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Safety, health and environmental impacts of commercial motorcycles in Sub-Saharan African cities

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ABSTRACT

In Sub-Saharan Africa, vulnerable road users make up approximately 50% of all traffic fatalities. Despite the dangers of using motorcycles for transportation, the usage of motorcycles—and more recently, motor tricycles—for both personal and commercial purposes has increased exponentially in most Sub-Saharan African cities. The study sought to study the safety, health and environmental impact of commercial motorcycles in Sub-Saharan African cities. Two cities—the national capital and a secondary city—were selected in each of our five study countries: Ghana, Liberia, Kenya, Tanzania and Uganda. Using a mixed-methods approach, motorcycle taxi operators were surveyed and key transport stakeholders were interviewed in these ten cities. In Ghana, where both motorcycle and motor-tricycle taxis are officially banned but continue to operate, we also surveyed motor-tricycle taxi operators. The results indicated variability in accident occurrence across countries for both minor and major road traffic collisions (RTCs) among motorcycle/tricycle taxi riders. Apart from Liberia, motorcycle/tricycle taxi unions in our study countries contribute to improving the safety of their riders. Interest in electric bikes is low amongst riders in all five countries, with education and infrastructure provision required to cause a shift from conventional bikes to electric bikes.

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Commercial motorcycles; motorcycle taxis; Sub-saharan African cities; environmental impact; safety and health

1. Introduction

There are now 1.35 million road traffic fatalities worldwide each year, with low- and middle-income countries (LMICs) accounting for the majority of these deaths (more than 90%) (World Health Organisation, 2018). Road traffic accidents are thought to cost

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the majority of nations 3% of their Gross Domestic Product (GDP) on average (World Health Organisation, 2018). In Sub-Saharan Africa (SSA), motorcycle riders, pedestrians, and cyclists—collectively known as vulnerable road users—make up more than 50% of all traffic fatalities (World Health Organisation, 2018). According to the World Health Organisation (World Health Organisation, 2017), alcohol consumption, failure to wear a crash helmet, inadequate infrastructure, speeding, and traffic conditions are the main risk factors for powered two- and three-wheeler (PTW) injuries. Most cities in Sub-Saharan Africa (SSA) have seen a continuing exponential development in the usage of motorcycles, and more recently, motor tricycles, for both individual and commercial purposes despite the risk associated with motorcycle transport. Due to their adaptability, flexibility, and related shorter journey times when compared to traditional public transportation, motorcycle taxi (MCT) services are highly utilised in the effort to reduce urban traffic congestion (Hagen et al., 2016; Oteng-Ababio & Agyemang, 2012). MCTs are the most accessible and widely used form of public transportation in a number of SSA cities as Diaz Olvera et al. (Diaz Olvera et al., 2016) described in the case of Lome, Togo, and Sietchiping et al. (Sietchiping et al., 2012) described in the cases of Lagos, Cotonou, Douala and Mombasa. Other factors contributing to their rising popularity are their ability to travel on poor roads and to provide door-to-door services at prices that are comparably low to those of private vehicles (Agyemang et al., 2021; Kumar, 2011; Sietchiping et al., 2012). Financially, investors and motorcycle taxi owners benefit greatly from the industry. Many motorcycle taxi drivers achieve an income exceeding their basic needs (Diaz Olvera et al., 2016), although Kisaalita and Sentongo-Kibalama (Kisaalita & Sentongo-Kibalama, 2007) argue that MCT (known locally as *boda-boda*) operators in Kampala barely made sufficient income to cater for their families due to the high fuel costs, vehicle rental fees, and taxation associated with their operations. However, in most cases, the MCT sector helps to absorb the growing number of unemployed youths by providing them with a source of income (Oteng-Ababio & Agyemang, 2012). Despite the clear social and economic benefits they create, in many African cities the MCT sector has a negative reputation, including often amongst authorities, based on perceptions that MCT operators drive aggressively, do not follow traffic laws or safety regulations, contribute to congestion, and therefore generate negative externalities such as accidents, insecurity, and air pollution (Peters et al., 2022). In Ghana, such perceptions have led to a nationwide ban on MCTs, however they continue to operate in contravention of this ban (Oteng-Ababio & Agyemang, 2015).

The safety of commercial motorcycle operations and the health of motorcyclists have been investigated in several SSA cities due to the vulnerable nature of motorcycles. Existing road crash statistics in some countries indicate that motorcycles (together with motor-tricycles) continue to experience higher fatality rates in the urban environment. For instance, in Ghana, the National Road Safety Authority (National Road Safety Authority, 2020) reports that motorcycle (including motorized three-wheeler) deaths represented 26.3% of the overall urban road user deaths in 2018, which was second only to pedestrian deaths (45.8%). Bishop and Amos (Bishop & Amos, 2015) report that official police statistics in Tanzania for 2013 indicated 1,100 motorcycle deaths and 6,500 motorcycle injuries. Aderamo and Olatujoye (Aderamo & Olatujoye, 2013) reports that motorcycle crashes, injuries and deaths in the city of Lokoja in the Kogi State of Nigeria rose steadily from 2006 to 2009. Self-reported prevalence rates of crash history among

MCT operators in SSA cities vary between 30% and 70% (Diaz Olvera et al., 2016; Dinye, 2013; Johnson, 2012; Kisaalita & Sentongo-Kibalama, 2007; Konlan et al., 2020; Odiwuor et al., 2015) and rise above 70% for MCT passengers (Nyagwui et al., 2016; Tuffour & Appiagyei, 2014). Minor crashes resulting in injuries not requiring hospitalization tend to be dominant compared to crashes resulting in more serious injuries (Diaz Olvera et al., 2016; Johnson, 2012; Matheka et al., 2015; Muni et al., 2019). MCT riders may therefore perceive their job to be less risky and opt to do it for a living (Diaz Olvera et al., 2016). A study by Agyemang et al (Agyemang et al., 2021) to determine the underlying factors of injury severity of rural and urban motorcycle crashes in Ghana established that urban motorcycle crashes commonly occurred at intersections and more commonly involved pedestrian collisions than rural motorcycle crashes. In contrast, rural motorcycle crashes were found to often occur under unlit road conditions and commonly involved head-on collisions (Agyemang et al., 2021). It was found that fatal injuries were mostly associated with motorcycle crashes that took place under dark or unlit road conditions, involved a pedestrian, or resulted in the motorcycle being run off the road (Agyemang et al., 2021). Motorcycle crashes occurring at nighttime stand a higher chance of resulting in bodily injuries than those occurring in the daytime (Tuffour & Appiagyei, 2014).

Factors highly rated by motorcycle riders as accounting for motorcycle-related road traffic crashes (RTC) include riders' years of experience and the type of training received, speeding, alcohol or drug use before riding, recklessness, poor road infrastructure, talking on phones, overtaking, and non-recognition in traffic by drivers of conventional transport (Davis, 2014; Diaz Olvera et al., 2016; Ehebrecht et al., 2018; Konlan et al., 2020; Matheka et al., 2015). In many cases, motorcycle operators have received short or inadequate training or have received no training at all due to a lack of proper training facilities or schemes for motorcycle operators. These operators might have learnt how to ride motorcycles by themselves or from friends (Diaz Olvera et al., 2016; Kisaalita & Sentongo-Kibalama, 2007). However, different studies have produced contrasting findings about whether driver inexperience is a cause of motorcycle crashes. Odiwuor et al. (Odiwuor et al., 2015) observed that more experienced riders (with 3 or more years of experience) were more prone to motorcycle crashes. In contrast, Kisaalita and Sentongo-Kibalama (Kisaalita & Sentongo-Kibalama, 2007) found rider inexperience as a cause of motorcycle crashes in Kampala. Muni et al. (Muni et al., 2019) established similar findings where regular MCT riders stood at higher risk of road traffic crashes compared to formally-trained riders offering app-based mobility services via the *SafeBoda* platform. As established by Kemajou et al (Kemajou et al., 2019), higher earnings are positively associated with high speeds. As such, the quest to make higher earnings compels MCT riders to engage in non-compliance with existing road traffic rules and regulations such as those concerning speeding and jumping red lights, for example (Diaz Olvera et al., 2016; Kemajou et al., 2019). The positive contribution of the wearing of personal protective equipment (gear) in reducing the severity of motorcycle taxi crashes was noted by Matheka et al (Matheka et al., 2015). However, helmet-wearing by motorcycle riders is reportedly low in some SSA cities such as Wa in Ghana (30%) (Dinye, 2013), Lome in Togo (25%) (Diaz Olvera et al., 2016) and Adidome in Ghana (43.6%) (Konlan et al., 2020). In certain cases, MCT riders were not oblivious to the existing regulations or safety benefits of crash helmets but still did not use them. Dinye (Dinye, 2013) reported that motorcyclists in Wa perceived the enforcement of crash helmet use as a means of

harassment while riding within the city. Other reasons for low crash helmet usage include perceived hearing impairment when receiving a call from a client while working, and headaches caused by heat within the crash helmets (Diaz Olvera et al., 2016). Meanwhile, better crash helmet-wearing rates by MCT riders have been reported in Kampala in Uganda (89.2%) (Muni et al., 2019) and Kigali in Rwanda (100%) (Vissoci et al., 2020) as a strategy to reduce the severity of injury or fatality of motorcycle crashes. Tuffour and Appiagyei (Tuffour & Appiagyei, 2014) also reported a higher passenger crash helmet use rate in Accra, Ghana (85%) due to greater awareness of the safety benefits of crash helmets, higher availability of helmets for passengers, and the need for operators to avoid police arrest for non-helmet use.

Commercial motorcycle drivers in African cities typically have long working hours and, coupled with the poor nature of roads, face negative health impacts such as back pains, vision challenges, headaches, and sexual weakness (Diaz Olvera et al., 2016; Inuwa et al., 2017). It is therefore not surprising that most bike operators in Kampala expressed interest in acquiring their own bikes to reduce the number of working hours and to make enough fares for themselves (Kisaalita & Sentongo-Kibalama, 2007). Motorcyclists also suffer from air and noise pollution (Kumar, 2011) since most of the motorcycles available in the SSA cities are petrol operated. Bike operators have also called for roads to be resurfaced to reduce the negative health impacts of their operations. Davis (2014) reports that in an effort to reduce crash occurrence motorcycle riders in Maryland County in Liberia now wear protective gear, adhere to traffic regulations, and have adopted a speed reduction.

Existing empirical studies on negative externalities of commercial motorcycle operations in SSA are skewed towards specific cities or local administrative areas of given countries. The few multi-country studies such as that conducted by Kumar (Kumar, 2011) in 2011 are not abreast of current issues such as technology usage in the commercial motorcycle sector. Therefore, our study sought to update our knowledge of the safety, health and environmental impacts of commercial motorcycle operations in SSA cities via a multi-country comparative study.

2. Methodology

The specific research questions underlying our study included:

- What is the frequency of involvement of MCTs in road traffic crashes and how do available crash statistics support this?
- What measures have MCT riders and unions taken to increase the safety of their services, what has worked, and how/why?
- What scope is there for urban planners to respond to the rapidly growing number of MCTs to increase road safety for this intermediate form of transport?
- Is there demand and interest for less polluting electric forms of motorcycle and/or motor tricycle transport?

The study was designed to utilise a mixed-methods approach as this was deemed necessary for answering the research questions. Due to funding constraints the data were gathered in the two SSA regions where motorcycle taxis are most numerous, namely

West and East Africa. More specifically, for West Africa, Ghana and Liberia were selected, while in East Africa, Kenya, Tanzania and Uganda were selected as case study countries. In each country, the national capital and a secondary city were selected as study locations. In Liberia, Kenya, Tanzania, and Uganda, standardized questionnaire surveys were conducted among 60 to 70 motorcycle taxi operators through convenience sampling. In Ghana, with no motorcycle taxis operating in our secondary city, Kumasi, just over 50 surveys were conducted with motor-tricycle taxi (MTT) operators. Approximately 80 additional surveys were then conducted in the capital city, Accra, where motorcycle taxis do operate. Note that commercial motorcycles and motor-tricycles have been banned across the whole country since 2012. Our lead researcher in Ghana opted to interview as many motorcycle/tricycle operators as expressed an interest during their allotted days at their various loading points. Due to an especially high interest in participation amongst operators, this resulted in a higher sample size in Ghana relative to other study countries. Motorcycle/tricycle taxi riders were approached at locations where motorcycle taxi operators congregate in our study cities, most commonly at motorcycle taxi stands where operators wait for fares. Previous work conducting rider surveys and traffic counts has shown us that busy operators are often concerned with maximising their earnings by returning to work quickly and are reluctant to give up too much time to answer researchers' questions. We therefore sought to keep questionnaires short and did not include questions allowing us to provide a more detailed description of the study population, such as their education levels or years of riding experience, for example. However, as we expected due to the demographics of motorcycle taxi riders across Africa (Ehebrecht et al., 2018), none of our researchers encountered any female operators. Therefore, in all study countries the study population was composed of (mainly young) men. The data were collected during the second half of 2020 across all ten cities. The study cities and sample sizes for the motorcycle/tricycle operator surveys from respective countries are shown in Table 1.

Due to the survey methods used, much of the data we present reflects the perceptions and beliefs of the motorcycle taxi riders who participated in our survey. Their views on causes of crashes, for example, represent their subjective perspectives based on their experiences. While participant perceptions may or may not fully align with official statistics, we believe understanding rider perspectives provides valuable insights. Because they reflect the views of riders themselves, our findings illuminate potential risk factors and hazards of motorcycle taxi riding from an emic perspective. For example, self-reporting traffic crashes provides useful complementary information to official crash records, which are often incomplete, especially for vulnerable road users like motorcycle taxi riders (Kamaluddin et al., 2018) We hypothesised that in our study contexts official

Table 1. Study cities and survey sample sizes for countries.

Study Country	Capital City	Secondary City	Sample Size
Ghana	Accra	Kumasi*	134 (51**)
Kenya	Nairobi	Kisumu	67
Liberia	Monrovia	Ganta	60
Tanzania	Dar es Salaam	Morogoro	60
Uganda	Kampala	Mbarara	61

*The only city where motor-tricycle taxis were surveyed due to non-existence of motorcycle taxis.
**number of motor-tricycle operators surveyed.

records likely underreport motorcycle taxi crashes, especially minor injuries. Self-reports can therefore complement this to better capture the safety situation. While self-reports have limitations like recall bias and social desirability bias, researchers increasingly 'trust' this methodology given its ability to provide insights not found in official data (Kamaluddin et al., 2018). Our goal therefore was not to use this method to provide definitive crash statistics, but rather insights into the safety situation and potential risk factors based on rider perspectives.

In addition to rider surveys, our study contained a qualitative component. We conducted a series of semi-structured qualitative interviews with 10–20 key stakeholders in each of our study cities. Purposive sampling was also used to identify and interview key transport stakeholders comprising users, non-users, regulators, enforcers, development workers, researchers and transport unions. Interviews were conducted in English, recorded, and transcribed. Analysis was conducted by lead researchers in each of our study countries, who identified key themes, related these to our main research questions, and compiled initial reports on the findings.

3. Results of the study

3.1 MCTs involvement in Road Traffic crashes

Generally, MCTs' involvement in minor[1] RTC was more prevalent in Ghana than in the four other study countries. While all MCT riders in Ghana indicated they had a history of minor road traffic crashes, the percentage of riders who professed to have ever been involved in minor road traffic crashes in Tanzania, Uganda, Liberia, and Kenya was 70%; 64%; 48% and 27% respectively. Further analysis of the frequency of MCT minor RTCs in Ghana indicated that 16% of those accidents occur once or twice a week; 41% once or twice a month; and 44% once or twice a year. Tanzania is the only country apart from Ghana where 15% of minor RTCs occur once or twice a month, more than the remaining countries. As shown in Figure 1, minor RTCs of MCTs occurring once or twice in ayear range from 21% in Kenya to 62% in Uganda.

Figure 1

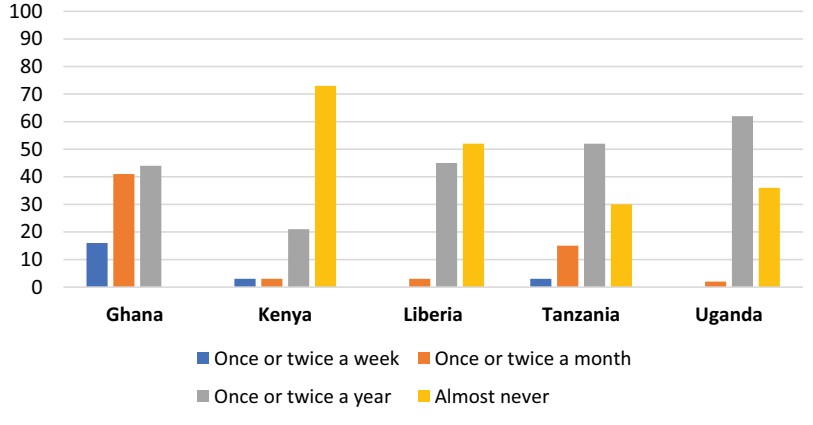

Figure 1. Frequency of involvement in minor RTC.

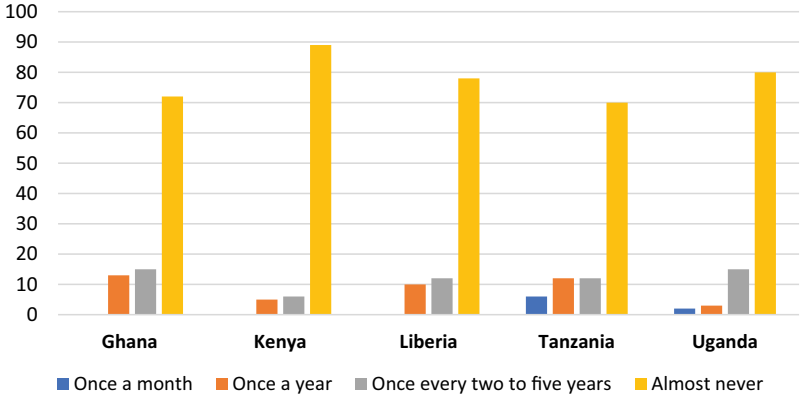

Figure 2. Frequency of involvement in major RTC requiring hospitalisation.

As provided in Figure 2, the percentage rates of involvement of MCT riders in major RTCs requiring hospitalisation show, as expected, improvement for all countries when compared with minor RTCs, ranging from 11% in Kenya to 30% in Tanzania. Below 7% of riders in Tanzania and Uganda indicated a major RTC occurrence rate of once a month while the occurrence rate of once-a-year and once-every-five years across all countries did not exceed 13% and 15% respectively. Interestingly, involvement in minor RTCs was reported by participants to occur most frequently in Ghana, where motor-tricycle taxi riders were included in the sample. Frequency of involvement in major RTCs by Ghanaian participants was comparable to other countries. This therefore appears to contrast with some perceptions that motor-tricycle taxis are inherently safer than motorcycles due to their sluggish engines and the greater stability offered by their extra wheel. We had initially hypothesised that safety data that could be biased towards presenting a picture that motorcycle taxis are safer in Ghana than they are in actuality due to the data from 'safer' motor-tricycle taxis skewing the data in that direction. We had planned to prevent painting a false picture by not presenting safety data from Ghana in our figures. However, given the results, we decided to include them in the figures above and attempt to provide some explanation for these findings. We suggest that there may be some unsafe characteristics of motor-tricycle taxis contributing to these findings that could be a focus for further research. For example, their small wheels may make potholes more damaging and create additional risks. Some motor-tricycle operators add spikes to their vehicles to prevent damage, but these may also pose risks to pedestrians who may be injured by such modifications. In addition, rates of drug and alcohol use may not differ across MCT and MTT operators. Factors and unique characteristics of motor-tricycles potentially contributing to accident risk for MTTs could be the subject of further investigation.

The perception that MCTs are more prone to RTCs was contested by some stakeholders as illustrated by a statement made by a motorcycle taxi union leader in Nairobi, Kenya: 'It is just a notion that we are prone to accidents; most of our members have gone to driving schools'. Another motorcycle union leader in Ghana explained that motorcycle RTCs come nowhere close to RTCs involving buses and other conventional means of

transport and that he foresees an agenda to make motorcycle taxis unpopular in Ghana. This is underscored by the following statement:

> 'Crashes that occur on our roads involving motorbikes are negligible as compared to cars and buses. The media only gives us a negative hype by mainly focusing on reporting motorbike crashes to make us look unattractive' – MCT union representative, Accra, Ghana.

However, a statement by a motorcycle union representative in Liberia indicated otherwise: 'Traffic accidents caused by MCT driving are very high'. According to his estimation, 80% of the riders have been involved in minor RTCs and 20% have been involved in major RTCs at some point.

Several factors were deemed to have accounted for MCT-related crashes. In Ghana, disregard of MCT riders by other road users was considered the main cause of MCT crashes while bad roads and overloading were ranked as the greatest factor for MCT crashes in Liberia and Tanzania respectively. In both Kenya and Uganda, rider speeding and inexperience were the two most common causes of MCT crashes as shown in Table 2. Again, faulty bike operations formed the second dominant cause of MCT crashes in Ghana while rider speeding was ranked second in both Liberia and Tanzania. Meanwhile, overloading was least associated with MCT crashes in Ghana and Liberia, just as pedestrians moving around occupied the lowest ranking in Kenya, Tanzania, and Uganda. Across all study countries, speeding seemed to be the most common reason assigned to MCT-related crashes with the fewest total points of 9.

The stakeholder interviews revealed the perception that the kind of roads designed and constructed in some African cities do not support the operations of motorized two- and three-wheelers or non-motorised transport such as bicycles, and make them prone to RTCs. This is exemplified in the statement: *'Roadways are not constructed to accommodate MCTs or bicycles. Other types of travel are not considered while designing roads'* (Transport Engineer, Dar es Salaam, Tanzania). A perhaps somewhat biased MCT Union representative from Ghana reinforced the notion that some drivers of conventional vehicles intentionally force motorcycle taxis into crashes especially when the police are attempting to arrest riders of MCTs due to their illegal operations. The statement below affirms this:

> 'Some taxi and bus operators intentionally force motorbikes into crashes, especially if the police are after the motorbike all because of the hatred taxi drivers have for motorbike riders. They feel the motorbike riders have taken over their businesses' – MCT Union representative, Accra, Ghana.

Table 2. Perceived reasons for motorcycle taxi RTCs.

	Rankings by Countries					
Perceived Reasons	Ghana	Kenya	Liberia	Tanzania	Uganda	Total
Bad roads (e.g. potholes)	6	3	1	4	3	17
Speeding by rider	3	1	2	2	1	9
Inexperienced rider	5	2	3	5	2	17
The bike is not in the proper order	2	5	4	6	3	20
Other road users, such as car and bus drivers, not taking MCT into account	1	4	5	3	6	19
Pedestrians moving around	4	7	6	7	7	31
Overloading	7	6	7	1	5	26
1-Most Common Reason; 7- Least Common Reason						

An interesting notion shared in Uganda was that the police also indirectly cause motorcycle RTCs through their operations because they aim to extort money from MCT riders rather than ensure safety, as alleged by one stakeholder:

> 'Every infraction by an MCT rider is interpreted as an offence; if the police cannot find a legitimate infraction, they create one. This extortionist policing causes MCTs to attempt to escape "victimization" by fleeing the scene, thereby causing accidents' – MCT union representative, Kampala, Uganda.

The prevalence of non-use of crash helmets and non-observance of traffic rules and regulations were also identified by Liberian stakeholders to account for the high injury and crash rates among motorcyclists as explained by the statement: '*Motorcyclists are constantly capitalizing on police deficiencies and ride motorcycles throughout the country with little or no safety wear and violate traffic rules at their will*' (MCT union representative, Ganta, Liberia). Again, the lack of proper arrangements for motorcycle rider training and licensing was identified to have contributed to motorcycle-related crashes in Liberia as suggested by one stakeholder: '*The driver's education and training must be undertaken within the Ministry of Transport (MoT) office and not outside the entity to get rid of manipulation and falsification of documents*' (Transport Union Representative, Liberia). It was explained that some MCT riders intentionally removed their side mirrors to enhance their maneuverability in traffic and to avoid side-swiping conventional transport during traffic jams. However, this practice invariably leads to MCT crashes as the bikes get blinded to what is occurring behind them. This was more commonly reported by Liberian riders.

3.2 Measures taken by MCT riders and unions to improve the safety of their services

For riders in Ghana, ensuring the safety of their operations (Figure 3) is achieved through always driving carefully and not speeding (41%), always wearing crash helmets (28%) and taking only one passenger at a time (26%). However, for Kenyan riders, the two most important tasks undertaken to make them safer are always wearing crash helmets (69%) and always driving carefully and not speeding (18%). Meanwhile, wearing additional protective gear such as high visibility jackets (37%), wearing crash helmets (26%) and driving carefully and not speeding constituted the dominant rider efforts to be safer in traffic in Liberia. Finally, in both Tanzania and Uganda, riders made their operations safer by driving carefully and not speeding (48% and 30% respectively) and always wearing crash helmets (35% and 23% respectively). In essence, riders from all the study countries indicated they attempt to drive carefully, do not speed, and always wear crash helmets to make their operations safer, although in different proportions.

Apart from Liberia, MCT unions in the other four countries also play a role in encouraging their members to be safer in their operations, according to the MCT operators. In Ghana, MCT unions prioritize careful driving and speeding reduction (60%) while the regular wearing of crash helmets (72%) is heavily promoted by the Kenyan MCT unions. For Tanzanian and Ugandan MCT unions, two areas are addressed to ensure the safety of their members – wearing crash helmets regularly (36%; 20%) and careful driving and not speeding (29%; 22%) respectively as shown in Figure 4.

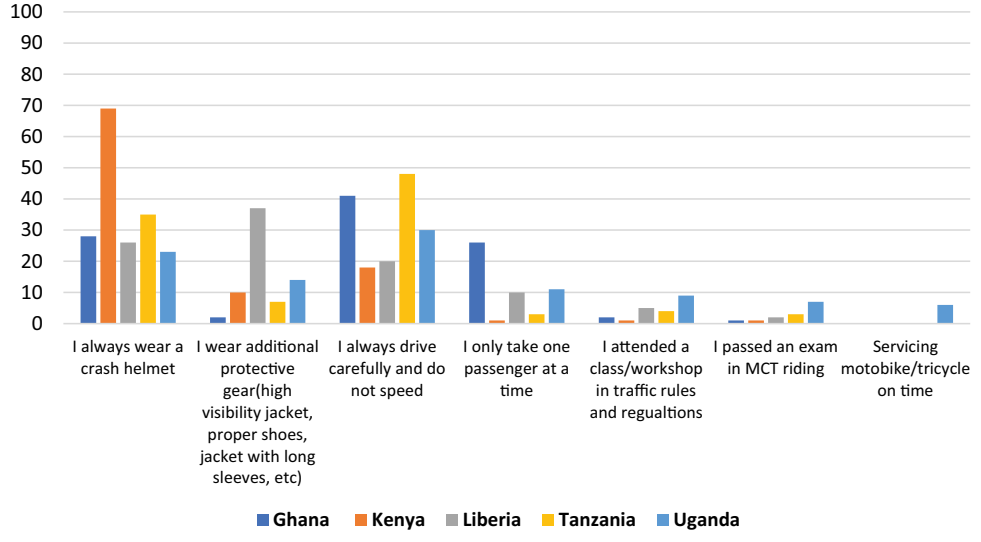

Figure 3. Role of riders in increasing safety of their operations.

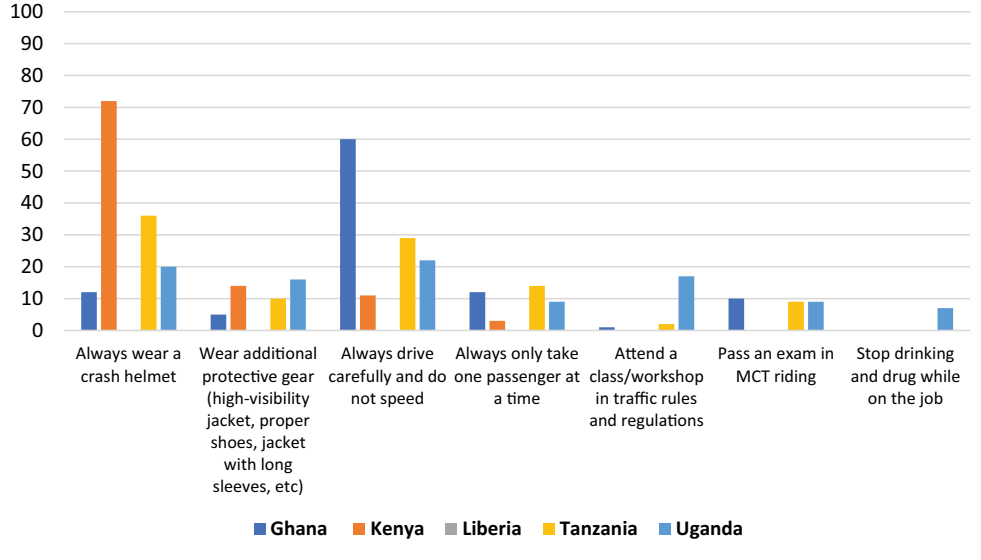

Figure 4. How MCT unions ensure the safety of its members.

MCT unions have tried to encourage compliance with traffic rules among their members to reduce RTCs. These may involve strategies based on holding members to account through self-enforcement, or through encouraging safer behaviours through training and education. MCT union stakeholders identified challenges in dealing with riders who do not belong to any unions, as alluded to in this statement:

> We ensure the discipline of our members, and whenever there is a problem or a complaint from a client, we can follow up and hold our members to account. But there are those riders

> who do not belong to any union and tracing them is a challenge. They are the ones destroying our name – MCT union representative, Kisumu, Kenya.

In Ghana, the MCT union occasionally organises safety training sessions for their members as explained in the statement:

> We sought to organise a training session for our members in Accra but due to the COVID-19 pandemic, we have halted the session. Riders in Kintampo [a town in Ghana with a high concentration of MCT] have already benefited from this training – MCT union representative, Accra, Ghana.

The National Road Safety Authority (NRSA) in Ghana partners with the MCT unions and other stakeholders to occasionally organise safety training for the MCT riders as illustrated in the statement:

> 'We the Municipal Assembly hold meetings with the DVLA[2], NRSA and National Disaster Management Organisation (NADMO) to train and educate them on the need to always ensure safety in their operations' – Municipal Transport Official, Kumasi, Ghana.

Similar initiatives have been instituted in Tanzania to emphasise the positive role of MCT unions in ensuring the safety of the services provided by their members. An MCT user observed: '*They wear helmets, as I have witnessed them reminding one another. If a motorcyclist only has one helmet, he borrows from other riders*' (MCT user representative, Dar es Salaam, Tanzania). This was further corroborated by a union representative: '*The union reminds its members every week to ride safely. Constant reminders have encouraged MCT riders to be cautious*' (MCT union representative, Morogoro, Tanzania).

Motorcycle taxi unions might play a useful role in encouraging greater adherence with safety regulations such as helmet wearing by motorcycle taxi operators. Evidence from elsewhere shows that efforts to enforce traffic laws have often achieved mixed results depending on the capacity of authorities to carry out effective enforcement actions. For example, in Rwanda a high degree of compliance has been achieved through strict regulation and tight enforcement (Goodfellow, 2014). However, according to Goodfellow (Goodfellow, 2014), in Uganda, the state's ineffectiveness in enforcing regulations has resulted in its lack of effective control over the MCT sector. In our study, Ugandan operators noted a range of roles played by MCT unions in encouraging rider safety, primarily in encouraging drivers to drive carefully and avoid speeding. Approaches to boosting safer riding behaviours and use of protective gear based on encouraging voluntary compliance may therefore complement overall efforts. Key stakeholders reported that MCT unions aim to encourage safer behaviours through education and training as well as by holding their members to account through enforcement actions. Given that riders recognise a number of the efforts already being undertaken by unions in a range of areas, expanding the role of MCT unions in overall regulatory and enforcement strategies should be considered by authorities. Working collaboratively and consultatively with unions may further assist messaging effectiveness and compliance, as we have discussed elsewhere (Peters et al., 2022).

3.3 Scope for urban planners to respond to the growing number of MCTs

In Table 3, recommendations to make the cities of the study countries better for motorcycle and tricycle taxis are prescribed by the MCT operators. Other measures

Table 3. How the city be better for motorcycle/tricycle taxis.

Responses	Rankings by Countries					Total
	Ghana	Kenya	Liberia	Tanzania	Uganda	
Quickly fix potholes	2	4	1	3	1	11
Make special lanes for motorcycle taxis	3	2	2	2	2	11
Limit conventional traffic on smaller roads in town, leaving those to be exclusively served by MCTs	4	3	3	4	4	18
Others e.g. Engage riders and Enforce compliance of traffic rules and regulations, etc.	1	1	4	1	3	10
1-Most Effective; 4-Least Effective						

such as engaging riders and enforcing compliance with traffic rules and regulations constituted the main effective measure in Ghana, Kenya, and Tanzania. Quick fixing of potholes was deemed most effective by Liberian and Ugandan MCT operators. Apart from Ghana, where the quick fixing of potholes was identified as the second most effective measure, all the remaining four countries were in support of making special lanes for motorcycle taxis as a secondary measure. Meanwhile, quick fixing of potholes and limiting conventional traffic on smaller roads in towns/cities were cited as the least effective measures in Kenya and Ghana respectively. Liberian, Tanzanian, and Ugandan riders saw the least benefit in limiting conventional traffic on smaller roads. Engaging riders and enforcing MCT compliance regulations was deemed the most effective measure to make the cities of the study countries better for MCTs (recorded the fewest number of points).

The need for exclusive lanes for motorcycle taxis in town planning was highlighted in the stakeholder interviews: '*Every mode of transport should be considered in road designs, especially pedestrians and bicycles. Special lanes for motorcycles could help reduce accidents*' (Transport Engineer, Dar es Salaam, Tanzania). Also, to enhance the constant engagement of city authorities with the leadership of MCTs, there has been a need for various smaller MCT unions to come under one big umbrella in various cities. This was underscored in a statement by a stakeholder: '*They [MCT unions] should be under a certain umbrella of leadership that the authority can talk to that responds on behalf of area/division chairmen for their respective divisions*' (Transport Officer, Kampala, Uganda). Meanwhile, some stakeholders in Ghana implored the government through the city engineers/planners to fix potholes as unattended potholes have the potential to cause accidents involving MCTs. To them, these represent a prudent way of responding to the growing numbers of MCTs in the cities by urban engineers/planners as a way of helping prevent or reduce all vehicle crashes.

3.4 Demand and interest in electric forms of motorcycles/tricycles for transport

Generally, interest in electric forms of motorcycles/tricycles (e-bikes) was very low among MCT riders. The highest rates of disinterest in e-bikes were associated with MCT riders from Ghana (81%) followed by Tanzania (74%), Uganda (57%), Kenya (51%) and Liberia (45%). Some of the reasons for disinterest in e-bikes included expected difficulties in repairing or sourcing parts for e-bikes; expected difficulties in charging e-bikes without access to the electrical grid; and long charging times. It is worth noting that 60% of riders in Ghana, 25% of riders in Kenya, and 17% of riders in Uganda

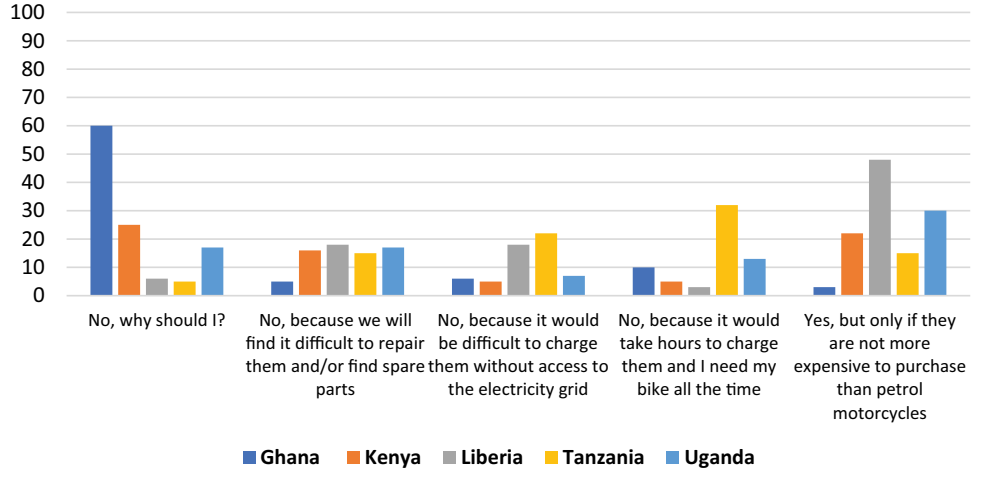

Figure 5. Would you be interested in electric motor tricycles and motorcycles?

objected without giving a particular reason for their disinterest. As shown in Figure 5, for many riders who expressed interest in e-bikes, their interest was conditional. For example, it was commonly stated by riders that e-bikes must be made cheaper to purchase than fuel-operated bikes. This was most evident with riders in Liberia (48%), Uganda (30%), Kenya (22%) and Tanzania (15%). Another condition for interest in e-bikes was that they must have a good range, however, this generally received low attention – below 10% in all study countries. Nevertheless, it appears some riders are already aware of the potential health, environmental and economic benefits of e-bikes. This includes the perception that e-bikes do not pollute [Kenya = 9%, Tanzania = 8%] and are cheaper to fill up [Kenya = 11%, Ghana = 6%].

The issues of cost, safety, policy direction and public awareness dominated the stakeholder interviews. These were expressed in varied opinions either for or against the demand and interest in e-bikes. The following statements buttress the above claim:

> 'Demand would be there only if electric motorcycles are better than the existing ones in cost and durability. They can also help reduce accidents because they are not as fast as ordinary bikes' – Transport Engineer, Dar es Salaam, Tanzania.

It was suggested that interest in electric motorcycles and motor tricycles would grow once they are introduced in greater numbers: *'Electric motorcycles are cheap, and when they are available, people will like them. The only problem is the reliability of power source'* (Land Transport Regulatory Authority Representative, Dar es Salaam, Tanzania). In Uganda, while some e-bikes have been introduced in the transport space, there were concerns over possible sabotage from the government officials in the petroleum sector due to lost revenue from the electrification of motorcycles which could threaten their sustainability. A stakeholder explained it this way:

> 'The moment the consumer approves it as what he wants, the government will find it difficult to stop them. But the government has people who are in the business of petrol and oil. They will look at that innovation as a threat to their businesses' survival' – Cooperatives Representative, Kampala, Uganda.

Key determinants of the demand for e-bikes in Ghana, as noted by stakeholders, is government policy and the cost or profit margins of e-bikes, as exemplified by the following statement:

> 'Maybe looking at cost and profit margins, it is possible for investors to invest in them [e-bikes] since we are in a technological era. Also, if it is in line with government policies' – Traffic Police Representative, Kumasi, Ghana.

However, an MCT union representative thought otherwise:

> No, it won't help us, the electric ones can leave you somewhere on the road. Also, the charges for electricity can be higher than that for fuel. That will not help unless certain facilities like charging stations are provided alongside – MCT union representative, Accra, Ghana.

4. Discussions

The study aimed to establish perspectives on safety, health and environmental impacts of commercial motorcycles in Sub-Saharan African cities. The research was designed as a mixed methods study involving qualitative interviews of key informants in the transport sector and a questionnaire survey of motorcycle/motor tricycle taxi operators from the national capital and secondary cities of five SSA countries – Ghana, Liberia, Kenya, Tanzania and Uganda. As we noted earlier in this paper, the findings of our surveys may not match with official statistics or reflect the situation in other contexts not included in our study, however this is not necessarily a shortcoming of our study. We have provided further insights into our survey findings by presenting the perceptions of key stakeholders from a range of different stakeholder groups, however because survey results are based on the subjective self-reporting of issues by participants, findings carry a risk of recall bias and social desirability bias. Nevertheless, our findings offer valuable insights from an emic perspective, potentially capturing insights that would be overlooked or missed when using different methodological approaches or when focusing research on different participant groups. They may also overcome some of the shortcomings of official statistics arising from underreporting of incidents – especially of minor accidents – and hint at the true safety situation, mitigation measures, and salient risk factors as perceived by the people who must contend with them daily.

The results indicate a higher prevalence of minor RTCs (27% in Kenya to 100% in Ghana) compared to major RTCs (11% in Kenya to 30% in Tanzania) among motorcycle taxi riders in the five SSA countries. This suggests that the levels of risk of commercial motorcycle operation differ across contexts and conditions with the risk levels generally acceptable by the operators. The preponderance of minor injury crashes by motorcycle taxi riders supports earlier findings in various jurisdictions: 75% in Southern Nigeria (Johnson, 2012), 90% in Central Kenya (Matheka et al., 2015), 36% in Lome (Togo) (Diaz et al., 2016), 77% in Kampala (Uganda) (Muni et al., 2019) and 61% in Kigali (Rwanda) (Vissoci et al., 2020). It is plausible the high prevalence of MCT crashes in Ghana and Tanzania compared to Kenya and Uganda could be attributed to rider inexperience on the MCT job in Ghana and Tanzania, or that the regulatory framework around MCTs in these countries is less developed. As Ehebrecht et al. (Ehebrecht et al., 2018) note,

motorcycle taxis have been in existence in Kenya and Uganda since the 1990s compared to their emergence in Ghana and Tanzania in the 2000s. Interestingly, involvement in minor RTCs was reported to occur most frequently in Ghana, where involvement in major RTCs was also found to occur with frequency comparable to other study countries. These were surprising findings, given that our Ghana sample included operators of motor-tricycle taxis, which are often perceived to be safer than motorcycle taxis due to the unique characteristics of the vehicles. They suggest potential factors or vehicle characteristics that may contribute to unique accident risks for motor-tricycle taxis. While we suggested some potential explanations in our results section, such as their small wheels rendering them vulnerable to potholes or vehicle modifications such as spikes increasing likelihood of collisions with pedestrians, these are areas for further investigation in the future.

The motorcycle/motor-tricycle taxi union stakeholders are divided over commercial motorcycles' susceptibility to RTCs with Ghanaian and Kenyan representatives dismissing such allegations while Liberian representatives accepted this as a fact. While motorcycle taxi crashes may be contestable by various stakeholders, the risk of death on urban motorcycles (both private and commercial) are high (26.3%) among motorized transport modes in Ghana (National Road Safety Authority, 2020). On-the-road disregard of MCTs by users of other types of vehicles is a major cause of MCT crashes in urban Ghana. In the northern part of Ghana, where motorcycles are a major part of the traffic system and sometimes dominate other transport modes, motorcycles are generally accepted and well-regarded by operators of other modes of transport. However, in the urban part of Southern Ghana, where motor vehicle ownership is high despite often congested roadways, motorcycles and three-wheelers are often perceived as a nuisance in the traffic system. Conventional transport drivers thus force drivers of two- and three-wheelers onto the shoulders of major roads instead of allowing them onto the main carriageways. In Kenya and Uganda, operators believed the major causes of MCT crashes to be speeding, rider inexperience, police harassment and infrastructural challenges. Speeding was also identified as a major threat to MCT safety in Tanzania and Liberia. Liberian transport stakeholders were most concerned about the bad condition of roads, non-use of protective gear, improper rider training and violation of traffic rules and regulations. Overloading of motorcycles was the main concern in Tanzania.

The main measures taken by MCT riders to ensure their safety in Ghana, Tanzania and Uganda were speed reduction/careful driving and routine use of crash helmets. Ghanaian MCT riders commonly avoid overloading by carrying one passenger at a time as a way of ensuring their safety. However, MTTs in Ghana grenerally carry three passengers and this was only reduced due to the physical distancing protocol during the COVID-19 pandemic (Peters et al., 2022). In Kenya and Liberia, MCT riders give importance to always wearing crash helmets (69%) and wearing additional protective gear (37%) respectively. Speed reduction and always wearing crash helmets are additional priority areas for MCT riders in Kenya and Liberia respectively. The above discourse on threats and strategies to promote the safety of MCT riders are not out of place in comparison with existing literature. Some reported dominant causes of MCT crashes include speeding (Amine et al., 2015; Davis, 2014; Ehebrecht et al., 2018; Inuwa et al., 2017; Johnson, 2012; Nyagwui et al., 2016; Odiwuor et al., 2015); non-adherence to traffic rules (Amine et al., 2015; Diaz et al., 2016; Inuwa et al., 2017; Konlan et al., 2020); poor

road infrastructure (Davis, 2014; Ehebrecht et al., 2018; Konlan et al., 2020; Matheka et al., 2015; Odiwuor et al., 2015); rider inexperience (Nyagwui et al., 2016); overloading (Diaz et al., 2016); reckless driving (Amine et al., 2015; Konlan et al., 2020; Muni et al., 2019); non-use of protective gear (Johnson, 2012; Muni et al., 2019; Nyagwui et al., 2016); and vehicle defects such as faulty brakes (Muni et al., 2019). Again, reported strategies employed by MCT riders to reduce their involvement in crashes include speed reduction (Davis, 2014; Dinye, 2013), adherence to traffic regulations (Davis, 2014) and wearing of protective gear (Davis, 2014; Matheka et al., 2015).

We suggested that MCT unions might play a useful role in ensuring safer driving behaviours and rider compliance with safety regulations. From the results, most of the existing motorcycle/tricycle taxi unions, except in Liberia, play a role in encouraging their members to improve their safety by adopting good practices and adhering with regulations. In addition to self-regulation, these include strategies based on encouraging voluntary compliance through education and training. Ehebrecht et al. (Ehebrecht et al., 2018) note similar health and safety functions, among other functions, of MCT rider associations in Nigeria, Tanzania, Sierra Leone and Uganda. In Uganda, for instance, a main umbrella MCT union in Kampala known as 'Boda Boda Association 2010' provides road safety seminars for its members in which they encourage members not to engage in speeding, to wear crash helmets, and to drive defensively (Raynor, 2014). Ismail (Ismail, 2016) reports improved road safety and crash reduction among MCTs in Sierra Leone due to the increased partnership of MCT unions with local NGOs to offer rider training on traffic rules and safety practices.

In Ghana, the separation of two and three-wheeler taxis from the main transport system was rejected by all transport stakeholders including MCT riders. It was explained during stakeholder workshops that such an approach would require further financial investment and could be a burden for the country considering its current economic hardship. Liberia was ranked last regarding union engagement of MCT riders with regard to traffic rules and regulations, which was somewhat surprising when it is considered that violation of traffic rules by MCT riders was a key concern among stakeholders interviewed in Liberia. Liberian riders reported that unions do not carry out the same health and safety functions reported in other study countries, potentially adding weight to our claim that unions play a valuable role in encouraging compliance.

The demand for electric motorcycles is often an awareness issue rather than one of outright resistance. The greater majority (60%) of Ghanaian riders who are simply not interested in electric bikes could be attributed to ignorance of e-bikes which were non-existent in the Ghanaian transport space at the time of the study. Lack of precedent may therefore have contributed to scepticism about e-bikes. In contrast to the West African sub-region, e-bikes are already operating in East Africa, yet some MCT riders in Kenya (25%) and Uganda (17%) are also simply not interested in them. The lower percentage of MCT riders with knowledge of the positive impact of e-bikes attests to the high ignorance of e-bikes in SSA cities. A lot of education would be required to convince riders to shift from conventional bikes to e-bikes. As our other findings show, there may be benefits to involving MCT unions in efforts to raise knowledge and awareness of these vehicles. However, infrastructural hurdles to widespread adoption of e-bikes in African cities should not be ignored. Several developing countries have energy crises (rampant power outages without prior

information) and frequent price hikes in electricity costs. These challenges raise doubts about the sustainable adoption of electric vehicles (EVs) in these countries in the short-to-medium term. Previous studies on barriers to the adoption of EVs have established that battery range, cost and charging infrastructure are the greatest concerns held by potential consumers of electric vehicles, even in regions where the infrastructural challenges mentioned above are less of a concern (Egbue & Long, 2015). The current study affirms these concerns in addition to concerns about the availability of spare parts or ease of maintenance in our study contexts. However, while Egbue and Long (Egbue & Long, 2015) established a moderate to high interest in EVs amongst potential consumers in the United States, the current study found relatively low interest in e-bikes amongst African motorcycle taxi operators. Governments' commitments or policy direction could either facilitate or militate against the adoption of EVs in the Sub-Saharan African motorcycle taxi sector.

5. Conclusion

This multi-country study was designed to explore issues of safety, health and environmental impacts of commercial motorcycles and motor tricycles in Sub-Saharan Africa's bustling and growing urban centres, where the mobility of millions of urbanites depends on the continued effectiveness of all levels of the transport sector. Our study identified variability in accident occurrence for both minor and major traffic crashes across study countries. MCT riders and unions have taken measures to increase the safety of their services. These include riders' adoption of safer riding practices, use of protective equipment and gear such as crash helmets, unions' provision of safety training sessions, and unions' policing of members' non-compliance with traffic rules. Urban planners may find scope to improve road safety for these fast-growing intermediate forms of transport by ameliorating bad road conditions, for example by patching potholes, and by creating innovative forms of infrastructure/road layouts including dedicated lanes for motorcycles and motor tricycles that further assist their valued provision of mobility services. The adoption of electric forms of motorcycles and motor tricycles at any scale appears to be some way off fruition, partly due to low interest and low confidence in the technology and the availability of associated infrastructure such as charging facilities. There appears to be a role for governments in promoting the benefits of electric vehicles and in providing the infrastructure necessary to ensure that the use of electric vehicles by commercial motorcycle riders is a viable option in a context where infrastructure quality and coverage are typically quite low compared to other regions of the world. Our findings on current MCT union involvement in safety training and education activities suggest that unions could also play a valuable role in efforts to raise awareness of e-bikes in the future. Together these may overcome the concerns of current operators in respect of the affordability, range, and sustainability of electric vehicles despite interest and awareness of the potential health, environmental and economic benefits of e-bikes.

Notes

1. RTC resulting in bruises or scratches and only requiring first aid without hospitalisation.
2. Driver and Vehicle Licensing Authority.

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Data availability statement

The data is available upon request.

References

Aderamo, A. J., & Olatujoye, S. (2013). Trends in Motorcycle Accidents in Lokoja, Nigeria. *2*(6), 251–261.

Agyemang, W., Adanu, E. K., Jones, S., & Galante, F. (2021). Understanding the factors that are associated with motorcycle crash severity in rural and urban areas of Ghana. *Journal of Advanced Transportation*, *2021*, 1–11. https://doi.org/10.1155/2021/6336517

Amine, A. D. D., Abubakar, K., & Clement Nkem, C. (2015). Prevalence of road accident by commercial motorcycle operators in Benue state, Nigeria. *Journal for Studies in Management and Planning*, *1*(8), 145–152.

Bishop, T. & Amos, P. (2015). *Opportunities to improved road safety through 'boda boda' associations in Tanzania. Final Report* (Report No. TAN2015G/SC14069). Thame, UK: Cardno.

Davis, P. D. (2014). An assessment of the perception of motorcyclists on risk Management in Maryland County. *International Researchers*, *3*(2), 12–22.

Diaz Olvera, L., Guézéré, A., Plat, D., & Pochet, P. (2016). Earning a living, but at what price? Being a motorcycle taxi driver in a Sub-Saharan African city. *Journal of Transport Geography*, *55*, 165–174. https://doi.org/10.1016/j.jtrangeo.2015.11.010

Dinye, R. D. (2013). The significance and issues of motorcycle transport in the urban areas in northern Ghana. *Scientific Journal of Review*, *2*(210), 256–272. https://doi.org/10.14196/sjas.v2i10.1032

Egbue, O., & Long, S. (2015). Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions. *Energy Policy*, *48*(2012), 717–729. https://doi.org/10.1016/j.enpol.2012.06.009

Ehebrecht, D., Heinrichs, D., & Lenz, B. (2018). Motorcycle-taxis in sub-Saharan Africa: Current knowledge, implications for the debate on "informal" transport and research needs. *Journal of Transport Geography*, *69*(), 242–256. https://doi.org/10.1016/j.jtrangeo.2018.05.006

Goodfellow, T. (2014). Taming the 'Rogue' sector: Studying state effectiveness in Africa through informal transport Politics. *Comparative Politics*, *47*(2), 127–147. https://doi.org/10.5129/001041515814224462

Hagen, J. X., Pardo, C. F., & Valente, J. B. (2016). Motivations for motorcycle use for urban travel in Latin America: A qualitative study. *Transport Policy*, *49*, 93–104. https://doi.org/10.1016/j.tranpol.2016.04.010

Inuwa, N., Jikan-Jatum, A. M., & Bello, H. Y. (2017). Motorcycles health and traffic safety: Evidence from. *Journal of Arts and Humanities*, *6*(5), 33–41. https://doi.org/10.18533/journal.v6i5.1101

Ismail, O. (2016). What is in a job? The social context of youth employment issues in Africa. *Journal of African Economies*, *25*(suppl 1), i37–i60. March 2016. https://doi.org/10.1093/jae/ejv028

Johnson, O. (2012). Prevalence and pattern of road traffic accidents among commercial motorcyclists in a city in Southern Nigeria. *Educational Research*, *3*(June), 537–542.

Kamaluddin, N. A., Andersen, C. S., Larsen, M. K., Meltofte, K. R., & Várhelyi, A. (2018). Self-reporting traffic crashes – a systematic literature review. *European Transport Research Review*, *10*(2). [Online]. Available. https://doi.org/10.1186/s12544-018-0301-0

Kemajou, A., Jaligot, R., Bosch, M., & Chenal, J. (2019). Assessing motorcycle taxi activity in Cameroon using GPS devices. *Journal of Transport Geography*, *79*(December), 102472. https://doi.org/10.1016/j.jtrangeo.2019.102472

Kisaalita, W., & Sentongo-Kibalama, J. (2007). Delivery of urban transport in developing countries: The case for the motorcycle taxi service (boda-boda) operators of Kampala. *Development Southern Africa*, *24*(2), 345–357. https://doi.org/10.1080/03768350701327319

Konlan, K. D., Doat, A. R., Mohammed, I., Amoah, R. M., Saah, J. A., Konlan, K. D., & Abdulai, J. A. (2020). Prevalence and pattern of road traffic accidents among commercial motorcyclists in the Central Tongu District, Ghana. *Scientific World Journal*, *2020*, 1–10. https://doi.org/10.1155/2020/9493718

Kumar, A. (2011). Understanding the emerging role of motorcycles in African cities a political economy perspective. *Sub-Saharan African Transport Policy Discuss Paper No. 13*.

Matheka, D. M., Faraj, A. O., Kipsaina, C., & Witte, J. (2015). Road traffic injuries in Kenya: A survey of commercial motorcycle drivers. *The Pan African Medical Journal*, *21*, 1–9. https://doi.org/10.11604/pamj.2015.21.17.5646

Muni, K., Kobusingye, O., Mock, C., Hughes, J. P., Hurvitz, P. M., & Guthrie, B. (2019). Motorcycle taxi programme is associated with reduced risk of road traffic crash among motorcycle taxi drivers in Kampala, Uganda. *International Journal of Injury Control and Safety Promotion*, *26*(3), 294–301. https://doi.org/10.1080/17457300.2019.1594952

National Road Safety Authority. (2020). *Road traffic crashes in Ghana: Statistics 2018. Final report*. Accra: National Road Safety Authority.

Nyagwui, A. E., Fredinah, N., Che, L. B., & Yulia, B. (2016). Motorcycle injury among secondary school students in the Tiko municipality, Cameroon. *The Pan African Medical Journal*, *24*, 1–8. https://doi.org/10.11604/pamj.2016.24.116.5069

Odiwuor, C.W., Nyamusi, E., & Odero, W. (2015). Incidence of road traffic crashes and pattern of injuries among commercial motorcyclists in Naivasha town. *International Journal of Applied Research*, *1*(11), 541–549.

Oteng-Ababio, M., & Agyemang, E. (2012). Virtue out of necessity? Urbanisation, urban growth and Okada services in Accra, Ghana. *Journal of Geography & Geology*, *4*(1). https://doi.org/10.5539/jgg.v4n1p148

Oteng-Ababio, M., & Agyemang, E. (2015). The Okada war in urban Ghana: A polemic issue or policy mismatch? *African Studies Quarterly*, *15*(4), 25–44.

Peters, K., Jenkins, J., Ntramah, S., Vincent, J., Hayombe, P., Owino, F., Opiyo, P., Johnson, T., Santos, R., Mugisha, M., & Chetto, R. (2022). COVID-19 and the motorcycle taxi sector in Sub-Saharan African cities: A key stakeholders' perspective. *Transportation Research Record*, *2677*(4), 751–764.

Raynor, B. (2014). *Informal Transportation in Uganda: A case study of the Boda Boda. Independent Study Project (ISP) Collection, 1923*.

Sietchiping, R., Permezel, M. J., & Ngomsi, C. (2012). Transport and mobility in sub-Saharan African cities: An overview of practices, lessons and options for improvements. *Cities*, *29*(3), 183–189. https://doi.org/10.1016/j.cities.2011.11.005

Tuffour, Y. A., & Appiagyei, D. K. N. (2014). Motorcycle taxis in public Transportation services within the Accra Metropolis. *American Journal of Civil Engineering*, *2*(4), 117. https://doi.org/10.11648/j.ajce.20140204.12

Vissoci, J. R. N., Krebs, E., Meier, B., Vieira, I. F., de Andrade, L., Byiringiro, F., Rulisa, S., & Staton, C. A. (2020). Road traffic crash experience among commercial motorcyclists in Kigali, Rwanda. International *Journal of Injury Control and Safety Promotion*, *1–7*. https://doi.org/10.1080/17457300.2020.1724158

World Health Organisation. (2017). *Powered two- and three-wheeler safety: A road safety manual for decision-makers and practitioners*. Geneva: World Health Organisation.

World Health Organisation. (2018). *Global status report on road safety*. Geneva: World Health Organisation.