Case Studies on Transport Policy 9 (2021) 930–938

Contents lists available at ScienceDirect

Case Studies on Transport Policy

journal homepage: www.elsevier.com/locate/cstp

Exploring changes in mobility experiences and perceptions after implementation of the bus rapid transit system in Dar es Salaam

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ARTICLE INFO

Keywords:
Bus Rapid Transit
Informal Public Transport
Perception

ABSTRACT

The use of Informal Public Transport (IPT) in Dar es Salaam, Tanzania, has been associated with mobility difficulties, i.e. traffic congestion, unscheduled service and lack of safety and security. The introduction of the Bus Rapid Transit (BRT) system was therefore considered as a powerful intervention for these mobility difficulties. In May 2016, the BRT started operating with exclusive bus lanes and a clear schedule to offer a qualitative, accessible and affordable system. This paper explores changes in travel experiences and perceptions of individuals (local inhabitants) regarding IPT and BRT use in meeting mobility demands before and after implementation of the BRT. Focus group discussions and short questionnaires were conducted before and after BRT to explore changes in mobility experiences among different individuals. Results show that in both periods, the demand for IPT use remained dominant, driven by a low fare, connectivity within a neighbourhood and outside the major road, flexibility and the possibility to commute with goods. The use of BRT was mainly attributed by relief in traffic congestion (when only considering in-bus time) and a lack of options along the corridor. Surprisingly, BRT users also experienced several mobility difficulties after implementation: long waiting time, overcrowding (in-bus and stations), and difficulties to commute with goods, and a lack of safety and security. Peri-urban individuals continued to experience more travel difficulties with both transport systems than individuals in areas adjacent to the BRT because of limited connectivity, congestion and unpaved local roads. For low-income individuals, the BRT was considered as another burden for their livelihoods (higher financial cost) rather than it was expected as a solution towards a high quality, accessible and affordable system. There is a need to integrate public transport with supportive improved local roads to serve multiple destinations.

1. Introduction

Public transport (PT) is a key service for many people in Global South cities (Campbell et al., 2019; Chowdhury et al., 2018; Pojani and Stead, 2015) of which most them are facing rapid population growth with an increased number of low-income people, lack of jobs and poverty (Salazar Ferro et al., 2013). The demand for PT use is mostly driven by the individuals' needs to overcome spatial mobility constraints of distance, time and isolation from social (visiting friends, shopping), economic (work, job search) and public services (healthcare, schools) (Lucas and Porter, 2016; Mackett et al., 2008; Stanley and Lucas, 2013). Individuals' movements with PT in desired activities are, however, constrained by several mobility difficulties in the majority of these cities: traffic congestion, high trip costs (time and money), and lack of safety and security during the journeys (Diaz Olvera et al., 2013). Low-income individuals tend to suffer the most, as they are least able to commute long distances when PT is not available within their premises or in an affordable way (Diaz Olvera et al., 2013, 2015; Grengs, 2010; Oviedo Hernandez and Titheridge, 2016; Shay et al., 2016).

In the Global South, the use of Informal Public Transport (IPT) [i.e. unscheduled and low capacity means of transport, which operates without supportive transport facilities] is associated with several mobility difficulties to the users, low-quality service, long travel times and lack of safety and security. These small and medium vehicles, minibuses, tricycles and motorcycles are the most available means of transport in different local environments (Behrens et al., 2015; Joseph et al., 2019). Although IPT is viewed as adaptable to changes in mobility demand patterns, it still creates congestion in dense areas. Because of

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https://doi.org/10.1016/j.cstp.2021.04.012
Received 10 May 2020; Received in revised form 10 March 2021; Accepted 20 April 2021
Available online 2 May 2021
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this, high capacity buses or more *formal* PT are preferred as a policy option by planners. Today, many cities are trying to replace IPT with Bus Rapid Transit (BRT) as a viable mobility solution (Mitric, 2013; Paget-Seekins, 2015; Kaenzig et al., 2010; Venter, 2013).

In general, Bus Rapid Transit (BRT) systems encompass fixed schedules, high capacity modern buses on dedicated lanes and off-board ticketing (Ferbrache, 2018; Poku-Boansi and Marsden, 2018; Vermeiren et al., 2015; Zhang et al., 2013). BRT systems have gained governmental support in Global South cities (e.g., Lagos, Johannesburg, Cape Town and Dar es Salaam) as a solution for many mobility difficulties (Hensher and Golob, 2008; Ka'bange et al., 2014; Poku-Boansi and Marsden, 2018; Venter et al., 2018). However, the ability of BRT systems in meeting the mobility demand of individuals in the Global South has remained debatable (Rodriguez et al., 2017; Schalekamp, 2017; Schalekamp and Behrens, 2010; Venter, 2013). Investments in BRT can be conducive to economic growth and the modern landscape, but its implementation does not guarantee meeting the social mobility needs in a local setting, with the complex nature of informality in land use (Paget-Seekins, 2015, Rodriguez et al., 2017). Besides, many African cities draw their experiences about BRT from most successful cities (e.g., Bogota, Curitiba) in other environments, with only limited experiences from their own local settings. Therefore, it is important to analyse whether the BRT works in these settings and to whom, and which actions need to be taken to improve its benefits to different users, particularly low-income individuals with limited travel options. A detailed understanding of the new mobility experiences with the BRT use from the perspective of individuals themselves is important (Casas and Delmelle, 2017; Casas and Delmelle, 2014). Every city has its own social-spatial system and unique background, which requires a contextualised understanding of the impacts of different mobility solutions in a respective city (Mallqui and Pojani, 2017; Prillwitz and Barr, 2011; Schalekamp and Behrens, 2010).

The objective of this study is to explore and compare mobility experiences and perceptions before and after BRT implementation in Dar es Salaam (DES) to understand mobility benefits of IPT and BRT use from local people's perspectives. The key research question is how IPT and BRT are perceived as important or not in supporting the individuals' mobility demands (i.e. activity participation and access to services) over time. The study explores who benefits from the BRT and for whom it is not really a solution when changes and transformations in PT occur.

2. Background on case study city

Dar es Salaam (DES) is one of the rapidly growing megacities in Africa, with an estimated population of 5.3 million. It is a monocentric city where most public services such as referral hospitals, wholesale markets, public offices, and commercial activities are concentrated in the Central Business District (CBD) (Kombe, 2005; Mkalawa and Haixiao, 2014; Moyd, 2009; Olvera et al., 2003). About 75% of all residential houses are built in unplanned neighbourhoods, which may grow or expand into marginal areas without transport facilities, social services and designated PT connections (Bwire and Zengo, 2020; D'hondt, 2009; Rasmussen, 2013). The emerging land use development in these areas indicates a mismatch with the professional planning standards, lacking an equitable distribution of basic infrastructure services (Magembe-Mushi and Lupala, 2015).

Transportation investments in DES are still directed to expand major roads and to ease the traffic congestion towards the Central Business District (CBD), while the majority of the population, including the low-income individuals, however, resides far away from major roads (Joseph et al., 2019). Experience in the early 1970 s showed that the state-owned PT company *Usafiri* Dar es Salaam (UDA) provided a high-quality service (i.e. luxury buses with air conditioners, schedules and loaded passengers based on bus capacity). However, UDA failed to operate because of the rapid expansion of unplanned settlements, flooding risks, and unreliable income sources for many residents to pay for the increased transport costs (Melbye et al., 2015). IPT has been used since the 1980 s, marked by vehicles of different sizes (e.g. minibuses, motorcycles and tricycles), adaptable to different users from very poor-to middle and high income. Much of its use occurs in the sprawling unplanned areas outside the CBD and high-density narrow streets, often far away from the major roads. The use of IPT has been associated with chronic traffic congestion, low-quality vehicles, lack of safety and security as well (Madinda and Mfinanga, 2013; Joseph et al., 2019).

To improve PT in DES, the Tanzanian government decided to implement the BRT system (phase 1) in order to offer a high-quality system, accessible and affordable PT for all residents. The BRT system mainly intends to ease traffic congestion and improve access to the CBD (URT, 2019). An idea of BRT was initiated in 2002 as an effort to address PT challenges in the city, where 141.1 km of dedicated trunk lanes to be implemented in six phases. The plan for BRT phase 1, 2, and 3 all converges to the CBD. Phase 1 of the BRT system, which is already in operational, runs from the CBD into some residential areas in the West. Phase 2 is now under construction, while and phase 3 and 4 are in the design stage. In terms of spatial planning, all planned phases of the BRT system will extend on major roads emanating from the CBD along the limited corridors.

As presented in Table 1, the BRT phase 1, named Dar es Salaam Rapid Transit (DART), launched its first bus service in early May 2016 (Joseph et al., 2019). The system aimed to provide affordable PT with a high capacity and high-quality service, separated from the mixed traffic flows using dedicated lanes. The BRT lane covers a total distance of 20.9 km, serving a range of areas along its corridor connecting *peri*-urban areas to the CBD. When the BRT started operation, city authorities banned all minibuses routes offering direct access between Mbezi/Kimara and Posta/Kariakoo (located in the CBD) with the assumption/expectation that the new system would work efficiently by reducing delays due to chronic congestion.Table 3.

This study explores possible changes in perceptions and travel experiences of both IPT and BRT systems in meeting the mobility demand of individuals before and after implementation of the BRT. Two study neighbourhoods were selected, of which one is located directly along the BRT corridor (Kimara), while the other is located in a *peri*-urban area at a substantial distance from the corridor (Mbezi). The location of both study neighbourhoods, as well as the location of the DART Phase 1, can be found in Fig. 1.

3. Method and materials

3.1. Research design

The study involved empirical data collected both before and after the

Table 1
Characteristics of the existing PT in Dar es Salaam.

Elements	IPT (1980 s-to date)	BRT (2016-to date)
Routes and stops	Fixed along the formal road	Closed trunk, bus-based
	Non-fixed outside formal roads	Exclusive dedicated lane
		27-stations, 4-transfer stations, 5- terminals
Scheduling	Leave after loading passengers	Fixed schedule (5 am-11 pm)
	Responsive to individuals demands	
Vehicle quality and capacity	Low capacity: small and medium	High capacity-large buses
	15–40 passengers for minibuses	150 passengers per vehicle
	1–4 passengers for tricycles	
	1–3 passengers for motorcycles	
Ownership	Individuals owners	Company

Table 3
Individuals characteristics before and after BRT.

Socio-demographic variables		Kimara (adjacent to BRT/ =20)Before /after	Mbezi (*peri*-urban /n = 21)Before /after
Gender	Male	10/10	10/10
	Female	10/10	11/11
Age	<35	8/7	6/6
	35–55	7/8	12/11
	>55	5/5	3/4
Marital	Single	6/6	4/4
	Married	13/10	15/12
	Divorced	0/3	2/4
	Widow	1/1	0/1
Education	Primary	10/10	10/10
	Secondary	6/6	7/7
	Higher	4/4	4/4
Car ownership	Car-owners	7/7	9/9
	non-car	13/13	12/12
Employment	Full-time	3/3	4/4
	Part-time	4/3	3/3
	Self-Employed	7/9	9/10
	Unemployed	2/1	2/1
	Student	2/2	2/2
	Retired	2/2	1/1
Special group	Disabled	1/1	1/1
Monthly income	<100€	11/9	5/4
	100-400€	5/7	10/12
	>400€	4/4	6/5
Travel frequency	Daily	12/10	15/11
	Weekly	2 /4	2/3
	Several trips a week	1/3	3/5
	Monthly	5/3	1/2

implementation of the BRT system to explore and compare travel experiences and perceptions on the importance of both IPT and BRT in supporting mobility demands. The first set of data was collected in February 2016, a few months before completion of the BRT implementation in May 2016. This intended to create a basis for a later follow-up study by establishing a deep understanding of individuals' experiences with the use of IPT and hypothetical assumptions or expected impacts of the planned BRT. This attempt was important because information about the contribution of IPT to fulfil mobility demands and the expected benefits of the planned BRT for potential users was rather limited in this case study city (DES).

The second data collection was conducted in August 2018, two years after the commencement of the BRT, by which time respondents were expected to have actual experiences with the BRT system. This follow-up study intended to monitor possible changes in individuals' perceptions relatively to the actual impact of the BRT. Data were collected from the same participants during both data collection periods (before and after BRT).

Participants were recruited from two low-income neighbourhoods: one adjacent to the BRT system (Kimara) and one *peri*-urban at a substantial distance from the BRT (Mbezi), based on the assumption that residents of the former neighbourhood are more likely to benefit from the BRT than residents of the second neighbourhood. Kimara is located 15 km from the CBD and is surrounded by shopping centres. Mbezi is approximately 30 km from the CBD, and far away from public services and the BRT corridor, where individuals do not have direct access to this main corridor connecting Mbezi *peri*-urban to the CBD. Peri-urban neighbourhood was selected because individuals in this area may experience additional transport challenges exposing them into a risk of transport exclusion due to lack of PT connections. Also, individuals in this area do not have other option to travel to the CBD, and previous research showed that individuals were travelling on this BRT corridor (Joseph et al., 2019, 2018). Besides, individuals tend to commute to different spatial destinations, often far away from their neighbourhoods, for different needs. Therefore, it is important to explore the mobility



Fig. 1. Location of the study neighbourhoods and the DART line Phase 1.

experiences and difficulties of those who will not be able to benefit from the BRT system. Individuals in this area are facing challenges to access PT services due to poor road conditions and a lack of connectivity within the neighbourhood. The use of IPT in both neighbourhoods was dominant for most individuals, as this transport mode covers different geographical locations (Joseph et al., 2019, 2018).

The characteristics of the population in both neighbourhoods indicate that females are higher than males (UMP-Ubungo Municipal Profile, 2016). In Mbezi, 43,447 are males and 46,088 females. While in Kimara, 44,718 are males and 48,706 females. A total population in Mbezi is 89,565, in Kimara 93,424 (UMP-Ubungo Municipal Profile, 2016). In general, about 75% of the residents of DES's unplanned settlements are unemployed and/or with the main source of income being non-skilled jobs and micro-enterprises (Rasmussen, 2013). A higher number of people in both neighbourhoods engage in small entrepreneurship (e.g. petty trading, street vending) and few individuals are employed in professional jobs with a reliable source of income (Joseph et al., 2019, 2018). Thus, the majority of individuals in these neighbourhoods do not have income power to own private car and to afford high transport costs.

3.2. Data collection

Focus group discussions (FGDs) were considered useful in exploring and examining users' perceptions, concerns and travel experiences on the use of IPT and BRT in supporting mobility demands (Chowdhury et al., 2018; Kahan, 2001; McCray and Brais, 2007; Hesse-Biber, 2010). The FGD method is suited to uncover social experiences, diverse perspectives and underlying reasons for specific choices. FGDs typically involve a group discussion of 8–12 individuals from similar social and cultural backgrounds (Boateng, 2012; O.Nyumba et al., 2018). For each data collection period (both before and after the BRT), a total of four FGDs were conducted [two in each study neighbourhood with an average of 10 participants in each group categorised by gender], the total number of participants in both neighbourhoods = 41. Each FGD session lasted for an average of 2 h and was held in the native language (Swahili) to enhance interaction between participants. A brainstorming technique was used by a researcher to stimulate interaction. Research assistants were involved in taking notes and recording.

By use of purposive sampling technique, participants of the FGDs were selected to capture different characteristics of transport users (women, men, employed, unemployed, disabled, elderly, adult, retired, car users and student). These participants were selected on the criteria that they are potential users of different transport systems. Hence, they would share their mobility experiences and provide rich information about the importance of IPT in their local settings and how the new system would serve or not serve their mobility demands. The selected participants considered relevant for insights on how local people perceive different transport systems as important in supporting their mobility demands. These participants intended to provide rich information about the differences and similarities in mobility experiences and perceptions regarding different transport systems in different periods.

In co-operation with local government leaders, participants from a range of backgrounds were identified and invited to join the FGDs. The participants from the two neighbourhoods were approached in person by their respective local leaders, who informed them about the FGDs and delivered official invitation letters (about topic, time, venue) requesting their participation in the study. Individuals participated voluntarily. The local leaders were vital to gain trust among (potential) participants and to guarantee that they felt secure while participating in the FGDs but were not present during the discussions to avoid socially (or politically) desirable responses.

The following were the main research questions included in the FGDs.

- How do individuals travel to different activities?
- How do individuals consider the IPT system as important?
- Why do people use or not using the IPT system?
- What does the IPT system offer that other modes do not offer?
- What their perceptions with or without IPT?
- How do people perceive the presence of the BRT bus service?
- Why do people use or not using the BRT system?
- What their perceptions with or without the BRT system?
- How can PT (e.g. BRT) be improved?

3.3. Socio-demographic characteristics of participants

Specific information about the characteristics of the participants such as age, gender, education, employment, marital status and vehicle ownership were captured by the use of short questionnaires (Sivakumar et al., 2006) (Table 2), which were administered to the participants before the FGD sessions. Each questionnaire lasted approximately 5 to 10 min, whereby both the researcher and the research assistants were involved in filling in questionnaire responses to serve time and to avoid possible challenges regarding reading and writing for some participants.

Individuals from different categories were included to understand commonalities and differences in transport use. The age range of participants in both neighbourhoods shows a low number of individuals older than 55 and a high number of participants in the age categories 36–55 and younger. This is not statistically representative of the entire population of DES in terms of the sample size but provides insights regarding existing variation among individuals in respect to transport use in the city (e.g. more self-employed than low car owners). Individuals who are small entrepreneurs were classified under the group of 'self-employed', including petty traders, street vendors, and those with small shops within/outside their neighbourhoods (La Porta and Shleifer, 2014), which was the largest occupational group in both neighbourhoods. Most individuals in the self-employed category travel to multiple destinations to look for local markets or to purchase products from the wholesale market. Vulnerable transport users, particularly disabled people, were included. Most participants in both areas have a lower educational level (primary and secondary). Full-time employed professionals are those with higher education, mostly employed in public and private sectors. After the BRT, changes in individuals' characteristics (e.g. age, income and marital status) were noted. The questionnaires provided general information about individuals' frequencies of making out-of-home trips.

3.4. Data analysis

The qualitative data analysis software Atlas ti.7 was used to assist in coding key themes/quotes and in categorising and identifying frequencies and patterns of the statements from the FGDs (Krueger, 2006). The analysis of the FGDs followed a systematic process of transcribing audio-taped recordings, interpreting FGD notes from Swahili to the English language, organising themes, and identifying main points and meanings from participants' discussions (Parker and Tritter, 2006), which helped to develop a storyline. The analytical process involved looking for differences, common ideas, themes, meanings and relationships of various concepts used to express participants' thoughts and values about the transport systems. The following underlying analytical aspect was considered to facilitate qualitative analysis (Onwuegbuzie et al., 2009).

- *Constant comparison analysis* involved organising the data and grouping it into broader categories for drawing out general themes that unite different perceptions across individuals.
- *Classical content analysis* involved a rich description of each theme. This analysis has been reflected in the results, where a detailed description of each key transport attribute was provided. Specific quotations emphasising the main themes were used.

4. Results

The results comprise the main aspects of both transport systems (IPT and BRT), revealing the mobility experiences of individuals from different neighbourhoods before and after BRT and how perceptions changed over time. From the local people perspectives, the main attributes for transport use were identified and explained in detail to reflect individuals' mobility experiences with different transport systems before and after the BRT. Based on the BRT standard guide of 2016, attributes related to the performance of the transport systems and those not related to the performance were categorised into different sections (The BRT Standard, 2016). The BRT standard guide was not used as a framework to discuss or change content analysis regarding local people perceptions and concerns about the use of different transport systems over time. Therefore, detailed explanations comparing individuals' perceptions from different neighbourhoods before and after the BRT are presented in the following sub-sections.

4.1. Performance-related attributes for transport use

4.1.1. Relief in traffic congestion

In both neighbourhoods, we noted changes in perceptions among individuals after BRT regarding the efficiency in travel time of IPT modes as compared to that of the BRT. Previously, individuals in both neighbourhoods explained that the use of motorcycles and tricycles was largely driven by its ability to manoeuvre and penetrate in heavy traffic congestion and to save travel times. This is because traffic congestion was one of the most serious mobility difficulties for individuals commuting with minibuses along the major roads providing access to the CBD. Hence motorcycles and tricycles were the main fastest and most available travel options for urgent trips. But after BRT, the perceptions of individuals about IPT use in serving travel times along this congested major road were changed, and differences between the neighbourhoods. Different individuals in the proximity of the new system who were using IPT before as the only option explained that the BRT system was attractive and faster than IPT because of exclusive dedicated lanes. However, other individuals, including *peri*-urban like professional workers, and car users, expressed that they were still facing similar problems related to traffic congestion, but in different ways: long waiting times, congestion at the bus stops and long queues when ticketing and boarding, but a lower only in-vehicle time. Besides, the electronic ticketing machines were in most cases not working, and there were poor internet and low technology to monitor the bus schedules, causing a lot of chaos, shortage of buses and struggles at the BRT stations and transfer terminals. In both neighbourhoods, BRT users, including those with private cars, were annoyed with the current situation whereby passengers spent more than an hour at the station waiting for a few overcrowded buses and without being sure for their trips. For private car users, more traffic was experienced nearly to all bus BRT stations due to congestion of individuals to and from the stations/terminals, causing chaos for other road users using mixed traffic lanes.

"We are spending much time at the station waiting for the BRT bus. But once you get into the bus, then one can predict the arrival time, estimated 40–45 min" (Male, employed, 39 years, Mbezi, after BRT).

4.1.2. Fare pricing

Fare pricing of the BRT received much attention from different individuals (particularly low-income individuals) before and after the BRT. We have noted similarities and differences in perceptions over time. Before BRT, only *peri*-urban individuals were concerned about the BRT fare, as compared to Kimara which is closely located to BRT system. After the new system, the strong attention from both neighbourhoods continued to persist among low-income individuals. It was explained that even if individuals did not have the exact amount of the fare (cash), in minibuses, they could still make a trip after negotiation with the driver or conductor. Therefore, IPT was perceived to use a *'laissez-faire'* approach to help and serve all users of different income status (e.g. low income without a reliable source of income). Compared with the BRT, individuals considered that the IPT fare was more affordable than the BRT (flat fare), which was perceived negatively by low-income individuals. These individuals expected that, if the BRT was intended to help different users, then the fare price should not be higher than the IPT. Individuals were also unhappy with a flat fare charged by the new system for each stop one makes, because their livelihoods activities involve short-distance trip chains. In contrary, private car users did not complain about the BRT fare as it was not the main problem.

"This is an important corridor, some of us travel to the CBD for health problems, and not to earn money! Charging a higher fare than that of the minibuses does not help us at all" (Female, retired 63 years, Kimara, after BRT).

4.1.3. Number of transfers

Before BRT, there were concerns about the number of transfers imposed by the BRT, especially for individuals residing in the *peri*-urban neighbourhood. Individuals expected an increase in the number of transfers, from a single direct route by a minibus along the same corridor to two or three transfers, which was perceived negatively in terms of time and fare cost. After the BRT, individuals were however not only concerned about the increased number of transfers, but also about associated mobility difficulties with this: waiting time, congestions of passengers, and general conflicts or struggling when boarding and/or alighting the BRT bus. This condition was considered more critical for *peri*-urban individuals than for those residing close to the BRT, as the former were required to use minibuses, motorcycles and tricycles to access the BRT stations, leading to an additional transfer. The increased number of transfers and all involved inconveniences were perceived negatively by women, small entrepreneurs, disabled, elderly, and students as another mobility difficulty imposed on them by the new system.

"We used to travel with minibuses without transferring, but now we are suffering. I decided to change my departure time. I wake up earlier than before (between 4:00 am and 3:00 am) to use minibuses because at this hour there are no BRT buses on the road and no traffic police to prohibit minibuses from going to the CBD" (Male 57, Mbezi, after BRT).

4.1.4. Crowding and comfort

In both neighbourhoods, it was expected that the planned BRT would offer comfortable journeys, less crowding than the low-quality transport system (IPT). But after BRT, overcrowding at the station and in-bus (i.e. attributed by long waiting time, less frequent and few buses come at the station), and a lack of comfort were identified as negative dimensions of the new system. Despite their direct access to the BRT, the car users in Kimara were more concerned about the new system for offering low quality service (e.g. no air conditioning, uncomfortable standing, overloading). Professional workers expected to enjoy high quality services, more comfortable mobility than minibuses, taking into consideration that the new system uses exclusive lane, modern bus and closed stations. In both neighbourhoods, high income and educated individuals expected that large investments in the new system would make the differences from minibuses by increasing its efficiency and high service quality for individuals to travel in a comfortable manner. Previously, the car users in the *peri*-urban articulated that they are forced to use private cars because of low-quality services offered by minibuses; after BRT, the new system was perceived unattractive to be used regularly by the car users even though it is too costly to use a car daily.

"I thought the BRT would be different, but now I can't see the difference; the buses are always overcrowded (no safety at all, we can't even breath!), without seating during the journey" (Female, student, 20 years, Mbezi, after BRT).

5. 1.5 safety and security

Both systems (IPT and BRT) in both periods were perceived to have

adverse effects in terms of safety and security but in different ways. The use of IPT modes was considered unsafe, by which the use of motorcycles was perceived by women as the most unsafe, especially when commuting with children. Most IPT modes operated without supporting transport facilities like designated pick-up and drop-off stops. Before BRT, individuals expected that the new system - promoted as a 'high-quality PT'- could guarantee high safe mobility and security of their movements. But unlike as it was expected, individuals in both neighbourhoods shared different scenarios, which signified a lack of safety and security after BRT. Unsafety scenarios in regard of BRT use included overcrowding (limited ventilation and fainting), sexual harassment for women, squeezing and pushing each other when boarding, and unsafe alighting (by which the driver did not care or wait for the passengers to alight safely). For pregnant mothers attending clinics, they considered themselves vulnerable if they did not have money to hire a taxi or use tricycles. Similarly, individuals (e.g. elderly, disabled and pregnant mothers) who were not able to struggle and compete when boarding for BRT bus perceived that the new system was for young and adults because they can sustain all struggles when boarding. However, as compared with the BRT, IPT was considered more risky for vulnerable groups as compared for young and adults.

"If you are not strong enough, it is difficult to board the bus. Individuals are just pushed when boarding or alighting; one can get physical injuries (legs or arms) or lose their personal belongings (e.g., shoes, phones, watches, necklaces)" (Male, 37 years, Kimara, after BRT).

5.1. Other attributes for transport use

5.1.1. Commuting with goods

Before the BRT, commuting with goods in minibuses was problematic because of inconveniences with overcrowding, particularly in peak/rush hours. It was noted that commuting with goods was part and parcel of the livelihoods' activities of most small entrepreneurs travelling to different destinations to sell their various products to the local markets and reaching door-to-door individual customers. Before the BRT, low-income individuals in both neighbourhoods were more concerned about the inconvenience they face in minibuses when commuting with their goods, hence expected the new system could solve this mobility difficult. After the BRT, the low-income individuals felt that it was somehow easier to commute with their goods (e.g. the boxes of tomatoes and buckets of fresh fish) in minibuses than in BRT, because of rejection at the entry of the bus station and inconveniences as there were security guards posted in BRT stations restricting entry of petty traders with their goods.

5.1.2. Access to high and low-density streets

The contribution of IPT in supporting individuals' movements continued to play a unique role compared with the BRT, as we noted similar perceptions on the importance of IPT in both data collection periods. This was because the coverage of the BRT service is inherently spatially limited, leaving many places (i.e. *peri*-urban and remote areas) without direct access to the system. After BRT, *peri*-urban individuals were required to make 2/3 transfers when using the BRT, while by minibuses, only one transfer was necessary to reach the destination (CBD). Small entrepreneurs explained that their customers live in both high and low-density streets where in most cases, it is only possible to penetrate with small vehicles because of unpaved and narrow streets. Similarly, in Kimara, individuals were more concerned about their mobility demands in non-skilled jobs and social activities conducted in multiple destinations. In both periods, the use of IPT perceived to be important among different individuals as a complement for unserved mobility demand by the BRT system.

"It is even difficult for an ambulance or a fire rescue truck to penetrate in our streets. I don't understand why their focus is still to expand the major road as if we all live and work in one place?" (Male, 58 years, retired, Kimara, before BRT)

5.1.3. Door-to-door access

In both periods, we noted similar perceptions about the importance of IPT in supporting door-to-door mobility demand, particularly for non-car users, elderly and disabled residing away from the major roads and those commuting with goods. The use of motorcycles and tricycles remained as important for supporting door-to-door mobility demand in both neighbourhoods as before the introduction of BRT. In comparison with minibuses, motorcycles and tricycles provided a simple solution for individuals to short-distance trips (<3km) within their neighbourhoods or from the minibus stop with their goods. In the *peri*-urban area, the use of IPT continued to be the only available primary travel option because of the lack of direct connections to the BRT bus stations, as walking was not a convenient option. Kimara neighbourhood was advantaged with more travel options as individuals were directly connected with the BRT and had the option to walk a few kilometres to the stations. However, due to unsafe pedestrian walkways, this was still not positive for the elderly, disabled, and those commuting with goods; therefore, door-to-door mobility demand by use of motorcycles and tricycles was considered very important in both periods. Women in both neighbourhoods considered themselves as active participants in social activities and small business; hence motorcycle and tricycle were used for trips to local markets and door-to-door trip chains. While for male entrepreneurs, the use of BRT perceived as suitable for long-distance trips to the CBD but less convenient for short trip chains conducted in multiple destinations outside the CBD.

"I like to use a tricycle if I have to visit my parents with my child. They live not far from my home (2 km), but it is difficult to walk with the child, as it is too sunny" (Female, 26 years, Kimara, after BRT)

5.1.4. Travel options

After BRT, in both neighbourhoods, the new system was perceived inefficient and less attractive because it offers limited mobility option for some individuals. For those with unreliable income source and *peri*-urban individuals, the use of BRT was perceived as a forced factor rather than a choice due to high travel costs. Small entrepreneurs were not attracted to the new system due to unreliability during the rainy season (flooding in some parts of the corridor and shutting down of service), leading to changing the route to use minibuses that operate in other destinations. In both neighbourhoods, banning of the minibuses along the BRT corridor was criticised and perceived negatively by diverse individuals commuting in different spatial destinations and without alternative means of transport. The effect of the BRT system on minibuses was perceived as unhealthy for low-income individuals, but on the other hand, benefiting the car users to continue enjoying the road space with their cars.

5.1.5. Flexibility

Before and after BRT implementation, there was a similar positive perception among individuals in both neighbourhoods regarding the importance of IPT in supporting their mobility demand in different spatial destinations. New mobility experience after BRT showed that the use of BRT among individuals was only limited within specific times and destinations; while IPT modes existed in different forms which responded well to the local conditions (unpaved roads, narrow streets, limited connectivity) where most non-skilled jobs (e.g. petty trading, street vending) were located. The use of IPT among *peri*-urban individuals remained dominant after the BRT because of its availability for trips conducted in different spatial–temporal dimensions, not restricted to fixed schedules and destinations. Also, in Kimara, motorcycles and tricycles helped individuals (e.g. women, students) to commute short trips to the local markets, dispensary and schools located within the neighbourhood, and to penetrate narrow density streets which were not covered by the BRT and sometimes not possible with minibuses or private cars. In both neighbourhoods, elderly, disabled and retired individuals were less concerned about the flexibility aspect, as compared to young and adults who were actively involved in door-to-door trading

activities. Women were involved in multiple activities, by which the use of tricycles and motorcycles after BRT was perceived as flexible and supportive for short-distance trip chains and urgent trips. Low-income individuals (e.g. unemployed, petty traders) in both neighbourhoods complained that banning some of the minibuses after BRT had reduced the flexibility of the system from serving their mobility demands in different destinations (e.g. referral hospital, markets). For higher-income individuals, the flexibility of IPT modes was not their main concern because they use private cars to access desired destinations.

"I usually open my small business in the evening because my customers are those from the offices. I don't have a specific time to close. I return home when it is late and when there are no customers anymore; only motorcycles and tricycles are available at that hour" (Male, street vendor, 39 years, Mbezi, after BRT)

"I don't travel daily to the CBD; I use the BRT only for trips to the Muhimbili referral hospital because nowadays there is no minibus to that route" (Female, unemployed, 44 years, Kimara, after BRT).

6. Conclusion and discussion

This study has a limited sample size (as only a number of individuals from Kimara neighbourhood and Mbezi *peri*-urban neighbourhood were involved), which is not representative of the entire population in the city of DES and can therefore not be generalised or quantified statistically. The focus of this paper was to explore individuals travel concerns, experiences and possible changes in perceptions towards IPT and BRT use in meeting mobility demands before and after the introduction of the BRT in Dar es Salaam. A bottom-up approach was used to deeply explore and compare individuals' experiences and use of transport in varying locations vis-à-vis the first BRT line, both before and after implementation of the BRT. The presented results may provide insights to other local settings in urban areas with similar characteristics, like informality in land use, the dominant use of IPT and limited experiences with BRT use. The study mainly focuses on individuals' experiences and perceptions (more subjective) to assess transport benefits in their real local environments, where the use of transport systems is driven by complex trip-making of the low-income individuals (for whom travelling with goods is their livelihood, and not all trips lead to destinations close to the BRT corridor).

The demand for IPT use, even after the BRT, shows that the mobility demands of some individuals in local contexts were still served by the IPT system. This is due to limited service coverage of the BRT, which is inevitably in the early stages of BRT introduction, and also associated with some mobility difficulties of the BRT ride along its corridor: high fare prices, difficulties in commuting with goods, congestions of passengers at stations, and long queuing for ticketing and overcrowding. These mobility difficulties of the BRT ride reveal its performance to the users, contrary to the BRT mission to offer an accessible, affordable and high-quality service to all residents in DES. The limited spatial coverage of the BRT was an important reason for demanding IPT to offer flexible transport for non-skilled jobs. These jobs are mostly conducted in non-fixed locations involving door-to-door mobility and access to low and high-density narrow streets (which are not able to be served directly by the BRT), particularly for the *peri*-urban neighbourhood and those without a private car. Some mobility difficulties of the BRT were not completely new but were also a feature of the existing minibuses, like overcrowding, long waiting times, and lack of comfort. Surprisingly, even individuals living closer to the BRT station, who seemingly did not experience the transfer issue to the BRT line, still faced barriers for using the BRT service because goods could not be taken, high fares (flat fares suitable for long-distance trips) and long waiting time for ticketing and boarding. This implies that for some individuals (e.g. low income individuals) the use of BRT was not only determined by proximity but also by individuals' capacities or characteristics (e.g. gender, employment, and income). In both neighbourhoods, some individuals (e.g. disabled, elderly and small entrepreneurs) were still facing mobility difficulties by the BRT use.

The mission for introducing the BRT system in DES was to offer high quality, affordable and accessible system, increasing the mobility options in a wide range of activities involved by low-income individuals in different spatial locations. However, banning some minibuses along the BRT corridor to make individuals ride in the BRT system was considered to add travel difficulties and costs for some individuals. Besides, DES is a monocentric city, individuals' trips along this important corridor were not only for economic reasons (income gains or work-related trips) but also for social and health reasons (e.g. trips made by elderly, disabled and pregnant mothers), by which an affordable PT to make diverse users ride regularly is very important in these neighbourhoods. The most positive about the BRT ride (or performance) relied on its ability to reduce in-vehicle time by use of its dedicated lane. In both neighbourhoods, even after BRT implementation, individuals still experienced important problems (i.e. lack of connectivity, unpaved road conditions, and lack of transport facilities) because they were travelling outside the BRT corridor lacking direct access to the system.

The results showed that meeting the individuals' mobility demands in different spatial locations is unrealistic by the BRT system *alone* in areas with a high level of informality in land use, low technology and poverty (with high levels of unemployment and low-income jobs). Joseph et al. (2019) found that IPT modes were suitable for trip destinations far away from designated major roads. A review of past studies showed that BRT systems aim to ease traffic congestion and reduce travel times, but indeed risk to exclude low-income individuals (Vermeiren et al., 2015; Del Mistro and Behrens, 2015; Lindau et al., 2014), which was confirmed in the present study. Each travel mode has its own inherent attributes which support individuals' mobility demand and interactions with social and economic activities. Banning IPT (like minibuses) along the BRT corridor in DES seemed to be less positive for those who already had limited travel options, like no access to private vehicles. The contribution of IPT needs to be considered as important and complementary for helping filling the mobility gap, rather than seen as a competitor for BRT. The BRT system's spatial coverage still needs to be further improved to address local mobility challenges by improving connectivity within neighbourhoods and serving a wide range of travel demands. An integration with IPT modes (which are flexible and demand-responsive) to complement the mobility demand of different individuals commuting far away from major roads is highly recommended (Rodriguez et al., 2017).

Efforts to address the mobility demand of individuals require not only the construction of new roads but rather expanding the route where BRT buses are able to ride along the paved road. The local roads (or sidewalks) providing access to destination ends should be prioritised towards inclusive mobility. By improving supportive infrastructure (within neighbourhoods and local markets) and facilities, IPT can guarantee the mobility demand within the local roads and fill the mobility gap (Del Mistro and Behrens, 2015), which is not covered by the BRT. There is a need for introducing different kinds of buses serving the high congested roads (large buses) and medium buses that offer services in various spatial destinations (e.g. in medium-less density streets). In other words, buses will leave the corridor at certain points to serve the neighbourhoods farther away from the BRT corridor, which allows the integration of exclusive and mixed lane services. BRT in DES can be a more flexible (open) rather than closed (fixed and less flexible) system (Cervero and Dai, 2014), so the first miles (origins) and last miles (destinations) are served by some of these BRT services. For example, Guangzhou's BRT system includes multiple bus routes which converge on a single dedicated BRT corridor, each serving different origin–destination patterns (Cervero and Dai, 2014). With an open BRT system, it would be possible for *peri*-urban individuals and destinations far away from major roads to ride in different BRT buses along this main corridor with less or no transfers (serve time and money). Different BRT bus sizes to serve diversity in mobility demands (e.g. commuting with goods) can leave dedicated exclusive lanes into paved local and/or

mixed roads to serve lower density areas, multiple destinations and commuting with goods. If BRT can operate in different forms and shapes, this is a cost-efficient solution to the government in the Global South with the limited financial capacity to improve existing roads and extending BRT routes.

The methodology employed is relevant for evaluating the impact of different transport systems which empowered the voice of the affected groups (Márquez et al., 2018) with possible transport interventions to be considered (Casas and Delmelle, 2017). It shows who benefits from the BRT and for whom it is not really a solution when changes and transformations in PT occur without an integrated system. These results emphasised that the mobility difficulties of the BRT need to be addressed urgently to serve at least those without a proper alternative. The findings can be used by planners and decision-makers to improve PT connectivity outside the CBD, major roads, and within neighbourhoods, to better serve the diverse mobility demands by use of the multi-model approach (i.e. use of small vehicles in low-density and high-density narrow streets), which creates mobility options by different modes where individuals can choose from or enjoy the flexibility of transport systems, rather than unimodal 'one-size fits all' (Mallqui and Pojani, 2017). The findings provide insights to other local settings with a similar background, e.g. a high level of low-income individuals, uncontrolled sprawl, unplanned activities, low technology and high demand for PT. The findings can serve as an important complement for more typical transport studies of demand, supply, operations (as common in practice), and of accessibility mapping (as common in academic research) to better improve PT connectivity in different local contexts. The study showed that BRT seems to overlook the complex trip-making of the urban poor (for whom being able to bargain travel costs is sometimes a lifeline) and the implications of the system and its rules (no minibuses on the main corridor, no fare integration between BRT and IPT) for the different users.

Further research is needed on understanding the performance of the BRT system from objective aspects using a representative sample to test and quantify BRT benefits in DES. It is important also to include other neighbourhoods (including a CBD community and users along the way of the BRT).

Acknowledgements

The author would like to thank the Transportation Research Institute (IMOB) of Hasselt University and the University of Dar es Salaam for their financial assistance to conduct field data collection in Dar es Salaam.

Declarations of interest

none.

Authors contributions

The conceptual model, methodology was designed by Joseph in close cooperation with Neven and based on feedback from Martens, Kweka, Jansen and Wets. Joseph conducted and analyzed all focus group discussion. The paper was written by Joseph, with substantial inputs from Neven. Martens, Kweka, Jansen and Wets provided regular feedback and comments. The authors critically reviewed and approved the final version of the paper.

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