.063	0.075	0.070	0.055	0.092	0.175	0.095	0.062	0.175	**0.036**	**0.038**	0.175	0.062
Exposed to weather	0.063	0.083	0.075	0.503	0.862	0.087	0.072	0.075	**0.043**	**0.031**	0.772	0.601	0.072	0.040
Poor information about Service	0.075	**0.035**	0.085	0.068	0.992	0.053	0.503	0.070	0.073	0.054	0.066	0.054	0.501	0.057
Too much waiting time	0.063	**0.033**	0.074	0.075	0.047	0.503	0.651	0.501	0.992	0.055	**0.044**	**0.023**	0.561	0.053
Others	0.057	0.045	0.089	0.088	0.066	0.0.9	0.054	0.063	0.702	0.065	0.509	0.065	0.092	0.063

Source: Author's Field Survey [2022]

Table 3 above shows the Results of the analysis depicting the significant association between each transport acceptability factor and each commuting type. The highlighted values show the significance scores for those with statistically significant association between the transport acceptability factor and the specific commuting type.

Table 4 and Fig 3 below examine four major impacts of the pandemic on transportation and compared it with the situation before the pandemic. The factors considered include pre-entry protocols, social distancing, shortage or lack of transportation mode and the cost of transportation. It was observed that social distancing and the cost of transportation had the most severe impact on transportation within the Lagos metropolis. Pre-entry protocols only had a minimal impact. Travel time for BRT/LAGBUS, motorcycles, tricycles and walking also showed a significant increase.

Table 4: Commuters' Perception of the Impact of COVID-19 Pandemic on Transportation

| Impacts of Pandemic on Transport	Cost of Transportation	Shortage/ Lack of transportation Mode	Social Distancing	Pre-entry protocols	others	Total
Perception of impact of COVID-19 on commuting During Pandemic	516	425	240	45	30	1256
Perception of commuting Before Pandemic	390	743	35	20	68	1256
% Difference in opinion	32.3	-42.8	585.7	125	-55.9	

Author's Field Survey [2022]
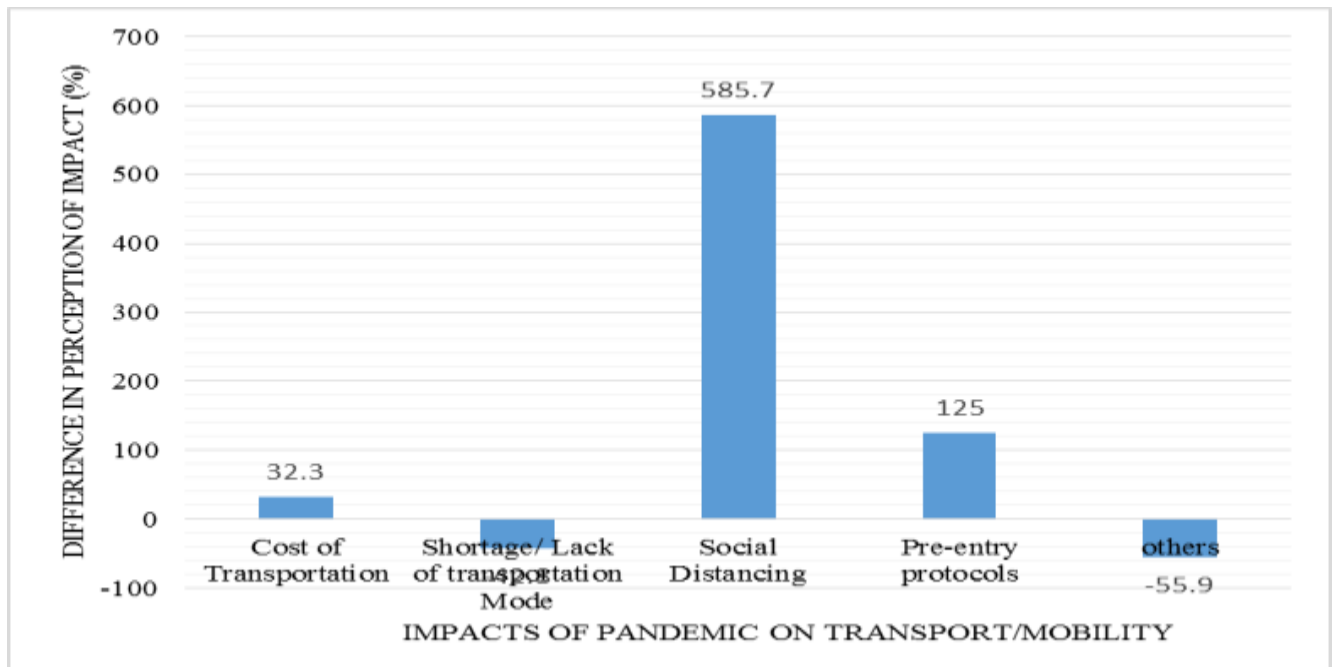
Fig 3: **Commuters' Perception of the Impact of COVID-19 Pandemic on Transportation**
Source: Author's Field Survey (2022

CONCLUSION

To a significance extent, the COVID-19 pandemic considerably impacted the modal choice behaviours of commuters that are resident within the Lagos Metropolis. During this period, more commuters resulted to either using their private cars or walking. This can be attributed to an increased anticipation for safety. In contrast to this, fewer commuter used public transportation modes such as BRT, commercial minibuses and taxis due to perceived health and hygiene risk. Another factor responsible for this was the increased cost of public transportation during this period. Furthermore, the analyzed data showed that commuters are of the opinion that cost of transportation and social distancing were the most severe impact of the pandemic on their mobility. Commuters that use private cars were most positively impacted by the pandemic due to the reduction in commuting cost and time. Conversely, commercial buses and taxi users were most negatively impacted based on commuting costs.

RECOMMENDATIONS

Despite the significant impact of the COVID-19 pandemic in Lagos based on frequency of travel, average weekly commuting cost and the average commuting time, road transport maintained its position as the most popular transportation mode for majority of Lagos residents. This is evident of the fact that commuters have limited choices asides road transportation. It is therefore recommended that policymakers step up their efforts to create an accessible network of metro line train systems for an affordable mass transportation of commuters since it is evident that pandemic occurs with its fair share of economic downturns. This advice is based on the idea that access to affordable transportation alternatives is a critical component in the economic mobility of commuters with minimal economic means. As a result, adequate investment in all modes of public transportation (rail, inland waterways, and road) is required, as this will not only ensure a balanced transportation system in the metropolis, but also ensure mass movement of commuters at the lowest possible cost, as well as quality environmental sustainability.

Therefore, a holistic view of transportation system can ensure we maintain resiliency, affordability, effectiveness and sustainability. These can be achieved through these recommendations
  i. Agile mobility: An intra-modal and inter-modal seamless commute. The goal is to plan transport that is not only supply-oriented, but essentially, above all, demand-oriented.
 ii. Provide infrastructure and policies that support walking and cycling. Alongside walkways, bicycle lanes and paths should be incorporated.
iii. To create a resilient and sustainability transportation system, the paradigm must move beyond "private" versus "public" mobility options
With these recommendations duly in place, the society will be better prepared in developing a resilient, sustainable and affordable transportation system to the public.

AUTHOR CONTRIBUTIONS

The authors confirmed contribution to the paper by the following to use part of the data in their study as a "pre-pandemic era data" in the research paper as titled below:

"Modal choice in Metropolitan Lagos"

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