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Article:
Uzondu, C., Mohaimanul Islam, M., Batool, Z. et al. (2024) Transport Services Resilience in the Global South in the Era of COVID-19: Lessons from Nigeria, Bangladesh and Uganda. Transportation in Developing Economies, 10 (2). 28. ISSN: 2199-9287

https://doi.org/10.1007/s40890-024-00210-4

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Transportation in Developing Economies

Transport services resilience in the Global South in the era of COVID-19: Lessons from Nigeria, Bangladesh and Uganda

--Manuscript Draft--

Manuscript Number:	TIDE-D-23-00054R1
Full Title:	Transport services resilience in the Global South in the era of COVID-19: Lessons from Nigeria, Bangladesh and Uganda
Article Type:	Original Article
Funding Information:	UK Research and Innovation (EP/V043226/1) Dr Zia Wadud
Abstract:	The impacts of the coronavirus (COVID-19) pandemic on the transport sector and the corresponding mitigation policies have been widely investigated across the world. There were uncertainties regarding the virus and its role in the context of transport. This paper examined the resilience of transport services in three cities of the Global South during the pandemic while focusing on three main areas: (1) the impacts of COVID-19 on transport services; (2) COVID-19 related challenges of the transport services; and (3) the necessary corrective actions undertaken by transport services to manage the spread of COVID-19 and future pandemics in cities. A series of expert stakeholder workshops were conducted in the cities of Owerri (Nigeria), Dhaka (Bangladesh) and Kampala (Uganda) between December 2020 and January 2021. The aim was to seek input from city planning officials, transport policy experts, transport operator associations, civil society and the academia, among others on how the pandemic affected mobility in these cities and to identify the areas of consensus and conflict. The findings revealed that captive users, who relied heavily on these transport services were disproportionately affected by the COVID-19 mitigation measures, consequently resorting to alternative modes of mobility including walking. When the lockdown measures were gradually eased, the pandemic exposed the severe inadequacies in the operation of transport services, particularly related to adherence to health and safety guidelines, carrying capacity, fare structure and organizational/administrative limitations. The need to ensure that transport systems are prepared for future pandemics is urgent, but also is the management of transport systems in cities of the developing world.
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Order of Authors Secondary Information:	
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Response to Reviewers:	Reviewer's commentsAuthors' responses Reviewer #1: 1. A sound literature review after Introduction is required to establish inter-relation between Transportation and Economy Response: Thank you for suggesting that we include a literature review to establish inter-relation between Transportation and Economy. We have now added a literature review section (page 2): •Literature review 2.1 Inter-relationship between Transportation and Economy Transportation plays an important role in economic development, influencing growth, productivity, and competitiveness worldwide. It's relationship with the economy is multifaceted, with transportation systems shaping various aspects of economic activity and development. For example, transport investments (such as infrastructure) have been shown to stimulate economic growth by reducing transportation costs, enhancing market access, and increasing productivity [11, 12]. These do not only stimulate economic activity but also generate multiplier effects by creating employment opportunities and attracting investments in related sectors [13]. Furthermore, Transportation links enhance connectivity between regions, facilitating regional specialization and trade integration. In the context of international trade and globalization, transportation is essential for reducing trade barriers, thereby enabling access to global markets, and fostering economic integration [13]. The relationship between transportation and economic development holds significant implications for countries worldwide. However, low- and middle-income countries (LMICs) face more unique challenges and opportunities in developing their transportation system. Such challenges include limited funding, inadequate infrastructure, and institutional capacity constraints. Improving transportation infrastructure in LMICs fosters export-led growth, and lures foreign investments, it also plays a crucial role in stimulating economic growth, generating employment opportunities, and reducing poverty [14]. Additionally, such investments have the potential to mitigate regional disparities, enhance connectivity between rural and urban areas, and encourage economic diversification [15]. 2.2 Impact of COVID-19 on transportation systems The COVID-19 pandemic brought unprecedented challenges to transportation systems and economies worldwide, with most LMICs facing particularly significant impacts. The pandemic's disruptions to mobility patterns in LMICs were profound, as governments implemented various measures to contain the virus's spread. Lockdowns, travel restrictions, and the suspension of public transportation services severely impacted transportation systems and mobility. Informal transportation modes like minibuses, motorcycle taxis, and rickshaws (motorised and unmotorised) which are vital for most travels were suspended and this restricted access to essential services, job opportunities, and economic activities, particularly for the vulnerable populations [16]. Services, which often rely on informal transportation networks for their operations, were disproportionately affected, exacerbating economic vulnerabilities [17]. Most countries could not afford lockdown measures for long as it severely affects the sustenance of low-income people and economic development. Transport is vital for keeping economic activities running, yet it was an important medium in spreading of the virus. The resulting economic contractions led to rising unemployment rates and income losses in LMICs. The informal transportation sector, which is a significant employer in LMICs, experienced widespread layoffs and income reductions, worsening poverty and economic inequalities [18]. Furthermore, the pandemic exacerbated existing challenges in transportation infrastructure and highlighted the importance of resilient and sustainable transportation systems in LMICs. 2. Justification for the reason of selecting these three cities requires more depth Response: Thank you for your feedback. We have revisited that section to provide more depth to justify the selection of the three cities. The updated content now better

outlines the specific factors and considerations that make the three cities valuable focus for the study (page 3):

3.1 Study area and impact of COVID-19
Three cities (Owerri [Nigeria], Kampala [Uganda] and Dhaka [Bangladesh] were selected for this study. They were selected based on several key factors including their diverse geographical representation, similarities in transport system which seem to be unorganised and for their contrasting predominant characteristics (e.g., cities are of different sizes: Dhaka is a mega city, Kampala is large and Owerri is small) allowing the research to consider how attitudes, actions and policies during the pandemic differ for each country while retaining some elements of the local context. Additionally, they were selected to ensure that the research findings are relevant to a wider range of countries.

These cities are in various continents (Owerri is in Sub-Saharan Africa, Dhaka in South Asia, and Kampala in East Africa) offering a diverse geographical representation across different regions of LMICs. Their inclusion meant that the project could capture a broader range of experiences and responses to the COVID-19 pandemic. Each of these cities faces unique challenges in their transport infrastructure struggling with issues such as congestion, inadequate public transportation systems, and the prevalence of informal transport services. These challenges have been further exacerbated by the COVID-19 pandemic, which disrupted travel patterns and highlighted existing vulnerabilities in urban transport systems. The impact of COVID-19 on these cities' transport systems varied based on factors such as government responses, various lockdown measures, population density, and the availability of resources. Understanding how these affected the resilience of transport services and how cities adapted to the challenges posed by the pandemic is crucial for informing future policy and planning efforts.
Finally, by examining these policies, the project aims to identify best practices and lessons for enhancing the resilience of transport services in urban areas in LMICs.

3. Comparison of situations among the three cities is missing. It would have been interesting to see if any city is better than other in some aspect

Response: Thank you for your suggestion, we have now provided some comparisons (page 5):

Generally, in response to COVID-19, Nigeria implemented various measures including lockdowns, travel restrictions, and the establishment of a task force. While proactive in approach, challenges like limited healthcare infrastructure hindered effectiveness. Uganda took swift action with strict lockdowns, border closures, and mandatory mask-wearing. Despite challenges, Uganda's proactive measures initially helped contain the virus. Bangladesh faced difficulties due to dense populations and socioeconomic disparities, implementing lockdowns, mask mandates, and vaccination drives. However, enforcement was challenging. Uganda demonstrated the most proactive approach with decisive early action, followed by Nigeria, while Bangladesh faced more challenges despite proactive policymaking. Uganda's strict measures and comprehensive response indicate greater proactiveness compared to Nigeria and Bangladesh.

4. Including statistics or figures on change in mobility before COVID, during COVID and after COVID in these countries and an average calculation of mobility in the world in general would provide a clear picture

Response: Thank you for suggesting some relevant statistics. We have incorporated these into the manuscript, enabling a comparative analysis of the impact of COVID-19 on mobility in the case study countries and the world (page 4) :
A comparative analysis of mobility activities in different countries reveals distinct changes in mobility patterns (Figure 2). Compared to baseline data (pre-pandemic), during the pandemic, Nigerians on average cut down activities at transit stations (including bus and train stations) by 51%, Uganda by 70% and Bangladesh by 67%. Visits to grocery shops and pharmacies had a 48% drop in Nigerian, 37 in Uganda and 29% in Bangladesh. Additionally, in Nigeria, retail and recreation spots (shopping centres, museums, movie theatres, restaurants, theme parks, cafes, and libraries)

were down by 53%, Uganda recorded 67% and Bangladesh 69%. These activities have shown an increase post-pandemic, indicating a gradual return to pre-pandemic mobility levels.

5. The explanations of the sub-themes presented in the paper needs more focus on the situation in all three countries

Response: Thank you for your feedback. We have revised our presentation to highlight sub-themes, relevant discussions, and quotes, allowing for more focus on the unique situations in various countries.

6. The paper claims that it enables to observe similarities and differences in policy development, implementation, effect and enforcement among and between these cities. However, this is not reflected throughout the discussion in the paper. While revising the paper authors must do justice to its claim

Response: Thank you for your suggestion. While we have addressed No 5 above, we have also provided a summary of the results, highlighting similarities and differences in policy development, implementation, effect and enforcement among and between these cities (page 18).

In summary, the impacts of COVID-19 on transport services were similar across Bangladesh, Nigeria, and Uganda. In Bangladesh, where public transport infrastructure was already strained, the pandemic further highlighted the need for improvements. The sharp decline in public transport use during lockdowns exacerbated existing challenges, prompting the government to prioritize infrastructure development. Road reconstruction and transport system reorganization were initiated to enhance efficiency and safety. In Nigeria, the pandemic exposed vulnerabilities in the transport sector, particularly regarding fare regulation and enforcement. With the significant increase in transport fares, commuters faced financial challenges, emphasizing the need for government intervention. Sensitization campaigns were launched to raise awareness about COVID-19 guidelines, while digital payment systems were proposed to facilitate contactless transactions and improve efficiency. In Uganda, the challenges of implementing COVID-19 regulations were compounded by inadequate awareness and enforcement. Despite efforts to mandate social distancing and hygiene practices, compliance remained low, highlighting systemic issues in the transport sector. Research into the pandemic's impact on travel behaviour was emphasized to inform policy interventions and infrastructure improvements tailored to local needs. Overall, while the pandemic presented challenges, it also provided opportunities for each country to address issues in their transport systems and develop resilient strategies for the future.
7. An analysis of COVID-19 in relation to each country must be presented as Bangladesh is one of the most affected while Nigeria and Uganda are not. The authors must use WHO COVID-19 dashboard for presenting intensity of COVID-19 on the capital cities selected here, as impact of COVID-19 is not similar everywhereThank you for your suggestion. While the WHO COVID-19 dashboard does not provide capital city data, we have provided an analysis of COVID-19, highlighting the intensity in relation to each country and the world (page 4).

The first case of COVID-19 was confirmed on the 27th of February 2020 in Nigeria, the 21st of March in Uganda and 8th of March 2020 in Bangladesh. Figure 1 provides COVID-19 indices and reveals varying intensities of its impact in the various countries, with Bangladesh experiencing higher levels (number of cases and deaths) compared to Nigeria and Uganda.

8. Before presenting the country specific demonstration, Authors should also present the transport scenario of each country in general and capital cities specifically

Response: This we already did but have also added more information regarding the case study countries to build reader’s understanding about local dynamics related to the transport sectors (page 5):

3.1.1 Case study cities

Owerri, Nigeria
Nigeria, located in West Africa with a population of over 200 million people is the continent's most populous country with annual GDP 472.6 billion USD [20]. It has a diverse cultural landscape and growing economy, primarily fuelled by the oil industry. Public transportation in Nigeria faces significant challenges despite the large population and economic potential. The sector primarily relies on buses, taxis, motorcycles (okadas), and tricycles (keke napep) for urban and inter-city travel. However, issues such as inadequate infrastructure, poor maintenance, safety concerns, and informal operations negatively impact the public transportation system. The COVID-19 pandemic exacerbated these challenges. Lockdown measures and movement restrictions significantly reduced passenger demand and revenue for public transport operators. The transportation sector experienced a 47.25% decline in real GDP growth in the second quarter of 2020 compared to the same period in 2019 [21]. Additionally, concerns about virus transmission in crowded vehicles prompted the implementation of hygiene and social distancing measures, further impacting the efficiency and affordability of public transportation. The government announced the first lockdown in Nigeria on 30 March 2020, however, the economic consequences of the lockdown prompted the government to announce a phased and gradual easing on 5 May 2020.

Owerri is the capital of Imo state Nigeria located in the South-Eastern region of the country and measures 5100 sqkm in size. The state has an estimated population of 4.8 million people and a population density that varies from 230 to 1,400 people per square kilometer [22]. Road transport is the primary means of transportation in the city, as it conveys an estimated 80% of all traffic [22]. People move around using buses, taxis, autorickshaws and motorcycles [23] which is majorly provided by the private sector. Motorcycles (locally known as Okada) and autorickshaws (locally known as Keke) are mainly used for journeys outside the main arteries in the city due to a ban eight years ago, leading to an increased number and demand of minibuses as a public means of transportation (about 80%) in the city [24]. Most residents either depend on these or walk to work and school. This Study involved stakeholders, users and operators of public transport services in Owerri, registered with the various transport unions in the different localities. The COVID 19 pandemic affected these transport services through a total lockdown which involved a ban on transport services except for essential services issued by the Federal government on 23 March 2020. Additionally, while the lockdown was being eased gradually (as announced on 4 May 2020), government developed measures guiding the use of transport services in the state. These are use of hand sanitizers, face masks, social distancing and reducing passenger-carrying capacity by 50% etc. As of March 2022, an estimated 255,415 cases with 3,142 deaths have already been recorded due to the pandemic in the country [25].

Kampala, Uganda
Uganda is a landlocked country located in East Africa with a population of about 49 million and annual GDP of 45.57 billion USD [20]. It has made tremendous socio-economic progress and invested heavily in infrastructure during the past three decades. In terms of public transportation, most people rely on buses, minibuses (locally known as matatus), motorcycles, and bicycles. However, the sector faces its share of challenges, including inadequate infrastructure, safety concerns, and informal operations. The COVID-19 pandemic brought unprecedented challenges to the public transportation system, causing a significant decline in passenger demand and revenue for transport operators. There was a notable 14.2% decline in the transport sector performance in the 2019/2020 fiscal year due to the pandemic [26]. Policies such as lockdowns and social distancing measures were developed to address the pandemic's impact on public transportation. However, despite these efforts, transport operators struggled financially. Lockdown which included suspension of public transport was imposed on 25 March 2020. The resumption of transport operations nearly-two and a half months later came with new restrictions and regulations including reduction of passenger carrying capacity. Despite the resumption, services were occasionally suspended following new waves of the pandemic in the country.

Kampala City is the capital and main center of economic, industrial and political activity in Uganda. It has a daytime population of about 3.5 million (nighttime population of 1.6 million people) owing to its national importance. The population is projected to reach

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10 million by 2030. Data from KCCA shows that it contributes over one third of the country's Gross Domestic Product (GDP). The city hosts 46% of all formal employment in the country and 70% of the country's manufacturing plants are clustered in the city. The number of public transport trips (not including boda bodas [motorcycle taxis commonly referred to as boda boda]) in 2003 was about 460,000 in the peak AM period or about 800,000 daily trips. This was projected to have increased to about 575,000 and one million respectively by 2018 [27]. A transport survey in 2003 revealed that about 146 trips per person per year were being made by public transport and these are projected to have increased in recent times. The low occupancy commuter taxis (matatus [vans]) constitute 41% of the modal share, NMT (dominated by walking at about 39%) and Motorcycles (constitute about 10% [28]). Following the COVID-19 pandemic, the government introduced "the 35 Presidential Directives", some of which were enforced by the city transport sector. At different periods, the city oscillated between very strict lockdown measures and a relaxation of some of the measures depending on the number of registered COVID-19 cases. Some of the measures included ban on all public transport; allowing private vehicles to carry a maximum of three passengers including the driver; advising passengers to maintain hygiene measures such as not coughing or sneezing in public vehicles, no spitting, regular handwashing with soap and water or using sanitizers, regularly disinfecting surfaces such as vehicle door handles.
Dhaka, Bangladesh
Bangladesh is a country in Southeast Asia projected to be one of the fastest growing economies in the world by 2050 [29]. It has a population of 160 million and an annual GDP of 460.2 billion USD [20]. Public transportation in Bangladesh is primarily facilitated by buses, minibuses, cycle rickshaws, and motorcycles. Challenges such as traffic congestion, inadequate infrastructure, and safety concerns, impact the efficiency of urban and inter-city travel. The COVID-19 pandemic significantly affected Bangladesh's public transportation, leading to reduced passenger demand and revenue for transport operators. There was a 14.8% decline in the GDP growth in the transport sector in 2020 due to the pandemic [30]. Efforts to mitigate the pandemic's impact on public transportation included banning the services and subsequent capacity restrictions. However, these measures posed financial challenges for transport operators, highlighting the sector's resilience despite these challenges. The government imposed two lockdowns which affected the public transport sector. All public transport activities (including trains and flights) were closed between March 28 and June 1 in 2020, when buses were allowed to operate at half capacity. The second lockdown also involved banning public transport on 5 April 2021, but this was changed within 2 days to allow public transport with 50% capacity in 11 large cities of Bangladesh.

Dhaka is the capital and largest city of Bangladesh. It has a population of 16.8 million living on an area of 456 km2 [31], making it the most densely populated city in the world. It is the main commercial centre of Bangladesh with many factories employing a majority of the population. According to Bangladesh Road Transport Authority, 1.6 million vehicles are running in the streets of Dhaka, among them 36,016 are buses, 20,516 are auto-rickshaws, 298,113 are private cars and 782,253 are motorcycles [32]. According to RSTP, [33] more than 60% of the travelers use public transport for their journey to work. The COVID-19 lockdown which started on 26th March 2020 affected these services. However, around September 2020 restrictions on general movement and public activities were lifted. But due to the second wave of COVID-19, countrywide lockdown started again on 5th April 2021. The second phase lockdown was lifted in August 2021 [34]. So far, the SARS-CoV-2 virus has infected more than 1 million people around the country, with over 28 thousand deaths [35].

9. An overview of country specific details should also be presented before the case studies including country profile, transportation and COVID-19. It should relate per-COVID 19 and post COVID 19 scenarios regarding these points

Response: Thank you for your suggestion, this has now been covered in the text above.
10. Consider rewriting or deleting last line of the conclusion. This is not considered in an academic writingThank you for your observation. The last line of the conclusion has been deleted.

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Reviewer #2:
1. The study is mainly based on workshops performed in the cities chosen by the authors. The questions were appropriate for studying the impact of Covid-19 on the transportation infrastructure. But the overall approach lacked any metric to measure the level of impact. No numerical data were presented.
The percentage of the participants answering specific yes/no questions should have been presented for easy statistical analysis. For example, a question like "did you trust the government's assurance on the cleanliness of the transportation system?" could generate valuable data on the level of public confidence on the government of developing countries during emergency situations
The participants perceptions about the issues related to the transportation sector have been presented, but in the absence of any relevant data it is difficult to determine the exact extent of the impact.
Table 1 shows the major issues identified from the workshop studies; but it should also include the information on the corresponding government policies which were involved or impacted those issues. A direct correlation between the government policies (or lack of) and the impact on the public transportation system should have been established in the study.

In view of the above, the authors should submit some numerical data to validate the claims made in the paper. Particularly they should present the data on percentage of the participants agreeing on important issues and a statistical analysis such as whether there is significant differences in opinion among the participants in the three cities.

Response: Thank you for your valuable feedback. We appreciate the time and effort you've invested in reviewing our work. We have carefully considered your comments and understand that there might be reservations regarding qualitative data. We also acknowledge that while quantitative methods have their merits, qualitative research also brings valuable insights. In the context of our study, which is exploratory in nature, the qualitative approach is deemed suitable.

As such, its focus was on exploring themes, patterns and narratives rather than employing statistical analysis or presenting numerical data. We aimed to prioritize the authentic voices of our participants, sharing their verbatim quotes to convey the nuances of their experiences. This approach allowed us to present a rich, in-depth exploration of the phenomenon under study. While we acknowledge the importance of statistical analysis and numerical data in certain types of research (for example Enam, A., Rahman, S. M., Mahmud, S. M. S., & Wadud, Z. (2023). Impacts of COVID-19-Related Non-Pharmaceutical Interventions on Mobility and Accidents in Bangladesh. Transportation Research Record, 2677(4), 917-933. https://doi.org/10.1177/03611981221118532), we believe that our qualitative approach aligns with the objectives and scope of our study and contributes to the broader understanding of the subject matter.
It is also very important to note that statistical information (% agreeing/disagreeing or similar) can be severely misleading in such stakeholder analysis type research and researchers have strongly recommended against use of such information for this type of work (e.g. Lilford R J and Braunholtz D. (1996). For Debate: The statistical basis of public policy: a paradigm shift is overdue BMJ doi:10.1136/bmj.313.7057.603; Wutich, A. et al. (2020). Identifying Stakeholder Groups in Natural Resource Management: Comparing Quantitative and Qualitative Social Network Approaches. Society & Natural Resources, https://doi.org/10.1080/08941920.2019.1707922; Friedrich, D. R. et al (2012). Stakeholder participation in priority setting – a consideration of the normative status of quantitative and qualitative methods. Journal of Evidence, Training and Quality in Health Care https://doi.org/10.1016/j.zefq.2012.06.005).

We sincerely hope this clarification addresses your concerns regarding the absence of statistical analysis and numerical data in our paper and that you can consider our approach in a fair light. If you have any further questions or suggestions for improvement, we would be more than happy to address them.

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Transport services resilience in the Global South in the era of COVID-19: Lessons from Nigeria, Bangladesh and Uganda

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Transport services resilience in the Global South in the era of COVID-19: Lessons from Nigeria, Bangladesh and Uganda

Abstract

The impacts of the coronavirus (COVID-19) pandemic on the transport sector and the corresponding mitigation policies have been widely investigated across the world. There were uncertainties regarding the virus and its role in the context of transport. This paper examined the resilience of transport services in three cities of the Global South during the pandemic while focusing on three main areas: (1) the impacts of COVID-19 on transport services; (2) COVID-19 related challenges of the transport services; and (3) the necessary corrective actions undertaken by transport services to manage the spread of COVID-19 and future pandemics in cities. A series of expert stakeholder workshops were conducted in the cities of Owerri (Nigeria), Kampala (Uganda) and Dhaka (Bangladesh) between December 2020 and January 2021. The aim was to seek input from city planning officials, transport policy experts, transport operator associations, civil society and the academia, among others on how the pandemic affected mobility in these cities and to identify the areas of consensus and conflict. The findings revealed that captive users, who relied heavily on these transport services were disproportionately affected by the COVID-19 mitigation measures, consequently resorting to alternative modes of mobility including walking. When the lockdown measures were gradually eased, the pandemic exposed the severe inadequacies in the operation of transport services, particularly related to adherence to health and safety guidelines, carrying capacity, fare structure and organizational/administrative limitations. The need to ensure that transport systems are prepared for future pandemics is urgent, but also is the management of transport systems in cities of the developing world.

Keywords: ***COVID-19, Transport services, Resilience, Global South, Developing Countries***

• Introduction

The Coronavirus disease (COVID-19) pandemic affected lives and wellbeing. The impact on transportation was very complex and devastating. The virus spread rapidly to different parts of the world, disrupting travel and urban systems [1]. Mitigation measures directly affected mobility through lockdowns, social distancing rules, quarantines, and sometimes direct suspension of most transport operations [2]. In addition, ridership declined substantially which resulted from government measures and choices made by individuals to refrain from travelling to reduce their exposure and spread of the virus [3]. This massive reduction in travel mostly affected transport services in many countries because it was perceived as high risk and could increase exposure or risk of contracting the virus. During the lockdown, governments banned the use of public transport where possible and advised that people should consider other forms or modes such as cycling, walking and use of private cars [4, 5]. Strict adherence to this rule could only be possible where there are infrastructure provisions for Non-Motorised Transport (NMT). This was not the case in most developing countries where there is little or no provision for NMT and many people do not have access and cannot afford private vehicles. These people were therefore left with the poorly developed transport modes (taxis, tricycles, motorcycles) as their only means of transportation. In countries like Nigeria, there are inadequate fleets of vehicles, bad road networks and little or no provision for NMT. Walking and cycling are only feasible for short trips, however, for long-distance trips, people rely on motorised transport, in this case, public transport. If the mitigation measures stipulated by the government were not applied, the drivers and passengers of these transport modes were also at an increased risk of contracting and spreading the virus, considering their close contact with their passengers [6] and use of the cash payment system which is very common in these modes.

After the lockdown was lifted, governments issued guidelines to operators and commuters of transport services to curb the spread of the virus in buses, taxis, autorickshaws and at the stations. Some of these rules included maintaining enhanced hygiene and cleaning standards, use of hand sanitisers, face mask-wearing and social distancing of at least 1m- 2m which would make operators reduce carrying capacity by 50% [2,7]. However, there were concerns about the feasibility of some of these policies as inadequate enforcement affected the effectiveness of managing and implementing these policies. Abiding strictly by the social distancing rules led to operators losing money and also spending their money on regular cleaning and provision of hand sanitisers (which was recovered from the passengers). However, results of a recent study by Bwambale [8] found that passengers were willing to pay for some of these measures.

Although governments and major urban authorities responded to the pandemic with various policy measures and practices to ensure mobility while safeguarding health and wellbeing, unfortunately, some of these rules which were made and adopted in a haste did not show how these policies affected commuters. Although there are studies on the impacts of the policies in many developed countries [9], these do not represent the true situation in developing countries, where motorisation and travel patterns are vastly different [10].

Therefore, this paper fills this gap by providing an understanding of how the COVID-19 pandemic impacted transport services in developing countries. It provides an understanding of how developing countries coped with the impact of the pandemic, presents an evaluation of the situation and mitigation measures in the case study cities. This study is expected to contribute to the literature on pandemic and post-pandemic management and delivery of transportation services, especially in developing countries and offers practical suggestions for governments on how to develop policies to protect operators and users of public transport.

vThe rest of the paper is organised as follows, Section 2 presents a brief review of the literature, while Section 3 covers the study design. Section 4 presents the findings and discussion, while Section 5 draws conclusions and policy recommendations.

***In this paper the term transport services will be used collectively for public transport and paratransit services.**

- ## Literature review

2.1 Inter-relationship between Transportation and Economy

Transportation plays an important role in economic development, influencing growth, productivity, and competitiveness worldwide. It's relationship with the economy is multifaceted, with transportation systems shaping various aspects of economic activity and development. For example, transport investments (such as infrastructure) have been shown to stimulate economic growth by reducing transportation costs, enhancing market access, and increasing productivity [11, 12]. These do not only stimulate economic activity but also generate multiplier effects by creating employment opportunities and attracting investments in related sectors [13]. Furthermore, Transportation links enhance connectivity between regions, facilitating regional specialization and trade integration. In the context of international trade and globalization, transportation is essential for reducing trade barriers, thereby enabling access to global markets, and fostering economic integration [13].

The relationship between transportation and economic development holds significant implications for countries worldwide. However, low- and middle-income countries (LMICs) face more unique challenges and opportunities in developing their transportation system. Such challenges include limited funding, inadequate infrastructure, and institutional capacity constraints. Improving transportation infrastructure

in LMICs fosters export-led growth, and lures foreign investments, it also plays a crucial role in stimulating economic growth, generating employment opportunities, and reducing poverty [14]. Additionally, such investments have the potential to mitigate regional disparities, enhance connectivity between rural and urban areas, and encourage economic diversification [15].

2.2 Impact of COVID-19 on transportation systems

The COVID-19 pandemic brought unprecedented challenges to transportation systems and economies worldwide, with most LMICs facing particularly significant impacts. The pandemic's disruptions to mobility patterns in LMICs were profound, as governments implemented various measures to contain the virus's spread. Lockdowns, travel restrictions, and the suspension of public transportation services severely impacted transportation systems and mobility. Informal transportation modes like minibuses, motorcycle taxis, and rickshaws (motorised and unmotorised) which are vital for most travels were suspended and this restricted access to essential services, job opportunities, and economic activities, particularly for the vulnerable populations [16]. Services, which often rely on informal transportation networks for their operations, were disproportionately affected, exacerbating economic vulnerabilities [17].

Most countries could not afford lockdown measures for long as it severely affects the sustenance of low-income people and economic development. Transport is vital for keeping economic activities running, yet it was an important medium in spreading of the virus. The resulting economic contractions led to rising unemployment rates and income losses in LMICs. The informal transportation sector, which is a significant employer in LMICs, experienced widespread layoffs and income reductions, worsening poverty and economic inequalities [18]. Furthermore, the pandemic exacerbated existing challenges in transportation infrastructure and highlighted the importance of resilient and sustainable transportation systems in LMICs.

• Study Design

3.1 Study area and impact of COVID-19

Three cities (Owerri [Nigeria], Kampala [Uganda] and Dhaka [Bangladesh] were selected for this study. They were selected based on several key factors including their diverse geographical representation, similarities in transport system which seem to be unorganised and for their contrasting predominant characteristics (e.g., cities are of different sizes: Dhaka is a mega city, Kampala is large and Owerri is small) allowing the research to consider how attitudes, actions and policies during the pandemic differ for each country while retaining some elements of the local context. Additionally, they were selected to ensure that the research findings are relevant to a wider range of countries.

These cities are in various continents (Owerri is in Sub-Saharan Africa, Dhaka in South Asia, and Kampala in East Africa) offering a diverse geographical representation across different regions of LMICs. Their inclusion meant that the project could capture a broader range of experiences and responses to the COVID-19 pandemic. Each of these cities faces unique challenges in their transport infrastructure struggling with issues such as congestion, inadequate public transportation systems, and the prevalence of informal transport services. These challenges have been further exacerbated by the COVID-19 pandemic, which disrupted travel patterns and highlighted existing vulnerabilities in urban transport systems. The impact of COVID-19 on these cities' transport systems varied based on factors such as government responses, various lockdown measures, population density, and the availability of resources. Understanding how these affected the resilience of transport services and how cities adapted to the challenges posed by the pandemic is crucial for informing future policy and planning efforts.

Finally, by examining these policies, the project aims to identify best practices and lessons for enhancing the resilience of transport services in urban areas in LMICs.

The first case of COVID-19 was confirmed on the 27th of February 2020 in Nigeria, the 21st of March in Uganda and 8th of March 2020 in Bangladesh. Figure 1 provides COVID-19 indices and reveals varying intensities of its impact in the various countries, with Bangladesh experiencing higher levels (number of cases and deaths) compared to Nigeria and Uganda.

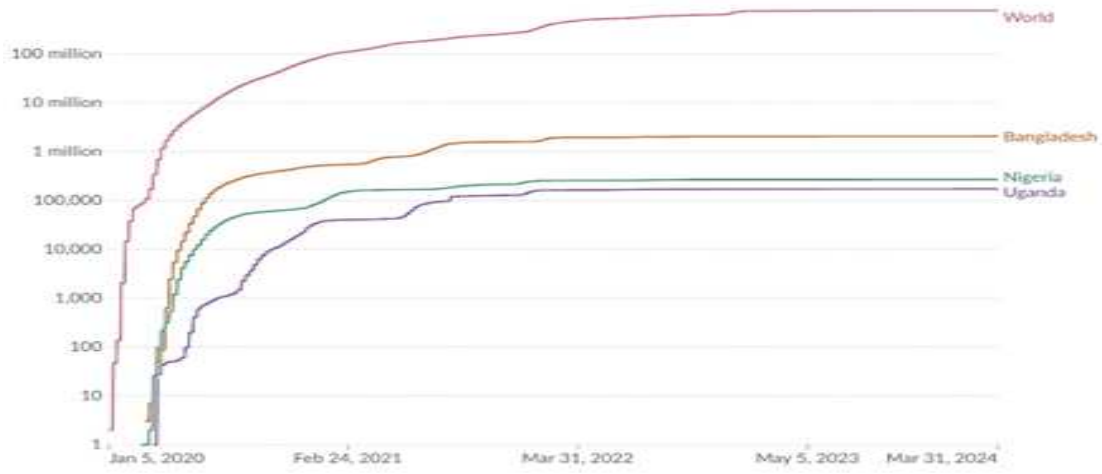

Fig. 1 Cumulative Confirmed COVID-19 Cases [19]

A comparative analysis of mobility activities in different countries reveals distinct changes in mobility patterns (Figure 2). Compared to baseline data (pre-pandemic), during the pandemic, Nigerians on average cut down activities at transit stations (including bus and train stations) by 51%, Uganda by 70% and Bangladesh by 67%. Visits to grocery shops and pharmacies had a 48% drop in Nigerian, 37 in Uganda and 29% in Bangladesh. Additionally, in Nigeria, retail and recreation spots (shopping centres, museums, movie theatres, restaurants, theme parks, cafes, and libraries) were down by 53%, Uganda recorded 67% and Bangladesh 69%. These activities have shown an increase post-pandemic, indicating a gradual return to pre-pandemic mobility levels.

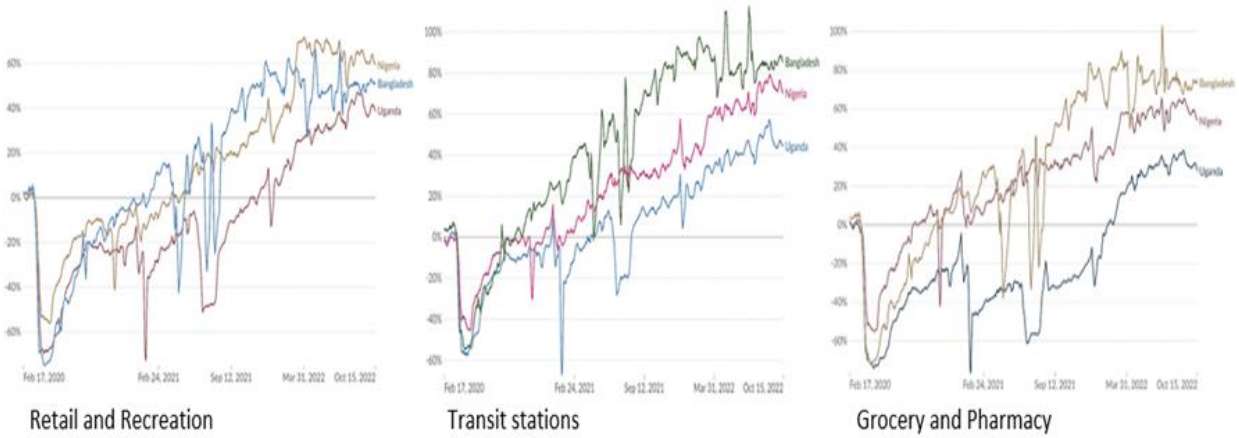

Fig. 2 Change in Mobility during the pandemic [19]

Generally, in response to COVID-19, Nigeria implemented various measures including lockdowns, travel restrictions, and the establishment of a task force. While proactive in approach, challenges like limited healthcare infrastructure hindered effectiveness. Uganda took swift action with strict lockdowns, border closures, and mandatory mask-wearing. Despite challenges, Uganda's proactive measures initially helped contain the virus. Bangladesh faced difficulties due to dense populations and socioeconomic disparities, implementing lockdowns, mask mandates, and vaccination drives. However, enforcement was challenging. Uganda demonstrated the most proactive approach with decisive early action, followed by Nigeria, while Bangladesh faced more challenges despite proactive policymaking. Uganda's strict measures and comprehensive response indicate greater proactiveness compared to Nigeria and Bangladesh.

3.1.1 Case study cities

Owerri, Nigeria

Nigeria, located in West Africa with a population of over 200 million people is the continent's most populous country with annual GDP 472.6 billion USD [20]. It has a diverse cultural landscape and growing economy, primarily fuelled by the oil industry. Public transportation in Nigeria faces significant challenges despite the large population and economic potential. The sector primarily relies on buses, taxis, motorcycles (okadas), and tricycles (keke napep) for urban and inter-city travel. However, issues such as inadequate infrastructure, poor maintenance, safety concerns, and informal operations negatively impact the public transportation system. The COVID-19 pandemic exacerbated these challenges. Lockdown measures and movement restrictions significantly reduced passenger demand and revenue for public transport operators. The transportation sector experienced a 47.25% decline in real GDP growth in the second quarter of 2020 compared to the same period in 2019 [21]. Additionally, concerns about virus transmission in crowded vehicles prompted the implementation of hygiene and social distancing measures, further impacting the efficiency and affordability of public transportation. The government announced the first lockdown in Nigeria on 30 March 2020, however, the economic consequences of the lockdown prompted the government to announce a phased and gradual easing on 5 May 2020.

Owerri is the capital of Imo state Nigeria located in the South-Eastern region of the country and measures 5100 sqkm in size. The state has an estimated population of 4.8 million people and a population density that varies from 230 to 1,400 people per square kilometer [22]. Road transport is the primary means of transportation in the city, as it conveys an estimated 80% of all traffic [22]. People move around using buses, taxis, autorickshaws and motorcycles [23] which is majorly provided by the private sector. Motorcycles (locally known as Okada) and autorickshaws (locally known as Keke) are mainly used for journeys outside the main arteries in the city due to a ban eight years ago, leading to an increased number and demand of minibuses as a public means of transportation (about 80%) in the city [24]. Most residents either depend on these or walk to work and school. This Study involved stakeholders, users and operators of public transport services in Owerri, registered with the various transport unions in the different localities. The COVID 19 pandemic affected these transport services through a total lockdown which involved a ban on transport services except for essential services issued by the Federal government on 23 March 2020. Additionally, while the lockdown was being eased gradually (as announced on 4 May 2020), government developed measures guiding the use of transport services in the state. These are use of hand sanitizers, face masks, social distancing and reducing passenger-carrying capacity by 50% etc. As of March 2022, an estimated 255,415 cases with 3,142 deaths have already been recorded due to the pandemic in the country [25].

Kampala, Uganda

Uganda is a landlocked country located in East Africa with a population of about 49 million and annual GDP of 45.57 billion USD [20]. It has made tremendous socio-economic progress and invested heavily in infrastructure during the past three decades. In terms of public transportation, most people rely on buses, minibuses (locally known as matatus), motorcycles, and bicycles. However, the sector faces its share of challenges, including inadequate infrastructure, safety concerns, and informal operations. The COVID-19 pandemic brought unprecedented challenges to the public transportation system, causing a significant decline in passenger demand and revenue for transport operators. There was a notable 14.2% decline in the transport sector performance in the 2019/2020 fiscal year due to the pandemic [26]. Policies such as lockdowns and social distancing measures were developed to address the pandemic's impact on public transportation. However, despite these efforts, transport operators struggled financially. Lockdown which included suspension of public transport was imposed on 25 March 2020. The resumption of transport operations nearly-two and a half months later came with new restrictions and regulations including reduction of passenger carrying capacity. Despite the resumption, services were occasionally suspended following new waves of the pandemic in the country.

Kampala City is the capital and main center of economic, industrial and political activity in Uganda. It has a daytime population of about 3.5 million (nighttime population of 1.6 million people) owing to its national importance. The population is projected to reach 10 million by 2030. Data from KCCA shows that it contributes over one third of the country's Gross Domestic Product (GDP). The city hosts 46% of all formal employment in the country and 70% of the country's manufacturing plants are clustered in the city. The number of public transport trips (not including boda bodas [motorcycle taxis commonly referred to as boda boda]) in 2003 was about 460,000 in the peak AM period or about 800,000 daily trips. This was projected to have increased to about 575,000 and one million respectively by 2018 [27]. A transport survey in 2003 revealed that about 146 trips per person per year were being made by public transport and these are projected to have increased in recent times. The low occupancy commuter taxis (matatus [vans]) constitute 41% of the modal share, NMT (dominated by walking at about 39%) and Motorcycles (constitute about 10% [28]). Following the COVID-19 pandemic, the government introduced "the 35 Presidential Directives", some of which were enforced by the city transport sector. At different periods, the city oscillated between very strict lockdown measures and a relaxation of some of the measures depending on the number of registered COVID-19 cases. Some of the measures included ban on all public transport; allowing private vehicles to carry a maximum of three passengers including the driver; advising passengers to maintain hygiene measures such as not coughing or sneezing in public vehicles, no spitting, regular handwashing with soap and water or using sanitizers, regularly disinfecting surfaces such as vehicle door handles.

Dhaka, Bangladesh

Bangladesh is a country in Southeast Asia projected to be one of the fastest growing economies in the world by 2050 [29]. It has a population of 160 million and an annual GDP of 460.2 billion USD [20]. Public transportation in Bangladesh is primarily facilitated by buses, minibuses, cycle rickshaws, and motorcycles. Challenges such as traffic congestion, inadequate infrastructure, and safety concerns, impact the efficiency of urban and inter-city travel. The COVID-19 pandemic significantly affected Bangladesh's public transportation, leading to reduced passenger demand and revenue for transport operators. There was a 14.8% decline in the GDP growth in the transport sector in 2020 due to the pandemic [30]. Efforts to mitigate the pandemic's impact on public transportation included banning the services and subsequent capacity restrictions. However, these measures posed financial challenges for transport operators, highlighting the sector's resilience despite these challenges. The government imposed two lockdowns which affected the public transport sector. All public transport activities

(including trains and flights) were closed between March 28 and June 1 in 2020, when buses were allowed to operate at half capacity. The second lockdown also involved banning public transport on 5 April 2021, but this was changed within 2 days to allow public transport with 50% capacity in 11 large cities of Bangladesh.

Dhaka is the capital and largest city of Bangladesh. It has a population of 16.8 million living on an area of 456 km^2 [31], making it the most densely populated city in the world. It is the main commercial centre of Bangladesh with many factories employing a majority of the population. According to Bangladesh Road Transport Authority, 1.6 million vehicles are running in the streets of Dhaka, among them 36,016 are buses, 20,516 are auto-rickshaws, 298,113 are private cars and 782,253 are motorcycles [32]. According to RSTP, [33] more than 60% of the travelers use public transport for their journey to work. The COVID-19 lockdown which started on 26th March 2020 affected these services. However, around September 2020 restrictions on general movement and public activities were lifted. But due to the second wave of COVID-19, countrywide lockdown started again on 5th April 2021. The second phase lockdown was lifted in August 2021 [34]. So far, the SARS-CoV-2 virus has infected more than 1 million people around the country, with over 28 thousand deaths [35].

3.2. The Qualitative Approach

Adopting a qualitative approach, this paper presents practical implications for public and private sector policymakers, operators, and users of public transport. The qualitative approach allows the collection of richer information on topics of this nature with limited understanding and provides room to capture diverse opinions and tap into both known and unknown issues. Data was collected through discussions from workshops carried out in the case study cities, with relevant stakeholders. To capture diverse perspectives, participants selected (or invited) were those who were affected by, have a direct interest in, or are somehow involved with COVID-19 and public transportation but also the policymakers that control access to transport resources. The workshops were arranged to understand how policies made by the governments during the pandemic affected operator's and passengers' preferences and use of transport services. The workshops sought to find answers to questions emanating from blog reports and studies on policies developed to guide the operation and use of these services in developing countries during and post-pandemic. Some of these questions were linked to the challenges in transport services which were made visible during, and post-pandemic, practical interventions and policy measures required in the public transport sector to manage the spread of the virus, the effectiveness of relevant frameworks and policies regarding managing the spread of the virus in transport services and evidence-based policies needed to improve the situation.

Literature review fed into the designing of the workshop exercises. It provided a framework for establishing the need for the study and showed the gaps to be filled. This led to the understanding that various stakeholders are important in the decision-making process and their opinion and perceptions are needed to develop active policies. Subsequently, stakeholder workshops were adopted as the main technique for data collection, and this allowed the exploration of participants' experiences regarding the operation and use of transport services during and post-pandemic and how government policies impacted these.

3.3 Workshops execution

The three workshops were half-day long (4-4.5 hours) and were carried out between December 2020 and January 2021 via Zoom (Bangladesh) and hybrid (Nigeria, Uganda). This was to accommodate policies in specific countries about gathering large numbers of people during the pandemic. The workshops were structured into three parts: project introduction, breakout discussion and summary of discussion and

feedback. The purpose of the project introduction was to inform participants about the project and contributions needed from them. During the breakout session, participants were grouped into different teams, each with 8 to 10 people. The number of groups depended on the number of participants at each workshop (for example, Nigeria: 3 online groups, 1 face to face group; Uganda: 2 face-to-face, 1 online group; Bangladesh: 2 online groups). While grouping participants, emphasis was placed on creating heterogenous settings with a mix of different experts. Each group discussed all research questions (section 2.3), took notes to collect the group's main ideas and prepared a summary of their discussions. This provided a chance for an in-depth exchange of experiences and ideas and enabled participants to contribute substantially to the discussions. These group discussions prompted participants' perceptions of present and future scenarios, and highlighted areas where participants supported or disagreed with policies developed. Discussions continued until saturation was reached when the same comments were repeatedly being made without providing additional new information. At the end of the group discussions, one person per group presented a summary of their discussion to all workshop participants. Finally, where applicable, additional questions were asked on topics that were only partially mentioned during the discussions.

We sought to employ the same workshop methodology in the three countries, but due to the necessity to adapt to local conditions, there were some differences in the preparations, attendance and conduct of the workshops. In all cases, the alternatives were discussed and accordingly adjusted before the workshops. COVID-19 protocols of face mask-wearing, social distancing, and use of hand sanitisers were strictly followed in all face-to-face workshops. At the end of the workshops, participants took pictures to obtain photo documentation.

3.4 Data Collection

Data were collected via the facilitators who moderated the sessions conducted in English language in Nigeria and Uganda, and the local language (Bangul/Bangla or Bengali) in Bangladesh. The veracity of the data was achieved through the involvement of multiple participants from different backgrounds, and the systematic protocols observed during the workshops. The stakeholder's workshops attempted to address three main questions: (1) What are the impacts of the health emergency - COVID-19 - on transport services? (2) What challenges in using/delivering transport services were made visible during and post COVID-19 crisis? and (3) What kind of practical interventions and policy measures were required in the public transport sector to manage the spread of COVID-19?

These questions were tailored by the researchers as appropriate, in order to prompt further deliberation and allow interesting points to be explored in more detail. As well as gauging participants' interest, the workshops served as a start for gathering broad views on the risks and opportunities associated with COVID-19 and challenges to implementation and adaptation. By exploring these causal interrelationships, this study points to a range of context-specific concerns and offers insight into ways stakeholders might develop relevant policy actions and operational strategies to deal with the research problems. All sessions of the workshops including the breakout sessions were recorded with the consent of participants.

3.5 Participants

A purposive sampling technique was adopted in the study. This is a nonprobability sampling method used to select cases that are of particular interest to the research. According to [36], it involves identifying and selecting individuals or groups of individuals that are highly knowledgeable in or experienced in a phenomenon of interest. Stakeholders were recruited from different organisations to broaden the range of participants and perspectives represented in the workshops. Spokespersons of relevant professional organisations, unions, and NGOs were used for recruitment. Some stakeholders were contacted by email and delivering letters at their offices. Transport operators were contacted through their unions, and

others such as auto dealers and public transport companies were recruited from referrals by other transport organisations. The purpose was not to compare and contrast their responses, but to draw on their extensive experience of the COVID 19 situation in the different cities of interest. Workshop 1 held in Owerri Nigeria included 43 participants, workshop 2 held in Kampala Uganda included 33 participants and Workshop 3 held in Dhaka Bangladesh included 25 participants.

3.6 Data Analysis

All discussions were recorded and transcribed verbatim after the workshops. The transcription was carried out by researchers in different countries and analysed independently by all researchers. This was done by examining the discussions for patterns of communication and interactions between participants and comparing across cases. Responses were collated against questions asked during the discussion. The issues highlighted by stakeholders were also collated and arranged in a structured order. Different themes were developed from these for each question discussed during the workshops. These were discussed by researchers until agreement was reached on the themes and sub-themes presented in the next section.

• Findings

This section represents the results of the discussions. It shows six broad themes identified from the questions (including impacts of Covid-19 on transport services, challenges in using transport services that were made visible during and post-pandemic, relevant frameworks for managing the spread of the virus in transport services, difficulties in implementation, improvement and opportunities provided by the pandemic, practical interventions and policy recommendations [see table 1]), links between them, similarities and differences between case study cities. Examination and analysis of the discussion mostly revealed similar patterns of communication and interaction across the three workshops. These include general statements and answers to questions. However, in some cases, there were diverse views and participants tended to concentrate on issues peculiar to their individual countries. The results from the discussions are reported, supported by quotes that capture the perception of selected participants where appropriate. Quotes are represented by countries (Nigeria: NG, Uganda: UG; Bangladesh: BD) and organisations participants represent.

Table 1: Themes identified from stakeholders' workshops

Broad Themes	**Sub-themes**
Impacts of COVID-19 on transport services.	• General decline in the use of public transport • Increase in transport fare • Preference for use of private vehicles and active mobility
Challenges in using transport services that were made visible during and post-pandemic	• Poor organisation of the public transport systems • Fare regulation • Inadequate health and hygiene consciousness in the public transport sector • Design and operation of the public transport system
Relevant frameworks for managing the spread of the virus in transport services.	• Social distancing (50% passenger-carrying capacity

	• Use of facemasks and hand gloves by drivers, conductors, and passengers • Hygiene, sanitization, disinfection of buses before and after use
Difficulties in Implementation **Improvement and opportunities provided by the pandemic**	• Lack of strict enforcement • Poor awareness of the rules • Infrastructure improvement • Proper organisation of the public transport system
Practical interventions and policy recommendations	• Sensitisation of the health implications of COVID-19 and improvement of the healthcare sector • Redesigning and rearrangement of the sitting position in the buses • Organisation of the public transport sector • Digitalisation of the payment system in public transports • Urgent research is required in the light of COVID-19

4.1 Impacts of COVID-19 on transport services

COVID-19 had a significant impact on public transport services across the world. Given that these services are the most common means of transportation for most people in developing countries, a very notable impact was the inability to access and use them, especially during the lockdown. Transport services were banned by the government to reduce the spread of the virus and ensure the safety of both operators and users. There were similarities and distinct differences in participants' perceptions as they discussed the challenges that came with it.

(i) General decline in the use of public transport: There was a consensus among the stakeholders from the three cities that there was a sharp decline in public transport use which resulted in more people resorting to using private cars. For Nigerian stakeholders, this was because of the imposed lockdown but for Bangladesh and Uganda, it was due to the fear of contracting the virus.

> *I need to go out every day for my work. Before COVID-19 I used to take public transport for my daily travel but after the COVID-19 breakout I have fully ignored the public transport (BD, Govt. official).*
>
> *Due to the restricted movements and imposed lockdowns across the country, there have been reduced use of transport services (NG, Govt. official).*
>
> *There was a decline in demand for transport services as it was believed that COVID-19 is transmitted by transport means (UG, Taxi operator)*

This is consistent with previous research [37, 38, 39] which showed that globally, a large decline was observed in mobility due to the fear of contracting the virus and the directive from various governments to mitigate the spread.

(ii) Increase in transport fare: The implementation of crowd control and social distancing rules stipulated by the government, in addition to people refusing to travel for various reasons affected transport operators' income. The pandemic exponentially increased the transport poverty and inequality gaps that

previously appeared invisible in the cities of interest. Nigerian and Ugandan participants attributed the increase in transport fares to reduced passenger-carrying capacity. They believed that operators sought ways to cover reduced fares/revenues by increasing fares. This is similar to the results of studies [40, 2] which revealed that a huge effect of the pandemic on transportation is an increase in transport fares. In Kampala City for example, even when the lockdowns were eased, the fares remained high especially in the commuter taxi (matatu) system while those in the motorcycle system remained almost stable.

> *Increase in transport fares to maintain operator revenues amid government's social-distancing guidelines, decline in ridership due to mode-shift to private cars (NG, Academic)*
>
> *There has been massive increase in cost of travel and people have resorted to walking and cycling (UG, Taxi operator)*

(iii) Preference for use of private vehicles and active mobility (walking and cycling): All the stakeholders agreed that the fear of contracting the virus led to a shift in modal choice. People who had private vehicles resorted to using them and more people cycled and walked. They expressed concerns over people resorting to active mobility despite not having the required infrastructure to support these modes of transport.

> *The number of motorbikes on road has increased a lot due to low availability of other public transports modes (BD, Academic).*
> *There was an increase in active mobility as people preferred to walk and cycle in order to reduce unnecessary contact with others" (UG, Govt. official).*
> *People cycled and walked without considering the poor state of infrastructure (NG, Academic).*

These are consistent with past research which shows that during the pandemic, the preference for public transport decreased remarkably. This could be attributed to studies suggesting that public transport is associated with a higher risk of viral infection [41, 38]. As a result, preference for private vehicles increased significantly in developed countries [38] but the reverse was the case in most developing countries like Bangladesh [42]. Most people who needed to go out and did not have access to private transport relied more on walking and cycling [43]. Despite the often-deplorable conditions and severe lack of infrastructure for safe and efficient active mobility in most developing countries, people still resorted to using those modes during the pandemic.

4.2 Challenges in using transport services that were made visible during and post-pandemic.

Both users and operators of transport services in the case study cities faced a lot of challenges during the pandemic. According to Sheth [44], the pandemic revealed various long-term changes in lifestyles and in the general society.

(i) Poor organisation of the transport services: Bangladesh and Nigerian stakeholders were disturbed about the lack of planning and organization of transport services in these countries, which the pandemic further exposed. It is evident that most developing countries lack basic public transportation infrastructure and little or no funding to improve these. Because most of them are privately owned, adequate regulation and monitoring to ensure passenger safety and security are lacking. For example, according to Mogaji [2], while the very few government operated buses may clean and disinfect their vehicles, the self-employed taxis, tricycles and minibus owners may not adhere to these standards possibly due to lack of willingness or resources.

It uncovered a lack of database for these operators and posed a problem in that even if the government wanted to provide some form of help to the operators, it would have been very difficult to organise. (BD, Govt. official)

It revealed a general lack/poor organization of the public transportation system. For e.g., operators were able to increase fares without consultation with any government body (Nigeria, NGO)

(ii) Fare regulation: Participants (Nigeria and Uganda) agreed that government must actively get involved especially in the regulation of fares. They expressed concerns over the manner public transport operators increased fares during the pandemic and how people who lost their jobs and didn't have any means of livelihood during that time found it very difficult to afford these high fares.

I can't even imagine the way transport fares increase without any prior notice (NG, Academic)
In Kampala City, public transport fares are determined at the discretion of the driver and conductor, and this was worse at the height of the COVID-19 pandemic (UG, Govt. Official).

However, Nigerian stakeholders believed that the operators may have done this to cover cost of operation considering the social distancing rules put in place by government which reduced their carrying capacity to only 50% of passengers. This argument is also supported by other researchers [2, 42, 45], and resulted in many public transport operators increasing their fares to recover losses [46].

I think that the increase in fare could be to cover cost (NG, NGO)

(iii) Inadequate health and hygiene consciousness in the public transport sector: In Nigeria and Uganda, stakeholders conveyed their concerns over the neglect of transport services in developing countries. Before the pandemic, most commuters didn't care about the cleanliness of these public transport vehicles, but this is no longer the case. In the case study cities, for example, all transport service operators were required to sanitize regularly before and after each trip.

It aroused health consciousness in both operators and users as they became more conscious of the hygienic conditions of these vehicles and what they do while on transit (Nigeria, Govt. official).
Public health e.g., hygiene facilities were lacking and there is an urgent need to plan for healthy and environmentally friendly modes of transport (UG, Govt. Official)

In addition to the above, participants from Uganda noted that operators were required to take more measures to further reduce the spread of the virus.

In Kampala city, the operators were also required to take the passengers temperature and sanitize the seat before taking new passengers. Motorcycle operators were also required to wear helmets which were to be sanitized (UG, Govt. Official).

Presently (until now), the operators are still conscious of this and clean their vehicles more often.

(iv) Design and operation of the public transport system: Stakeholders deliberated more on operational problems and infrastructure deficit. This is not surprising because as noted by participants from Uganda and Bangladesh, the present public transport systems in the different cities are in deplorable states but this became more obvious during the pandemic.

Mechanical and physical condition of most of the vehicles are poor but now being improved because of registration of taxis to operate, taxis in poor conditions were denied to operate (UG, Bus operator)
Public transport was never designed in consideration of pandemic or diseases (BD, Govt. official)

These are consistent with Mogaji [47]. They showed that the inadequate fleets of public transport vehicles and sparse road networks in Nigeria present significant concerns for the country pre-COVID, and worse scenarios are anticipated post-pandemic.

4.3 Relevant frameworks for managing the spread of the virus in transport services.

Various national and international organizations influenced the process of policy development during the COVID-19 pandemic. The WHO guidance helped to direct policies formed by most governments. With the information they provided which was constantly updated, governments in all three countries acted promptly and developed frameworks and policies targeted at reducing the spread of the virus and ensuring safe public transport operations.

(i) Social distancing: Stakeholders were aware of the available reports from WHO [48] and other relevant bodies regarding the importance of physical distancing in limiting the spread of COVID-19. Consequently, most countries (including the case study countries) included this measure to protect people from spreading the virus, especially in public transport. The social distancing resulted in the reduction of passenger carrying capacity to 50%.

Social distancing [transport operators to go half capacity] (UG, Govt. Official)

Maintaining social distancing while seating in these public transport vehicles (NG, NGO)

(ii) Use of facemasks and hand gloves by drivers, conductors, and passengers: Research shows that facemask use can be an effective way of reducing the spread of the virus in public transport if properly used and handled correctly [49]. All the participants noted how these were used and enforced in different countries including the difficulty people encountered in having access to them. These challenges were later overcome by engaging local producers and administering fines to those who refuse to comply.

Wearing of masks was made compulsory (UG, Govt. Official)

Drivers, conductors and passengers were mandated to use face masks and hand gloves while on transit (NG, Operator)

No mask, No service (BD, Govt. official)

(iii) Hygiene, sanitization, disinfection of buses before and after use

Research suggests that physical contact with a contaminated surface is a potential mode of COVID-19 transmission [50]. Ugandan and Nigerian participants reported wide adoption of frequent cleaning and sanitization of public transport vehicles and stations as was mandated by the government.

Hand washing/sanitization stipulated means additional cost to operators (UG, Taxi operator)

Operators were also asked to always disinfect their buses before and after use (NG, Govt. official)

In Nigeria, apart from the measures listed above, the government enforced provision of handwashing facilities and running water in bus stations/parks. These are in line with past studies which show that different countries implemented measures such as social distancing [51], use of facemasks and improved hygiene, sanitisation, and ventilation [52] during the pandemic.

4.4 Difficulties in Implementation

Despite developing these measures, many challenges affected implementation. In some instances, the guidelines were not strictly adhered to. This seemed common in all three countries. Stakeholders were also disturbed by the misconceptions about the virus from various sources. In Nigeria and Uganda, people seem to lack adequate knowledge about the virus. In Bangladesh and Nigeria, most people were not following the guidelines because they were taking advantage of the situation to maximize their profit. There were also concerns about the price of personal protection equipment (PPEs) in Uganda and Nigeria which led to people not using them.

(i) Lack of strict enforcement: Generally, participants noted the general lack of strict enforcement which made both operators and users of public transport services not adhere strictly to specified guidelines. This could be related to the organisation of public transport services in developing countries. According to Tirachini [53] and Gwilliam [54], the public transport system is either unregulated or poorly regulated, without proper safety and hygiene standards. There are no public subsidies, and drivers' income depends entirely on the number of passengers carried. It could then become a challenge to enforce regulation in a sector where the government has no total control.

Implementation of these policies is easier in organized transport sectors, but very difficult with the unorganized sector. The policies have not been quite effective as people have been violating them and there is no proper enforcement (NG, Academic)

At the beginning of the pandemic, its management was largely built out of fear of the virus and compliance relied heavily on the Presidential Directives and other Standard Operating Procedures (SOPs). A large number of persons operated and worked under fear of being arrested and the increasing cases of COVID-19. Ultimately, compliance has gone down now, in some places it is zero compliance (UG, Govt. Official)

Enforcement of these rules were strict at the beginning, but they slowly faded away, No institutional arrangement of monitoring (BD, Academic).

(ii) Poor awareness of the rules: Participants from different countries expressed similar views concerning the near lack of sensitization and awareness-raising campaigns by the government to properly educate the general public about the virus and the measures developed to reduce the spread.

Lack of proper awareness to educate the public on the virus and how it is spread has resulted in most users and operators, concluding that there is no COVID (Nigeria, Govt. official).

Poor outreach especially in the rural areas (NG, NGO)

People haven't yet understood the measures or how the virus spreads (UG, Taxi operator)

4.5 Improvement and opportunities provided by the pandemic

According to World Bank [14], one advantage of the pandemic is that it accelerated innovative solutions and the use of digital applications for formal and informal public transport. This is also true for case study countries. For example, Kampala City with the existing poor state and organization of the public transport system received funding from the Netherlands Government and took advantage of the lockdown period to improve selected features of the commuter taxi system including but not limited to reconstruction of some old taxi parks, filling of potholes, registration of public transport vehicles, issuance of route charts and upgrading of strong water drainage systems.

The pandemic and lockdown period gave us an opportunity with the Ministry of Works and Transport to reorganise and improve our road system but also refurbish the Old Taxi Park without the routine hindrances and opposition that we frequently receive from opposition politicians and taxi operators. All these improvements were done in a relatively free and calm atmosphere for over two months, given that public transport commuter taxis were not operational (UG, Govt. Official).

The reorganisation of the transport systems in Kampala City during the pandemic brought about some changes in the transport system. On one hand, there were proposals to introduce COVID-19 shields to reduce the spread of the virus between passengers and riders. On the other hand, there were proposals to create a boda boda exclusion zone; a zone that bans passenger motorcycles from operating in the Kampala City Centre. Additionally, boda boda operators were required to be registered at gazetted stages which should have been their addresses to enable COVID-19 contact tracing in case of COVID-19 infections. The boda boda operators were also required to keep records of their clients including telephone contacts and residences that authorities could trace them should any of the contacts test positive for COVID-19. The proposal to ban motorcycle operations has received opposition from the

motorcycle operators themselves and other government officials who argue that the ban would create massive unemployment and breed insecurity across the city.

4.6 Practical interventions and recommended policy

Even though intervention measures were developed to reduce the spread of the virus during the pandemic, participants believed that these measures should have included policies focused majorly on improving the present transport conditions. Additionally, in Bangladesh, participants maintained that government policies should not result in operators losing any source of income. Encouraging cashless transactions was suggested in both Nigeria and Uganda to reduce contact with people. Specifically:

(i) Sensitisation on the health implications of COVID-19 and improvement of the healthcare sector: Participants (Nigeria, Uganda and Bangladesh) reached a consensus that adequate sensitisation is needed to inform people about the virus and its long-term effect on health. This was found very important because of the misconceptions about the virus which could disrupt the implementation of measures and adoption of safety guidelines. Sensitizing and enlightening the public on issues about the pandemic and encouraging good hygiene and public health practices are key to any emergency response and should be emphasized by the government.

> *Adequate sensitization on the health implications of COVID 19 and the need to respect government policies in that regard in the transport sector is very important as this will create more awareness of the present situation (NG, Govt. official)*
>
> *Encouraging commuters to use handwashing facilities at bus stops and use of facemasks is very important (BD, Govt. official)*
>
> *There should be proper outreach to reinforce positive norms e.g., public health practices (UG, Academic)*

Additionally, participants from Nigeria and Uganda agreed that implementing this through channels such as print and social media, religious and traditional bodies would help to get more people adequately informed.

> *More attention should be given to enlightening the citizens and securing their co-operation and voluntary compliance through various media outlets. (NG, NGO)*
>
> *Use the available platforms and technologies to sensitize the public (UG, Civil Society)*

They also emphasized that providing adequate training for health personnel would go a long way in improving the situation.

> *Adequate training of ambulance drivers employed in times of pandemics to mitigate further spread of the disease. (NG, Govt. official)*
>
> *Incorporate public health consideration and training of personnel into transport planning and services (UG, Govt. Official)*

(ii) Redesigning and rearrangement of the sitting position in the buses: Participants across all countries expressed similar concerns regarding the sitting arrangement in especially buses and the aspirations to have these redesigned by making more space between seats in order to protect commuters. In the discussions, the positive attitude towards this line of thought aligned with what some local authorities proposed especially in Uganda.

> *Interior redesign e.g., partitioning and disposable (or re-usable) seat covers (possibly provided by the passenger) (NG, Academic)*
>
> *Adequate rules to use alternate or diagonal seats in public vehicles, including providing separate entry and exit points (BD, Consultant)*
>
> *Reduce the number of seats in public vehicles to enforce social distancing (UG, Govt. Official)*

(iii) Organisation of the public transport sector: All participants shared similar views regarding making the public transport sector a safe and efficient viable option of travel. This would, however, require coordinated effort from policymakers, public transport unions, operators, and users**.**

The organization of the public transport sector and encouragement of cashless transactions (NG, Academic)

Incorporate public health consideration into transport planning and services and re-plan and design transport service centres (UG, Govt. Official)

The system must address planning level faults and work their way up (BD, Academic)

Discussions centered mainly on the urgent need for the government to provide infrastructure to support and encourage active mobility. Their contributions to this were mostly convergent in the sense that they built on what others said earlier. They emphasized the need for the government to explore and invest in alternative means of transportation to encourage people who do not have private vehicles to move around safely without fear. The pandemic prompted governments especially in the developed countries to create more and wider walkways and cycle paths thereby encouraging people to walk and cycle. According to Popovich [55], it encouraged less air pollution and more livable places. This was not the situation in many developing countries. Participants (Bangladesh and Uganda) described the difficulty experienced in walking and cycling as it mostly affects the lack of infrastructure.

Bicycle facilities should be encouraged for a sustainable/healthy future. Cycle rent facilities are helpful to deal with pandemic situation (BD, NGO)

Design of transport system that incorporate bike and motorbike lanes, walking lanes are needed (UG, Govt. Official)

(iv) Digitalization of the payment system in public transports: Nigerian and Ugandan participants recalled the general lack of application of simple Information and Communication Technology (ICT) resources in the public transport sector. They noted that the most common fare payment system is with cash and maintained that this present system could be replaced with a digitalized cashless system to avoid exchange of cash between operators and commuters.

Government subsidization of transport fares to encourage commuters and transporters to obey the COVID-19 health protocols (NG, Operator)

Infrastructure to support ticketing and prepayment including digitization of payments to discourage cash payments and facilitate contact tracing (UG, Consultant)

(v) Urgent research required in the light of COVID-19

While more evidence on the impacts of COVID-19 has been accumulating, there are still many unknowns. Participants from different countries suggested that more research efforts should be made, including improvements in the present study. They stressed the urgent need to improve research on the impact of COVID-19 on the transport sector, change in modal share and how this could be applied in future pandemics. In Uganda and Nigeria, research on alternative travel modes especially walking and cycling during the pandemic was suggested. Even though participants agreed that there is a potential for increasing active travel, this will depend on policies supporting provision of adequate infrastructure, changes in lifestyles and attitudes. Active travel should be promoted especially for avoiding infection risks, making transport systems more resilient, sustainable transport development and healthy lifestyles.

Research should focus on why people do not cycle or use scooters and inform design of our built environment (NG, Govt. official)

Research on affected bus service owners and changes in travel modes due to issues such as COVID-19 (BD, Govt. official)

On the other hand, they suggested that research on travel behaviour needs to be undertaken as this may have changed following the pandemic. The preventive measures affected the way people undertake travel, contributed to limiting the number of trips and changing modes of travel and destinations.

> *Research should look at peoples' travel behaviour, i.e., where people go more and what modes they use often (NG, Academic)*
>
> *There have been fewer visits during the festive season compared to the pre-pandemic period (Uganda, Consultant)*

Transport related air pollution and exposure to COVID-19 were also suggested as potential research areas.

> *Research on understanding the link between users with pre-existing conditions that are transport related (through air pollution) and exposure to COVID-19 (Uganda, Academic)*

• Conclusion and Policy Recommendation

This study explored stakeholders' perceptions of the effect of policies made during the pandemic regarding the use and operation of transport services in selected cities. It enabled us to observe the similarities and differences in policy development, implementation, effect, and enforcement among and between these cities which would help develop sustainable and safe urban mobility post-pandemic. A key difference from previous research is that our study recognises that developing countries have different economic and social challenges before the pandemic, which may suggest the need for tailored policies. Therefore, this study uncovers how the adopted policies made during the pandemic affected operators and users of public transport by bringing additional evidence on the (potential) adverse effects of inadequate planning and organisation on people's wellbeing. By exploring these, our qualitative findings shed light on how issues pertaining to these services could be approached and how various factors interact to shape their effective operation and use.

There was a consensus on the impact of COVID 19 in the case study cities. Some areas of agreement are the decline in the use of public transport services, associated preference for the use of private vehicles, walking and cycling, and the increase in transport fares. This shows that people who live in cities without NMT infrastructures and who do not have and cannot afford private cars suffered substantial hardships during the pandemic. Therefore, urban and transport planners in these countries should utilize this opportunity to focus on promoting NMT modes which contribute to enhancing human health and well-being as well as reducing the exposure of a public transport system [56].

This study further revealed a range of issues relevant and unique to the cities of interest during the pandemic, which was mostly a result of the poor planning and organisation of the transport system. The conversations around this unequivocally reflected the gaps and multiple barriers (such as unorganised transport systems, improper fare regulation, lack of health consciousness and poor design and operation of the public transport systems) pertaining to the proper functioning of these services and how the pandemic revealed some of these limitations. The similarities in recommendations and regulations by countries regarding public transportation could be explained by the prevalence of COVID-19 in these countries. The findings corroborate the results of previous studies [57, 58] showing that, to an extent, different people experienced similar difficulties during the pandemic.

Participants shared similar views on the preventive measures which ranged from mandatory use of facemasks, social distancing (2m for Nigeria and Uganda; 1m for Bangladesh), cleaning and disinfecting stations etc. These corroborate findings from a review by Tirachini and Cats [52]. Additionally enforcing these may have contributed to resolving the concerns of the public transport users.

The study also found robust evidence that despite implementing similar protective measures across all three cities, the intensity of responses and adherence to these measures varied. Participants attributed the non-adherence of the rules to poor sensitization and awareness-raising and lack of strict enforcement. Additionally, in most developing countries, there was no form of support from the Government to help transport owners mitigate the financial effects and impact of the pandemic. Most of the operators may not be financially capable of coping with these measures and may ignore some of the rules especially if enforcement is low. In Bangladesh and Nigeria, the rules were not always strictly adhered to because of low enforcement and poor sensitisation compared to Uganda, where enforcement was stricter initially but equally reduced. In some places in the urban areas in Nigeria and Uganda (while the lockdown was gradually being eased), special task forces were physically inspecting and ensuring that all drivers and commuters wore their face masks before boarding any vehicles and while on transit. Those who didn't have theirs were either refused to board or made to buy new ones as was also noted by Agyemang et al. [59]. However, this enforcement did not cover the entire cities as people flaunted the rules, especially in the rural areas.

The pandemic came with massive changes in mobility patterns. This study has revealed the urgent need to improve transport infrastructure investments in the study locations and developing countries at large. This could be in investments into public transport infrastructure, design and development of walking and cycling networks, redesigning and changing the seating arrangements in these vehicles to create more space, digitalization of the payment system by exploring other alternatives such as contactless payment or prepaid online ticketing systems to reduce person-to-person contacts. Additionally, more research is needed to understand how the pandemic has affected mobility patterns throughout the world and how this could be improved considering that other variants of the virus are still being discovered.

In summary, the impacts of COVID-19 on transport services were similar across Bangladesh, Nigeria, and Uganda. In Bangladesh, where public transport infrastructure was already strained, the pandemic further highlighted the need for improvements. The sharp decline in public transport use during lockdowns exacerbated existing challenges, prompting the government to prioritize infrastructure development. Road reconstruction and transport system reorganization were initiated to enhance efficiency and safety. In Nigeria, the pandemic exposed vulnerabilities in the transport sector, particularly regarding fare regulation and enforcement. With the significant increase in transport fares, commuters faced financial challenges, emphasizing the need for government intervention. Sensitization campaigns were launched to raise awareness about COVID-19 guidelines, while digital payment systems were proposed to facilitate contactless transactions and improve efficiency. In Uganda, the challenges of implementing COVID-19 regulations were compounded by inadequate awareness and enforcement. Despite efforts to mandate social distancing and hygiene practices, compliance remained low, highlighting systemic issues in the transport sector. Research into the pandemic's impact on travel behaviour was emphasized to inform policy interventions and infrastructure improvements tailored to local needs. Overall, while the pandemic presented challenges, it also provided opportunities for each country to address issues in their transport systems and develop resilient strategies for the future.

Some caveats still remain. The qualitative insight from this study was based on the open-ended questions stakeholders answered and discussed during the workshops, future studies may want to include questionnaire survey which will provide more insight into the experiences of these stakeholders and provide more rigour to the qualitative data. Future studies may also want to explore the impact of COVID-19 on service provision and replicate the study in more developing countries.

Despite these limitations, the findings and recommendations of this study are relevant to policymaking in developing countries, and other areas with similar public transport characteristics. The insights from this study could have implications for urban and transport planners, developers, and government policymakers to make suitable adjustments to the built environment, develop technology to aid service delivery and the integration of other relevant transport technologies which would help improve the transport services post-COVID. Additionally, identification of user needs, requirements, and concerns prior to the development of policies is also very important in meeting the transport needs of the public, particularly during possible future pandemic situations. This section is very well written.

Acknowledgements
We acknowledge the support from UK Research and Innovation as part of the Global Challenges Research Fund (GCRF) and Newton Fund Agile Response Call to address COVID19 (No. EP/V043226/1).

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CRediT authorship contribution statement

Chinebuli Uzondu: Conceptualization, Methodology, Resources, Data collection, Formal analysis, Validation, Investigation, Writing – original draft, Writing – review & editing

Md Mohaimanul Islam: Resources, Data collection, Validation, Investigation, Formal analysis, Writing – original draft

Zahara Batool: Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing

Paul Mukwaya: Conceptualization, Methodology, Resources, Data collection, Validation, Investigation, Formal analysis, Writing – original draft

Farzana Rahman: Conceptualization, Methodology, Resources, Data collection, Validation, Investigation, Writing – original draft

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Conflict of interest

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Conflict of Interest

The authors declare that they have no known conflicts of interests.

Cover Letter
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Editor-in-Chief
Transportation in Developing Economies
4 May 2024

Dear Prof Chakroborty,

I hope this letter finds you well. I am writing to submit an updated version of our manuscript titled '**Transport services resilience in the Global South in the era of COVID-19: Lessons from Nigeria, Bangladesh and Uganda**' for consideration and publication in your esteemed journal.

We acknowledge the time spent by the reviewers, to provide helpful comments to improve our manuscript. We have provided point – by – point response to each of the reviewers' comments. We have also included a 'Response to reviewers' comment document for your ease of reference.
In summary, we have included a literature section, provided a better description of the study locations and added more COVID-19 statistics as suggested by Reviewer #1. While we acknowledge Reviewer #2's suggestion to include statistical analysis and numerical data in our manuscript, we believe that in the context of our study, which is exploratory in nature, the qualitative approach is deemed suitable. It aligns with the objectives and scope of our study and contributes to the broader understanding of the subject matter.

Thank you for considering our submission, I look forward to your feedback and the opportunity to contribute to the valuable content of Transportation in Developing Economies

Sincerely,

Chinebuli Uzondu
For Authors

Responses to reviewer's comments
Click here to access/download;Supplementary Material;Responses to reviewers comments.docx

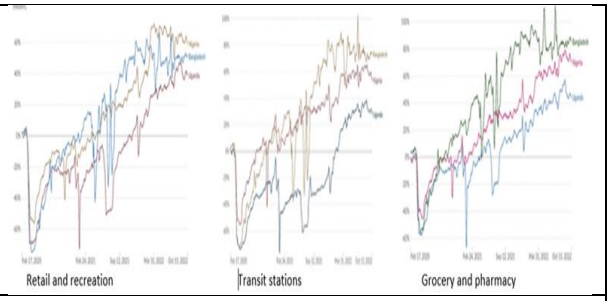
Responses to reviewers' comments

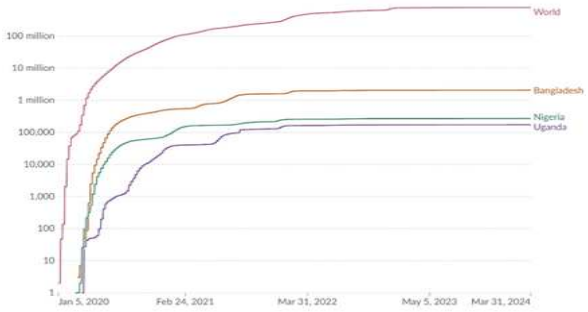
Reviewer's comments	Authors' responses
Reviewer #1:	
1. A sound literature review after Introduction is required to establish inter-relation between Transportation and Economy	Thank you for suggesting that we include a literature review to establish inter-relation between Transportation and Economy. We have now added a literature review section (page 2): • **Literature review** **2.1 Inter-relationship between Transportation and Economy** Transportation plays an important role in economic development, influencing growth, productivity, and competitiveness worldwide. It's relationship with the economy is multifaceted, with transportation systems shaping various aspects of economic activity and development. For example, transport investments (such as infrastructure) have been shown to stimulate economic growth by reducing transportation costs, enhancing market access, and increasing productivity [11, 12]. These do not only stimulate economic activity but also generate multiplier effects by creating employment opportunities and attracting investments in related sectors [13]. Furthermore, Transportation links enhance connectivity between regions, facilitating regional specialization and trade integration. In the context of international trade and globalization, transportation is essential for reducing trade barriers, thereby enabling access to global markets, and fostering economic integration [13]. The relationship between transportation and economic development holds significant implications for countries worldwide. However, low- and middle-income countries (LMICs) face more unique challenges and opportunities in developing their transportation system. Such challenges include limited funding, inadequate infrastructure, and institutional capacity constraints. Improving transportation infrastructure in LMICs fosters export-led growth, and lures foreign investments, it also plays a crucial role in stimulating economic growth, generating employment opportunities, and reducing poverty [14]. Additionally, such investments have the potential to mitigate

	regional disparities, enhance connectivity between rural and urban areas, and encourage economic diversification [15]. **2.2 Impact of COVID-19 on transportation systems** The COVID-19 pandemic brought unprecedented challenges to transportation systems and economies worldwide, with most LMICs facing particularly significant impacts. The pandemic's disruptions to mobility patterns in LMICs were profound, as governments implemented various measures to contain the virus's spread. Lockdowns, travel restrictions, and the suspension of public transportation services severely impacted transportation systems and mobility. Informal transportation modes like minibuses, motorcycle taxis, and rickshaws (motorised and unmotorised) which are vital for most travels were suspended and this restricted access to essential services, job opportunities, and economic activities, particularly for the vulnerable populations [16]. Services, which often rely on informal transportation networks for their operations, were disproportionately affected, exacerbating economic vulnerabilities [17]. Most countries could not afford lockdown measures for long as it severely affects the sustenance of low-income people and economic development. Transport is vital for keeping economic activities running, yet it was an important medium in spreading of the virus. The resulting economic contractions led to rising unemployment rates and income losses in LMICs. The informal transportation sector, which is a significant employer in LMICs, experienced widespread layoffs and income reductions, worsening poverty and economic inequalities [18]. Furthermore, the pandemic exacerbated existing challenges in transportation infrastructure and highlighted the importance of resilient and sustainable transportation systems in LMICs.
2. Justification for the reason of selecting these three cities requires more depth	Thank you for your feedback. We have revisited that section to provide more depth to justify the selection of the three cities. The updated content now better outlines the specific factors and considerations that make the three cities valuable focus for the study (page 3):

	3.1 Study area and impact of COVID-19 Three cities (Owerri [Nigeria], Kampala [Uganda] and Dhaka [Bangladesh] were selected for this study. They were selected based on several key factors including their diverse geographical representation, similarities in transport system which seem to be unorganised and for their contrasting predominant characteristics (e.g., cities are of different sizes: Dhaka is a mega city, Kampala is large and Owerri is small) allowing the research to consider how attitudes, actions and policies during the pandemic differ for each country while retaining some elements of the local context. Additionally, they were selected to ensure that the research findings are relevant to a wider range of countries. These cities are in various continents (Owerri is in Sub-Saharan Africa, Dhaka in South Asia, and Kampala in East Africa) offering a diverse geographical representation across different regions of LMICs. Their inclusion meant that the project could capture a broader range of experiences and responses to the COVID-19 pandemic. Each of these cities faces unique challenges in their transport infrastructure struggling with issues such as congestion, inadequate public transportation systems, and the prevalence of informal transport services. These challenges have been further exacerbated by the COVID-19 pandemic, which disrupted travel patterns and highlighted existing vulnerabilities in urban transport systems. The impact of COVID-19 on these cities' transport systems varied based on factors such as government responses, various lockdown measures, population density, and the availability of resources. Understanding how these affected the resilience of transport services and how cities adapted to the challenges posed by the pandemic is crucial for informing future policy and planning efforts. Finally, by examining these policies, the project aims to identify best practices and lessons for enhancing the resilience of transport services in urban areas in LMICs.

3. Comparison of situations among the three cities is missing. It would have been interesting to see if any city is better than other in some aspect	Thank you for your suggestion, we have now provided some comparisons (page 5): Generally, in response to COVID-19, Nigeria implemented various measures including lockdowns, travel restrictions, and the establishment of a task force. While proactive in approach, challenges like limited healthcare infrastructure hindered effectiveness. Uganda took swift action with strict lockdowns, border closures, and mandatory mask-wearing. Despite challenges, Uganda's proactive measures initially helped contain the virus. Bangladesh faced difficulties due to dense populations and socioeconomic disparities, implementing lockdowns, mask mandates, and vaccination drives. However, enforcement was challenging. Uganda demonstrated the most proactive approach with decisive early action, followed by Nigeria, while Bangladesh faced more challenges despite proactive policymaking. Uganda's strict measures and comprehensive response indicate greater proactiveness compared to Nigeria and Bangladesh.
4. Including statistics or figures on change in mobility before COVID, during COVID and after COVID in these countries and an average calculation of mobility in the world in general would provide a clear picture	Thank you for suggesting some relevant statistics. We have incorporated these into the manuscript, enabling a comparative analysis of the impact of COVID-19 on mobility in the case study countries and the world (page 4) : A comparative analysis of mobility activities in different countries reveals distinct changes in mobility patterns (Figure 2). Compared to baseline data (pre-pandemic), during the pandemic, Nigerians on average cut down activities at transit stations (including bus and train stations) by 51%, Uganda by 70% and Bangladesh by 67%. Visits to grocery shops and pharmacies had a 48% drop in Nigerian, 37 in Uganda and 29% in Bangladesh. Additionally, in Nigeria, retail and recreation spots (shopping centres, museums, movie theatres, restaurants, theme parks, cafes, and libraries) were down by 53%, Uganda recorded 67% and Bangladesh 69%. These activities have shown an increase post-pandemic, indicating a gradual return to pre-pandemic mobility levels.

	
5. The explanations of the sub-themes presented in the paper needs more focus on the situation in all three countries	Thank you for your feedback. We have revised our presentation to highlight sub-themes, relevant discussions, and quotes, allowing for more focus on the unique situations in various countries.
6. The paper claims that it enables to observe similarities and differences in policy development, implementation, effect and enforcement among and between these cities. However, this is not reflected throughout the discussion in the paper. While revising the paper authors must do justice to its claim	While we have addressed No 5 above, we have also provided a summary of the results, highlighting similarities and differences in policy development, implementation, effect and enforcement among and between these cities (page 18). In summary, the impacts of COVID-19 on transport services were similar across Bangladesh, Nigeria, and Uganda. In Bangladesh, where public transport infrastructure was already strained, the pandemic further highlighted the need for improvements. The sharp decline in public transport use during lockdowns exacerbated existing challenges, prompting the government to prioritize infrastructure development. Road reconstruction and transport system reorganization were initiated to enhance efficiency and safety. In Nigeria, the pandemic exposed vulnerabilities in the transport sector, particularly regarding fare regulation and enforcement. With the significant increase in transport fares, commuters faced financial challenges, emphasizing the need for government intervention. Sensitization campaigns were launched to raise awareness about COVID-19 guidelines, while digital payment systems were proposed to facilitate contactless transactions and improve efficiency. In Uganda, the challenges of implementing COVID-19 regulations were compounded by inadequate awareness and enforcement. Despite efforts to mandate social distancing and hygiene practices, compliance remained low, highlighting systemic issues in the transport sector. Research into the pandemic's impact on travel behaviour was emphasized to inform

	policy interventions and infrastructure improvements tailored to local needs. Overall, while the pandemic presented challenges, it also provided opportunities for each country to address issues in their transport systems and develop resilient strategies for the future.
7. An analysis of COVID-19 in relation to each country must be presented as Bangladesh is one of the most affected while Nigeria and Uganda are not. The authors must use WHO COVID-19 dashboard for presenting intensity of COVID-19 on the capital cities selected here, as impact of COVID-19 is not similar everywhere	Thank you for your suggestion. While the WHO COVID-19 dashboard does not provide capital city data, we have provided an analysis of COVID-19, highlighting the intensity in relation to each country and the world (page 4). The first case of COVID-19 was confirmed on the 27th of February 2020 in Nigeria, the 21st of March in Uganda and 8th of March 2020 in Bangladesh. Figure 1 provides COVID-19 indices and reveals varying intensities of its impact in the various countries, with Bangladesh experiencing higher levels (number of cases and deaths) compared to Nigeria and Uganda. 
8. Before presenting the country specific demonstration, Authors should also present the transport scenario of each country in general and capital cities specifically	This we already did but have also added more information regarding the case study countries to build reader's understanding about local dynamics related to the transport sectors (page 5): **3.1.1 Case study cities** ***Owerri, Nigeria*** Nigeria, located in West Africa with a population of over 200 million people is the continent's most populous country with annual GDP 472.6 billion USD [20]. It has a diverse cultural landscape and growing economy, primarily fuelled by the oil industry. Public transportation in Nigeria faces significant challenges despite the large population and economic potential. The sector primarily relies on buses, taxis, motorcycles (okadas), and tricycles (keke napep) for urban and inter-city travel. However, issues such as inadequate infrastructure, poor

	maintenance, safety concerns, and informal operations negatively impact the public transportation system. The COVID-19 pandemic exacerbated these challenges. Lockdown measures and movement restrictions significantly reduced passenger demand and revenue for public transport operators. The transportation sector experienced a 47.25% decline in real GDP growth in the second quarter of 2020 compared to the same period in 2019 [21]. Additionally, concerns about virus transmission in crowded vehicles prompted the implementation of hygiene and social distancing measures, further impacting the efficiency and affordability of public transportation. The government announced the first lockdown in Nigeria on 30 March 2020, however, the economic consequences of the lockdown prompted the government to announce a phased and gradual easing on 5 May 2020. Owerri is the capital of Imo state Nigeria located in the South-Eastern region of the country and measures 5100 sqkm in size. The state has an estimated population of 4.8 million people and a population density that varies from 230 to 1,400 people per square kilometer [22]. Road transport is the primary means of transportation in the city, as it conveys an estimated 80% of all traffic [22]. People move around using buses, taxis, autorickshaws and motorcycles [23] which is majorly provided by the private sector. Motorcycles (locally known as Okada) and autorickshaws (locally known as Keke) are mainly used for journeys outside the main arteries in the city due to a ban eight years ago, leading to an increased number and demand of minibuses as a public means of transportation (about 80%) in the city [24]. Most residents either depend on these or walk to work and school. This Study involved stakeholders, users and operators of public transport services in Owerri, registered with the various transport unions in the different localities. The COVID 19 pandemic affected these transport services through a total lockdown which involved a ban on transport services except for essential services issued by the Federal government on 23 March 2020. Additionally, while the lockdown was being eased gradually (as announced on 4 May 2020), government developed measures guiding the use of transport

	services in the state. These are use of hand sanitizers, face masks, social distancing and reducing passenger-carrying capacity by 50% etc. As of March 2022, an estimated 255,415 cases with 3,142 deaths have already been recorded due to the pandemic in the country [25]. ***Kampala, Uganda*** Uganda is a landlocked country located in East Africa with a population of about 49 million and annual GDP of 45.57 billion USD [20]. It has made tremendous socio-economic progress and invested heavily in infrastructure during the past three decades. In terms of public transportation, most people rely on buses, minibuses (locally known as matatus), motorcycles, and bicycles. However, the sector faces its share of challenges, including inadequate infrastructure, safety concerns, and informal operations. The COVID-19 pandemic brought unprecedented challenges to the public transportation system, causing a significant decline in passenger demand and revenue for transport operators. There was a notable 14.2% decline in the transport sector performance in the 2019/2020 fiscal year due to the pandemic [26]. Policies such as lockdowns and social distancing measures were developed to address the pandemic's impact on public transportation. However, despite these efforts, transport operators struggled financially. Lockdown which included suspension of public transport was imposed on 25 March 2020. The resumption of transport operations nearly-two and a half months later came with new restrictions and regulations including reduction of passenger carrying capacity. Despite the resumption, services were occasionally suspended following new waves of the pandemic in the country. Kampala City is the capital and main center of economic, industrial and political activity in Uganda. It has a daytime population of about 3.5 million (nighttime population of 1.6 million people) owing to its national importance. The population is projected to reach 10 million by 2030. Data from KCCA shows that it contributes over one third of the country's Gross Domestic Product (GDP). The city hosts 46% of all formal employment in the country and 70% of the country's manufacturing plants are clustered in

	the city. The number of public transport trips (not including boda bodas [motorcycle taxis commonly referred to as boda boda]) in 2003 was about 460,000 in the peak AM period or about 800,000 daily trips. This was projected to have increased to about 575,000 and one million respectively by 2018 [27]. A transport survey in 2003 revealed that about 146 trips per person per year were being made by public transport and these are projected to have increased in recent times. The low occupancy commuter taxis (matatus [vans]) constitute 41% of the modal share, NMT (dominated by walking at about 39%) and Motorcycles (constitute about 10% [28]). Following the COVID-19 pandemic, the government introduced “the 35 Presidential Directives”, some of which were enforced by the city transport sector. At different periods, the city oscillated between very strict lockdown measures and a relaxation of some of the measures depending on the number of registered COVID-19 cases. Some of the measures included ban on all public transport; allowing private vehicles to carry a maximum of three passengers including the driver; advising passengers to maintain hygiene measures such as not coughing or sneezing in public vehicles, no spitting, regular handwashing with soap and water or using sanitizers, regularly disinfecting surfaces such as vehicle door handles. ***Dhaka, Bangladesh*** Bangladesh is a country in Southeast Asia projected to be one of the fastest growing economies in the world by 2050 [29]. It has a population of 160 million and an annual GDP of 460.2 billion USD [20]. Public transportation in Bangladesh is primarily facilitated by buses, minibuses, cycle rickshaws, and motorcycles. Challenges such as traffic congestion, inadequate infrastructure, and safety concerns, impact the efficiency of urban and inter-city travel. The COVID-19 pandemic significantly affected Bangladesh's public transportation, leading to reduced passenger demand and revenue for transport operators. There was a 14.8% decline in the GDP growth in the transport sector in 2020 due to the pandemic [30]. Efforts to mitigate the pandemic's impact on public transportation included banning the services and subsequent capacity restrictions.

	However, these measures posed financial challenges for transport operators, highlighting the sector's resilience despite these challenges. The government imposed two lockdowns which affected the public transport sector. All public transport activities (including trains and flights) were closed between March 28 and June 1 in 2020, when buses were allowed to operate at half capacity. The second lockdown also involved banning public transport on 5 April 2021, but this was changed within 2 days to allow public transport with 50% capacity in 11 large cities of Bangladesh. Dhaka is the capital and largest city of Bangladesh. It has a population of 16.8 million living on an area of 456 km^2 [31], making it the most densely populated city in the world. It is the main commercial centre of Bangladesh with many factories employing a majority of the population. According to Bangladesh Road Transport Authority, 1.6 million vehicles are running in the streets of Dhaka, among them 36,016 are buses, 20,516 are auto-rickshaws, 298,113 are private cars and 782,253 are motorcycles [32]. According to RSTP, [33] more than 60% of the travelers use public transport for their journey to work. The COVID-19 lockdown which started on 26th March 2020 affected these services. However, around September 2020 restrictions on general movement and public activities were lifted. But due to the second wave of COVID-19, countrywide lockdown started again on 5th April 2021. The second phase lockdown was lifted in August 2021 [34]. So far, the SARS-CoV-2 virus has infected more than 1 million people around the country, with over 28 thousand deaths [35].
9. An overview of country specific details should also be presented before the case studies including country profile, transportation and COVID-19. It should relate per-COVID 19 and post COVID 19 scenarios regarding these points	Thank you for your suggestion, this has now been covered in the text above.
10. Consider rewriting or deleting last line of the conclusion. This is not considered in an academic writing	Thank you for your observation. The last line of the conclusion has been deleted.
Reviewer #2:	
1. The study is mainly based on workshops performed in the cities chosen by the authors. The questions were	Thank you for your valuable feedback. We appreciate the time and effort you've invested in reviewing our work. We have carefully

appropriate for studying the impact of Covid-19 on the transportation infrastructure. But the overall approach lacked any metric to measure the level of impact. No numerical data were presented. The percentage of the participants answering specific yes/no questions should have been presented for easy statistical analysis. For example, a question like "did you trust the government's assurance on the cleanliness of the transportation system?" could generate valuable data on the level of public confidence on the government of developing countries during emergency situations The participants perceptions about the issues related to the transportation sector have been presented, but in the absence of any relevant data it is difficult to determine the exact extent of the impact. Table 1 shows the major issues identified from the workshop studies; but it should also include the information on the corresponding government policies which were involved or impacted those issues. A direct correlation between the government policies (or lack of) and the impact on the public transportation system should have been established in the study. In view of the above, the authors should submit some numerical data to validate the claims made in the paper. Particularly they should present the data on percentage of the participants agreeing on important issues and a statistical analysis such as whether there is significant differences in opinion among the participants in the three cities.	considered your comments and understand that there might be reservations regarding qualitative data. We also acknowledge that while quantitative methods have their merits, qualitative research also brings valuable insights. In the context of our study, which is exploratory in nature, the qualitative approach is deemed suitable. As such, its focus was on exploring themes, patterns and narratives rather than employing statistical analysis or presenting numerical data. We aimed to prioritize the authentic voices of our participants, sharing their verbatim quotes to convey the nuances of their experiences. This approach allowed us to present a rich, in-depth exploration of the phenomenon under study. While we acknowledge the importance of statistical analysis and numerical data in certain types of research (for example Enam, A., Rahman, S. M., Mahmud, S. M. S., & Wadud, Z. (2023). Impacts of COVID-19-Related Non-Pharmaceutical Interventions on Mobility and Accidents in Bangladesh. Transportation Research Record, 2677(4), 917-933. https://doi.org/10.1177/03611981221118532), we believe that our qualitative approach aligns with the objectives and scope of our study and contributes to the broader understanding of the subject matter. It is also very important to note that statistical information (% agreeing/disagreeing or similar) can be severely misleading in such stakeholder analysis type research and researchers have strongly recommended against use of such information for this type of work (e.g. Lilford R J and Braunholtz D. (1996). For Debate: The statistical basis of public policy: a paradigm shift is overdue BMJ doi:10.1136/bmj.313.7057.603; Wutich, A. et al. (2020). Identifying Stakeholder Groups in Natural Resource Management: Comparing Quantitative and Qualitative Social Network Approaches. Society & Natural Resources, https://doi.org/10.1080/08941920.2019.1707922; Friedrich, D. R. et al (2012). Stakeholder participation in priority setting – a consideration of the normative status of quantitative and qualitative methods. Journal of Evidence, Training and Quality in Health Care https://doi.org/10.1016/j.zefq.2012.06.005).

	We sincerely hope this clarification addresses your concerns regarding the absence of statistical analysis and numerical data in our paper and that you can consider our approach in a fair light. If you have any further questions or suggestions for improvement, we would be more than happy to address them.