Analysis of non-motorised travel conditions on the Jogoo Road corridor in Nairobi

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SUMMARY

This paper details the prevailing conditions under which pedestrians and bicyclists operate with regard to safety, security, comfort, and convenience with a view to evaluating NMT corridor experience in a holistic manner. In trying to establish NMT Level of Service on the Jogoo Road corridor, the study employed manual count techniques, and attitudinal surveys at pre-selected sites along Jogoo Road so as to capture typical NMT operating environment especially at peak hours. The roadway capacity is today extremely constrained and *matatus* (paratransit) invade sidewalks with impunity, thus compromising the safety of pedestrians and cyclists. Over-speeding motorists during off peak hours have also made the roadway difficult to cross by pedestrians. The use of sidewalks by motorized traffic when the roadway is congested has further exposed pedestrians and cyclists to accidents. NMT operating conditions on Jogoo Road corridor, as reported in this paper, are not very conducive in terms of safety, convenience and security of road users. Many of the problems documented herein could be attributed to inadequate design and supply of the necessary infrastructure. The tested alternative methods of evaluating the performance of NMT infrastructure have proven plausible and give indicative performance consistent with attitudinal survey results on some aspects. They are, therefore, appropriate least-cost methods for transport planning practice in low-income cities.

Keywords: *NMT operating conditions, safety, convenience, roadway environment*.

1. INTRODUCTION

The travel conditions for non-drivers along the Jogoo Road corridor in Nairobi are severely degraded arising from inequitable provision of quality transport for all categories of road users. The Nairobi City Council has over the years had a skewed focus on transport infrastructure investments that has tended to promote the needs of motorized means of movement, consequently trivializing the importance of non-motorized means (pedestrians and bicyclists).

Figure 1: The Jogoo Road corridor study area

The Jogoo Road corridor was selected as the pilot study area due to the fact it is one of the major arterials linking Nairobi's Central Business District (CBD) to the populous low-income Eastlands area of Nairobi, which stretches as far as the Outer Ring road. These two road links connect several middle-class to low-class residential estates of Buruburu, Umoja, Donholm, and Embakassi, extending up to Jomo Kenyatta International Airport. There also exist pockets of informal settlements lying along the periphery of these middle class estates. The low class housing areas are the main generators of walking trips (pedestrians) as most of the slum dwellers generally earn their living from the informal sector (*jua kali* industry[1]) found predominantly in this part of the city. The kinds of trip patterns are normally diffused—dispersed both in space and time as observed by Nash (1997)

[1] *Jua-kali* is a Swahili phrase for small-scale, home-grown manufacturing sector. The artisans have largely acquired their skills through apprenticeship outside the formal education system.

The pilot road is 5.56 km long from tachometer measurement. There are two roundabouts along the road. Two other roundabouts are located at the ends of the Jogoo Road link. The road is basically straight and had high pedestrian activity, which made it an ideal site for this study and a good representation of what NMT travel in Nairobi really looks like. Figure 1 is a Google Earth image of the study area. Jogoo Road is marked in yellow. The location of the Nairobi CBD is ahead of the survey station 7 in the diagram.

2. METHODOLOGY

The study employed manual count techniques, pedestrian crossing observation, and attitudinal surveys at pre-selected sites along Jogoo Road, to capture as typical as possible NMT operating environment especially at peak hours when the roadway capacity is constrained and competition for road space is heightened. In this study, a procedure involving the timing of arbitrary crossing pedestrians at preselected sites, and recording road crossing characteristics, was undertaken. Average walking speeds were then derived from these crossing time data, and compared with standard literature values (HCM, 2000).

This comparison provides a useful guide for assessing the severance imposed by a road facility in terms of pedestrian safety and convenience for crossing. Two survey assistants manned each crossing location; one recording while the other selected a pedestrian randomly and timed the waiting and crossing movement. A pedestrian was selected arbitrarily after a one-minute time lapse of a complete timed cross.

An attitudinal survey was conducted by administering questionnaires to a sample of 200 randomly selected bicyclists at activity centres (shopping places and bicycle repair areas) and passenger pick-up points along the corridor. The survey points are marked on the study area in Figure 1.

3. RESULTS AND DISCUSSION

3.1 Pedestrian crossing observation

From the tabulated crossing times in Table 1, there is evidence to the fact that it takes relatively long (up to 16 seconds) for pedestrians to find adequate gaps in the traffic stream so as to cross the Jogoo Road. At busy sections like the Hamza crossing point, the crossing manoeuvres take longer to be completed as pedestrians get trapped and sandwiched between the two traffic streams as a result of overcrowding on the roadway by vehicles or speeding motorists. Pedestrians actually wait right on the reserve for up to 16 seconds on average, before adequate gaps are available for crossing. This normally has the effect of inducing anxiety in pedestrians to the extent that they now want to literally run across the roadways, occasionally leading to fatal accidents.

Further, considering a walking speed of about 1.1m/s[2] for pedestrians in the city of Nairobi, the minimum time they need to comfortably (safely) cross a 7m carriageway would be 7.7 seconds for a two-lane roadway like the Jogoo Road (De Langen and Tembele, 2001).

[2] The 1.1m/s walking speed is the average literature value quoted for an ordinary pedestrian taking into cognizance sickness, pregnancy and many other factors like old age (Highway Capacity Manual, 2000). The same figure is quoted in *Productive and Liveable Cities – Guidelines for Pedestrian and Bicycle Traffic in African Cities* by M. De Langen and R. Tembele (2001), page 52.

The results here indicate that, on average, pedestrians take 5.5 seconds to cross the entire roadway, which implies that they literally run across the road most of the times due to inadequate gaps for crossing, arising mainly from over-speeding motorized traffic.

Table 1: Mean roadway crossing time

Pedestrian crossing point		N	Min (sec)	Max (sec)	Mean	Stdev
Muthurwa	Time taken to cross first half of the road	210	1	8	4.9	1.215
	Waiting time at the median	210	1	15	3.9	1.566
	Time taken to cross second half of the roadway	210	1	15	4.4	2.152
Mbotela Stage	Time taken to cross first half of the road	200	1	10	5.1	1.681
	Waiting time at the median	200	1	38	15.3	9.946
	Time taken to cross second half of the roadway	200	0	11	5.6	1.669
Makadara Footbridge	Time taken to cross first half of the road	200	1	19	4.6	2.289
	Waiting time at the median	200	1	39	13.7	8.730
	Time taken to cross second half of the roadway	200	2	19	5.1	2.334
Hamza Stage	Time taken to cross first half of the road	210	1	20	6.1	2.621
	Waiting time at the median	210	2	99	16.2	13.038
	Time taken to cross second half of the roadway	210	3	66	8.4	6.713

Research into road crossing speeds has indicated an average value in the range 1.2m/s to 1.35m/s at busy crossings with a mix of pedestrian age groups. However, if crossings are less busy, then the average walking speeds approximating to the free-flow walking speeds on pedestrian courses of 1.6m/s can be expected. However for disabled people a more appropriate value is 0.5m/s if the needs of most disabled people are to be satisfied (Leake, 1997).

In Figure 2, the majority of pedestrians cross the roadway individually, due to the fact that there are no designated crossing points *per se* on this road, and again, there is a uniform spread of human activities along its entire length. The difficulties experienced by pedestrians crossing this road are further depicted by crossing patterns in Table 3. Most pedestrians never cross at the zebra crossing points as vehicles hardly stop to allow them to cross. Compliance by motorists at the zebra crossing points is disappointing. The use of such measures to aid crossing of pedestrians needs re-evaluation so that more effective measures can be selected in such cases. The police will never have adequate resources or inclination to satisfactorily enforce their usage, as observed by Slinn *et al* (2005). Planners and engineers would thus have to devise more appropriate and sustainable location-specific infrastructure measures that require less enforcement.

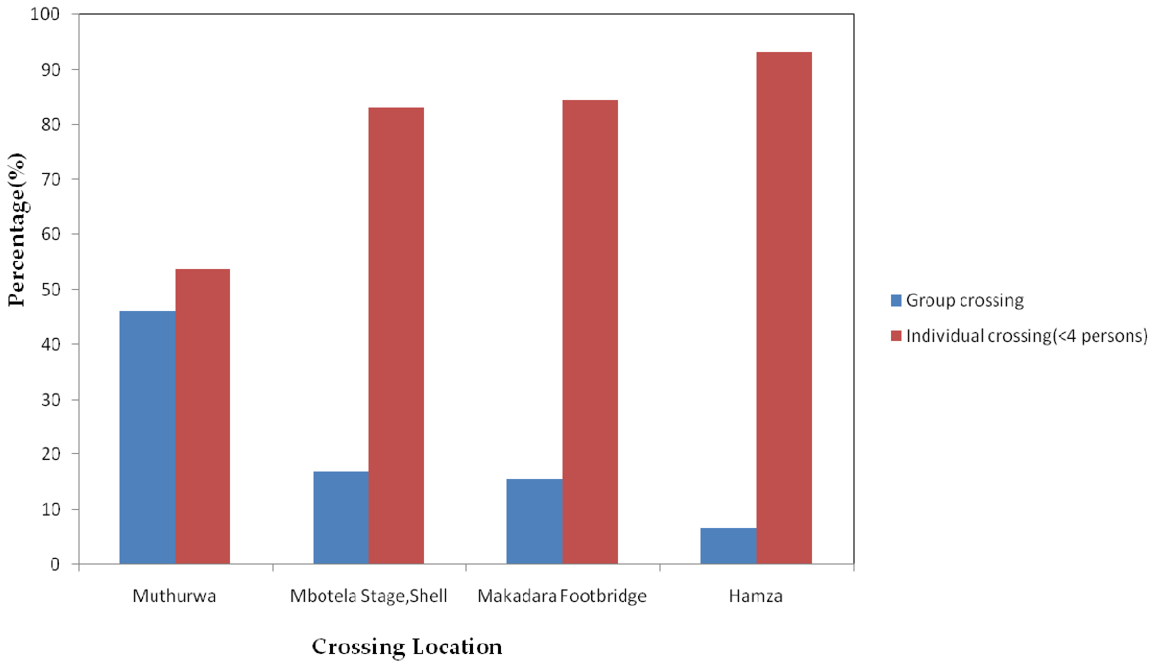


Figure 2: Crossing behaviour of pedestrians on Jogoo Road

The crossing behaviour of pedestrians as captured in Table 2 provide indications of accident risk: at both the Mbotela and Makadara crossing points, disproportionate numbers of pedestrians cross the roadway in a diagonal manner, which is indicative of inadequate gaps for crossing at these points. At such locations, the authorities should be considering interventions aimed at calming traffic speeds. The usefulness of such surveys is demonstrated in cases like this, and need to be mainstreamed in transport planning practice in such cities as viable tools of evaluating safety aspects of infrastructure with regard to NMT. These survey methods are less costly and do not need highly specialised skills to undertake, and would therefore fit the ever-shrinking infrastructure development budgets in low-income cities.

Table 2: Pedestrian crossing trajectory on Jogoo Road

Pedestrian crossing point	Line of Crossing	Frequency	Percent
Muthurwa	At right angle	138	65.7
	Crosses diagonally	72	34.3
Mbotela Stage, Shell	At right angle	94	47.0
	Crosses diagonally	106	53.0
Makadara Footbridge	At right angle	121	60.5
	Crosses diagonally	79	39.5
Hamza	At right angle	101	48.1
	Crosses diagonally	109	51.9

Table 3: Pedestrian crossing spot

Crossing Location	Point of crossing	Frequency	Percent
Muthurwa	Besides (within 20m)	149	71.0%
	Besides(20-100m from crossing point)	61	29.0%
Mbotela Stage, Shell	Crossing point(RZC/painted)	95	47.5%
	Besides (within 20m)	70	35.0%
	Besides(20-100m from crossing point)	35	17.5%
Makadara Footbridge	Crossing point(RZC/painted)	54	27.0%
	Besides (within 20m)	105	52.5%
	Besides(20-100m from crossing point)	41	20.5%
Hamza	Besides(20-100m from crossing point)	210	100.0%

Ordinarily, crossing of roadways would signal higher perception of accident risk and pedestrians would thus find safety in numbers by bunching together to cross the roadway. This is thought to impose a psychological challenge to speeding motorists to slow down. This effect would normally come out is cases where the road has designated crossing points like painted zebra crossings that are increasingly being disregarded by aggressive motorists in Nairobi. Moreover, this grouping by pedestrians to enable them to challenge the speeding motorists seems to work within some traffic stream speeds—for roads with average speeds in excess of 80kph, the pedestrians would be severely intimidated as the risks are higher and generally would not attempt to do so. This is what seems to play out at the Mbotela, Makadara, and Hamza crossing points in this study. The Muthurwa crossing point is closer to the CBD and the prevailing average speeds are closer to 50kph or much lower, in which case, motorists would be able to break safely if challenged by large numbers of crossing pedestrians.

Pedestrian crossing observations can be mainstreamed in traffic engineering practices at the municipal councils as a means for identifying hazardous locations requiring safety improvement interventions. This study documents these alternative initiatives as a way of sharing the knowledge with practitioners from other cities and academia. Some of the data gathering methods in practice have predominantly been developed in the highly industrialized cities with completely different traffic stream characteristics. The application of some of these procedures in low-income cities with heterogeneous traffic composition would in most cases lead to an incorrect diagnosis of traffic problems.

The old/disabled were in general stressed and nervous while crossing the road, and children were predominantly either running or nervous as they crossed the roadway. It is the more able adults who were observed to be relaxed as they walked across this road, albeit with some signs of traffic induced stress showing on their faces. A significant proportion of them run across this road.

Table 4: Age and pedestrian crossing behaviour

Pedestrian crossing point	Age	Crossing behaviour observed as one crosses the roadway			Total
		Relaxed	*Stressed, nervous*	*Running across*	
Muthurwa	Child	4	11	16	31
	Adult	46	24	43	113
	Old age/ disabled	25	37	4	66
	Total	*75*	*72*	*63*	*210*
Mbotela Stage, Shell	Child	2	8	5	15
	Adult	77	48	40	165
	Old age/ disabled	7	10	3	20
	Total	*86*	*66*	*48*	*200*
Makadara Footbridge	Child	4	9	3	16
	Adult	116	27	34	177
	Old age/ disabled	2	5	0	7
	Total	*122*	*41*	*37*	*200*
Hamza	Child	2	4	19	25
	Adult	67	60	46	173
	Old age/ disabled	0	11	1	12
	Total	*69*	*75*	*66*	*210*

From the data analysis in Table 5, there is no distinct gender-related road crossing behaviour at all the crossing points sampled in the study. Weighted percentages of relaxed males compared with relaxed females are equal–40% of males against 41% of females were observed to be relaxed while crossing the roadway. Of interest in this study is the fact that males, unlike females, on average tend to run more across the roadway when circumstances dictate, which is largely attributed to the superior physical agility of males over females across all ages.

It can then be safely deduced from the patterns in both Tables 4 and 5 that the prevailing motor vehicle speeds on Jogoo Road are perceived by slow NMT road users to be sufficiently high to impose severance effects on them. The other negative effect of this severity is the reduced accessibility to the city's industrial area and other informal sector activity centres which are located majorly along the Jogoo Road corridor. The disproportionate percentage of pedestrians who are either stressed or running across the roadway at any one time is a strong indicator of poor levels of traffic safety along the corridor. Difficulty in accessing economic activity points along this road, coupled with high traffic accident risk, will over the years constrain citywide equal growth in the City of Nairobi as a result of a gradually deteriorating mobility situation as observed by Jönson and Tengström (2005).

Table 5: Gender and pedestrian crossing behaviour

Pedestrian crossing point	Gender	Crossing behaviour observed as one crosses the roadway			Total
		Relaxed	*Stressed, nervous*	*Running across*	
Muthurwa	Male	34 (32%)	31(30%)	40(38%)	105(100%)
	Female	41(39%)	41(39%)	23(22%)	105(100%)
	Total	75	72	63	210
Mbotela Stage, Shell	Male	50(48%)	29(28%)	25(24%)	104(100%)
	Female	36(38%)	37(39%)	23(24%)	96(100%)
	Total	86	66	48	200
Makadara Footbridge	Male	76(67%)	14(12%)	24(21%)	114(100%)
	Female	46(53%)	27(31%)	13(15%)	86(100%)
	Total	122	41	37	200
Hamza	Male	36(32%)	32(28%)	45(40%)	113(100%)
	Female	33(34%)	43(44%)	21(22%)	97(100%)
	Total	69	75	66	210

Pedestrian Level of Service (LoS) evaluation

Level of Service is a quality measure describing operational conditions within a traffic stream. The LoS concept expresses some ‘degree of freedom of choice’ accorded to the road user by a system or a facility (e.g. road, walkway, seating space, etc.). Six LoS levels are normally defined and assigned letters A to F, with letter A representing the best operating conditions based on the facility user’s perception of the prevailing service environment.

The Highway Capacity Manual, 2000 was used to evaluate the pedestrian LoS along the segments of Jogoo Road. The criteria for LoS evaluation are presented in Table 6.

Table 6: Walkway Level of Service

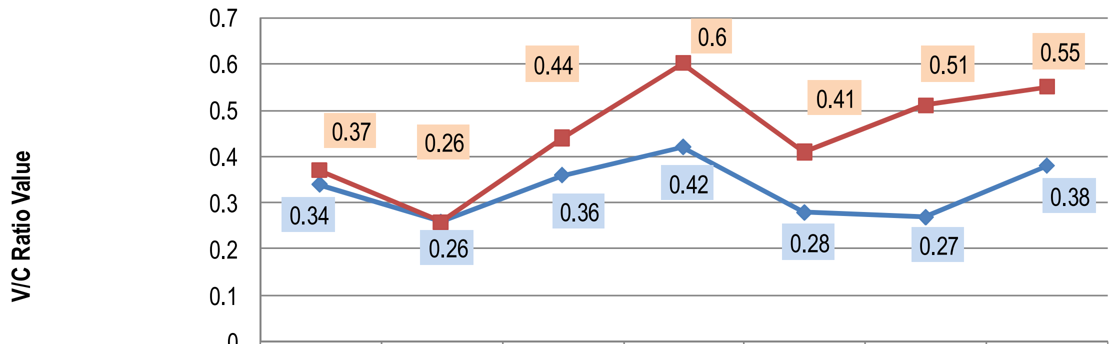
Level of Service	Pedestrian Space (m^2/pedestrian)	Flow rate (ped./min./m.)	Speed (m/s)	v/c ratio
A	>5.6	≤16	>1.3	≤0.21
B	>3.7 – 5.6	>16 – 23	>1.27 – 1.3	>0.21 – 0.31
C	>2.2 – 3.7	> 23 – 33	>1.22 –1.27	>0.31 – 0.44
D	>1.4 – 2.2	>33 – 49	>1.14 –1.22	>0.44 – 0.65
E	>0.75 – 1.4	>49 – 75	>0.75 – 1.14	>0.65 – 1.0
F	≤0.75	Variable	≤0.75	Variable

Source: HCM 2000

It is important to note that average flow rates can be misleading because of the minute-by-minute variations in pedestrians flows, caused by random arrivals. Studies have shown that pedestrians move in platoons and the LOS is generally one level poorer than that determined by average flow criteria.

Volume to Capacity ratio

Volume to Capacity ratio (V/C) is a facility performance measure and relates the resident traffic volume to the available/provided capacity. The operating conditions get worse when the ratio nears 1, as the operating volume approaches the provided capacity and there is no more room for traffic to operate and the system nears stagnation. This concept has been used as the criteria for designating the Level of Service. Figure 3 shows the calculated volume to capacity ratio for the segments.



	Don Holm - Tom Mboya Section	Tom Mboya - Hamza Section	Hamza - Makadara Section	Makadara - Mbotela Section	Mbotela - Church Army Section	Church Army - Rikana Section	Rikana - Muthurwa Section
Volume to Capacity Ratio-Peak Town Bound	0.34	0.26	0.36	0.42	0.28	0.27	0.38
Volume to Capacity Ratio-Peak Don Holm Bound	0.37	0.26	0.44	0.6	0.41	0.51	0.55

Figure 3: Volume/capacity ratio for walkways on Jogoo Road

It is instructive to note that v/c ratios for pedestrians tend to indicate saturations of flow at much lower values than for motorised traffic due to unguided flow on the walkways and counter flows of pedestrian traffic which imposes additional traffic friction. The evaluation of level of service for pedestrians is therefore not as straightforward as it is for motorised traffic, given that walking environment quality is a function of a myriad of factors, a number of them not yet fully known by researchers (ITE, 2004). In this paper, the LoS was based on average density, which is a measure of the number of pedestrians per unit area on the walkway.

Evaluated Level of Service

The corresponding Level of Service based of density criterion obtained from HCM 2000 is presented in Table 7.

Table 7: LoS for the segment links along Jogoo Road

Section	Pedestrian flow p/m/ft		Volume to Capacity Ratio-Peak		Level of Service	
	Town Bound	Don Holm Bound	Town Bound	Don Holm Bound	Town Bound	Don Holm Bound
Don Holm - Tom Mboya Section	8	9	0.34	0.37	C	C
Tom Mboya - Hamza Section	6	6	0.26	0.26	B	B
Hamza - Makadara Section	8	10	0.36	0.44	C	C
Makadara - Mbotela Section	10	14	0.42	0.6	C	D
Mbotela - Church Army Section	6	10	0.28	0.41	B	C
Church Army - Rikana Section	6	12	0.27	0.51	B	D
Rikana - Muthurwa Section	9	13	0.38	0.55	C	D

From Table 7, the following conclusions can be drawn:

- Tom Mboya Hall – Hamza section operated at the highest LoS. This section has restricted access to settlements which means that most pedestrians take longer detours to their homes or activity centres away from the road. The few pedestrians captured here are those crossing over the Outer Ring road to lower settlements of Umoja and Donholm that have alternative routes to the industrial area, the major traffic attractor in this area.
- Makadara – Mbotela, Church Army - Rikana and Rikana - Muthurwa Sections operated at a low LoS D. These sections experience the highest peak pedestrian flows due to the nearby Burma Market and other light industries that attract large numbers of low-income informal workers that accomplish most of their daily trips by walking.
- Donholm - Tom Mboya Hall and Mbotela - Church Army sections operated at an intermediate LoS C, partly attributable to relatively less development density here compared to other sections with poor levels of service.

If all other environmental factors influencing the quality of service perceived by pedestrians, such as the surface condition of the walkway, protection from motorized traffic afforded by the infrastructure design, accessibility of the walkway by all cadres of pedestrians (children, disabled, and old people), were taken into consideration, the resulting level of service would have been lower than what has been reported here. There exists a research gap currently that needs to be bridged by developing a framework that can provide more robust indices depicting an entire corridor's pedestrian experience.

3.2 Social characteristics of cyclists plying Jogoo Road corridor

This sub section reports on the cyclists social characteristics, with a unique gender aspect. The study found no women cyclists and the reporting is limited to male cyclists who ride along Jogoo Road corridor. The majority (85%) of them are below 40 years, falling between 26-39 years (48.5%) and between 18-25 years (36%). The latter is a prime age composed of largely school leavers and young men looking for economic opportunities, which is limited, in particular within the formal sector. A few (15%) of the sample were above 40 years. The study did not capture women cyclists as they were hard to come by in the field during data collection. The reason for under representation of women could not be established under this study as data collection was concentrated mainly within the corridor and not at the household level.

The cyclists were asked why they choose to cycle and not use '*matatu*' or 'walk', and the majority (60%) indicated that *matatus* were expensive (60%), while bicycles were quicker (22%). Other explanations included: no *matatus* for the destination (6.5%); waiting for *matatu* takes longer (3%); walk to *matatu* stage takes longer (2.5%), while 4 percent had no particular reason. The same question was applied to walking, and a majority (55.5%) responded that walking takes too much time (55.5%) and is also tiring (23.6%). Other reasons were mainly safety and infrastructure related, and included: feeling unsafe when walking and fear of attack (6.5%); fear of traffic accidents (3.4%); no particular footpath along the roads (3%); while others (1.5%) indicated they were in a hurry otherwise they would walked.

Matatu fare levels are largely perceived by travellers to be expensive. Those that reported having used a *matatu* state that they were in a hurry–if it were not so, they would have opted to walk. It implies that *matatus* are preferred mainly for non-discretional trips (Figure 4). This underscores the critical role cycling stands to play if supportive conditions for cycling are availed. It is estimated that the poor constitute 60% of the urban population in Nairobi today (UN-Habitat, 2008), the majority of them reside in the slums. There is a general feeling of immobility and difficulty in accessing activity locations by non-drivers, as public transport services in Nairobi remain unaffordable.

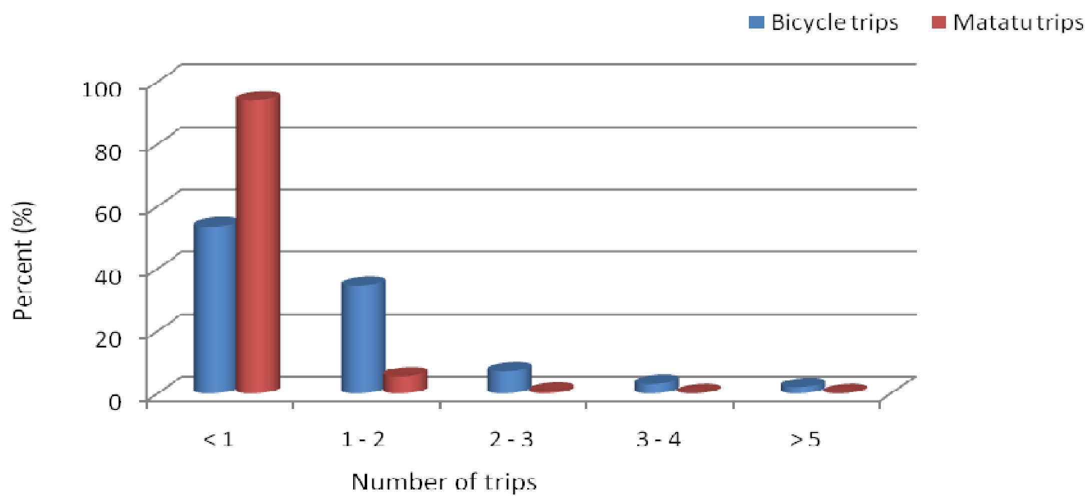


Figure 4: Distribution of daily trips within the Jogoo Road corridor

The study probed the number of trips made by cyclists the previous day by bicycle and *matatu*. The findings reveal that the choice of a mode depends on the number of daily trips, to some extent—for those that move a lot, a bicycle would be the preferred mode and for those that have less daily trips, *matatus* comes handy. It can be inferred then that those that use *matatus* make non-discretionary trips like work related trips in the formal sectors, whereas those who use bicycles earn their living mainly from the informal sector, characterised by a wider spatial dispersal of activities within the larger Eastlands area, with less restrictive work reporting times.

In spite of many cyclists using *matatus* and bicycles, the majority of respondents were not enthusiastic about these modes. The majority rated bicycle ride comfort as fair (53.5%), while 50.5 percent rated *matatu* comfort as good. The rating of `very good' was 18.5 per cent and 38.5 per cent for bicycles and *matatus* respectively. The rest scored bicycle comfort as poor (17.5%), good (7%) and very poor (3.5%); and *matatus* as fair (5%), poor (5%) and very poor (0.5%).

A question assessing the speed of both modes shows that bicycles are viewed as faster than *matatus*. This is due in part to the fact that bicyclists normally require less space to ride compared with motorized means, and the fact that they could use even footpaths in between the settlements serves to improve accessibility as experienced by bicyclists. Improvement of accessibility in such areas would thus go a long way in significantly improving economic productivity of citizens in terms of their participation in nation building. Litman (2009) indeed underscores the potential for realizing sustainable and equitable economic growth by promoting infrastructure investments that enhance the transport diversity of the majority. Litman asserts that investment policies favouring NMT stand to yield longer term economic stimulants than those that focus on expanding highways especially in the urban areas.

Waiting time for bicycles was reported by users to be shorter than that for *matatus*. For bicycles, 70% of the respondents' rated waiting time as an attribute as very good while only 2.5% of interviewed *matatu* users rated their perception of waiting as very good. This difference is embedded in the lack of travel schedule for *matatus* despite an oversupply of this mode on the streets of Nairobi. The *matatu* ride is often characterized by long waiting time for vehicles to fill up before a journey starts, in keeping with their demand-responsive nature of operations. On the other hand, bicycles riders have the flexibility on when to make their trips, and on which route to follow, and do not have unnecessary stops trying to get passengers as is the case with the *matatu* mode.

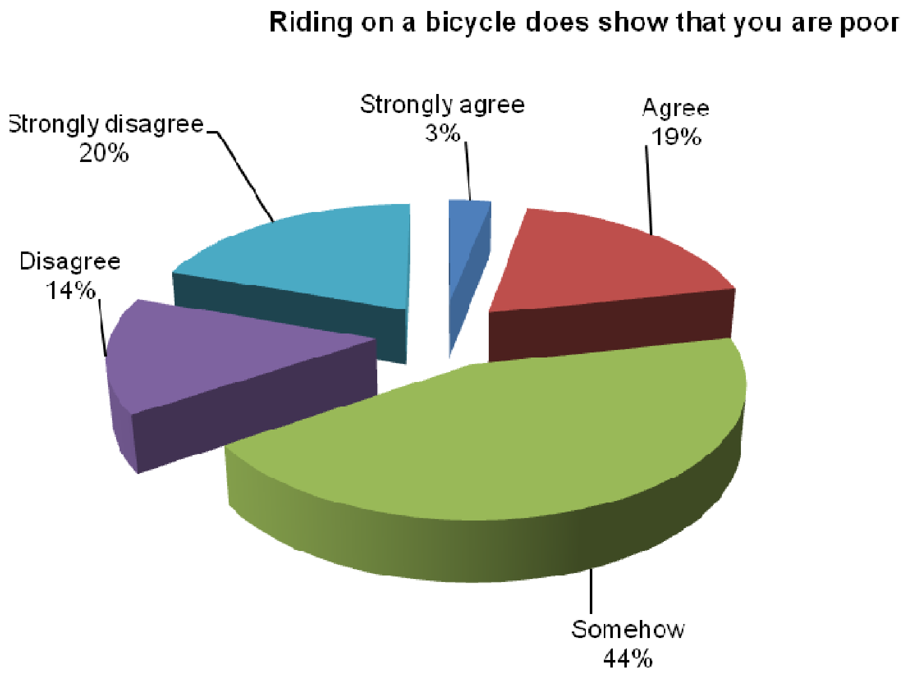


Figure 5: Linking travelling by bicycle to poverty

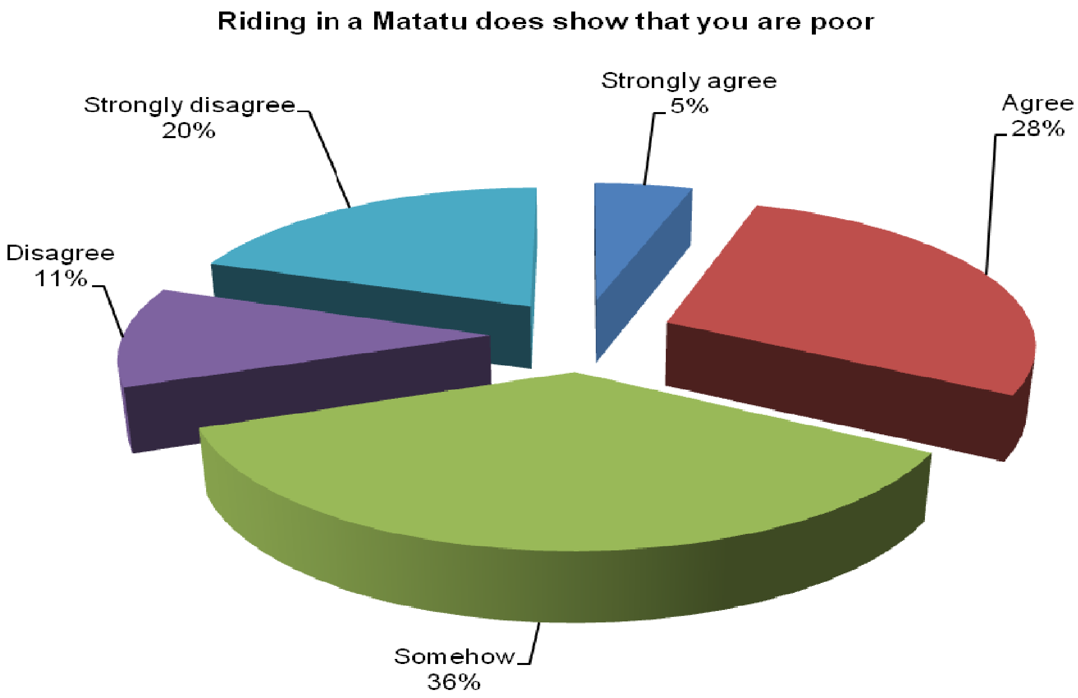


Figure 6: Linking travelling by *matatu* to poverty

Most of the cyclists interviewed had not spent many years cycling on Jogoo Road. The majority (38%) had spent 4 years: the increasing cost of public transport is slowly turning most travellers to cycling, particularly given the rising inflation that has served to erode the purchasing power of most households. Bicycling has assumed importance lately as a means of travel in the City of Nairobi replicating trends in other major Kenyan cities like Kisumu. This is a demonstration of the falling financial accessibility of public transport in Nairobi; this gap is then bridged by the relatively cheap bicycle mode. The City authorities then need to respond in a timely manner by addressing the transport situation by providing an enabling environment for cyclists and pedestrians by way of increased NMT infrastructure investments.

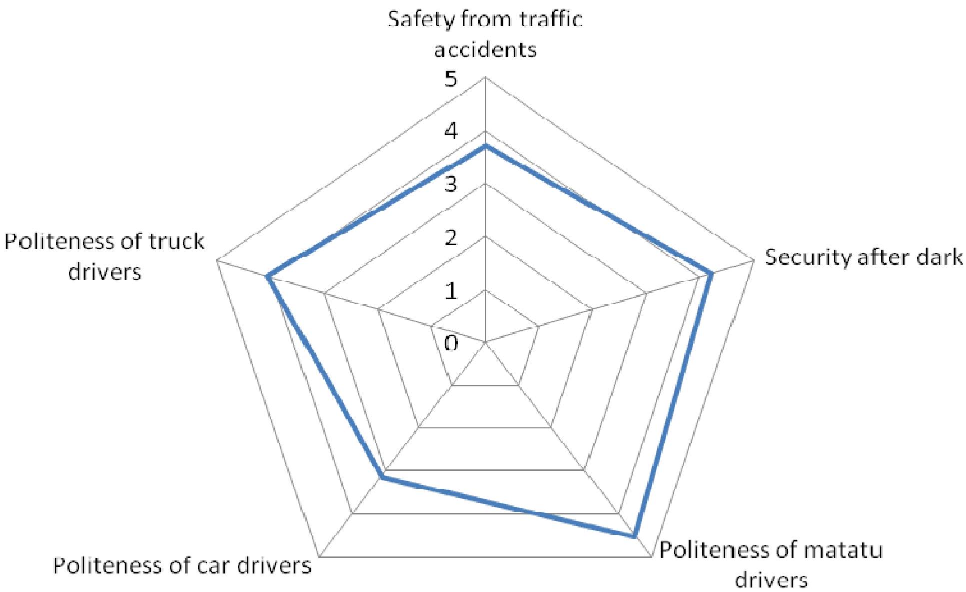
The pattern reflected in the Figures 5 and 6, where a significant number of respondents feel that using these modes is indicative of poverty, is partly arising from the severely degraded travel conditions in Nairobi (Sclar *et al*, 2007), which is a product of unregulated paratransit transport operations. Most middle to upper class residents have lately acquired cheap second-hand private cars for convenience, thereby creating the perception that those who use these two modes of transport must be captive in the sense that they cannot afford alternative personalized transport for themselves—private cars in Nairobi have lately become a necessity for those that can afford, thus the association of bicycling or use of *matatus* with poverty.

Unlike most parts of the World where governments have subsidized transport and effectively regulated operations, public transport in Nairobi remains unregulated with fragmented ownership. This has resulted in a poor transport service, as the majority of the population are poor and would therefore not raise enough fares to adequately service investments in better vehicles and a high quality service to the citizens. Transport operators are forced by market forces to accept low fares as that is what majority travellers can afford to pay; in essence, poverty has distorted the true cost of transport in Nairobi to the detriment of the overall service quality and sustainability of the transport enterprise.

It is unfortunate that travelling in bicycles and *matatu* modes is associated with poverty. The negative attitude on NMT is not only limited to ordinary citizens, but also public officials who ignore these modes during planning and development of infrastructure.

The survey probed cyclists' knowledge of heavy injury, light injury, and heavy damage accident causes. In all these categories of injury, collision with pedestrians topped the list. In heavy injury it scored 12%t, light injury 11%t, and heavy damage 8.5%. Falling due to a mechanical defect of the bicycle was ranked second in all, except in heavy damage accidents, where falling due to poor riding surface was the second factor causing accidents. Other reasons included: collision with car or pick up; collision with other bike, and with *matatu* or taxi. The predominance of collision with pedestrians often occurs due to the shared use of infrastructure within the corridor.

The operating NMT conditions are generally poor on the corridor, and the pilot survey reveals a poor record of safety from traffic accidents, security after dark, and the friction between cyclists and *matatu* drivers as reflected by the radar plot in Figure 7. The majority of cyclists do not feel safe on the Jogoo Road corridor. When asked whether cycling was safe on the corridor, 38 % indicated it was fair. This was followed by poor (27%), very poor (26.5%), good (7%), and very good (0.5%).



Ranking scale: 1 = very good, 5 = very poor

Figure 7: Operating conditions as experienced by cyclists on the Jogoo Road corridor

The survey further probed whether two sections of the corridor, namely: between Likoni Road and Donholm Railway underpass and between the City Stadium roundabout and Likoni Road had sufficient space for cyclists to operate safely. The majority of the cyclists disagreed and strongly disagreed noting, that the two sections did not have enough space for cyclists to operate as shown in Figures 8 and 9. This is a general pointer to the fact that current transport infrastructure investment practices tend to favour motorized means at the expense of NMT modes that actually serve the majority in the city of Nairobi.

Most of the cyclists noted that there was strong competition (49.5%) and very strong competition (36.5%) with *matatus* over riding space. A further question asking whether the cycling track is spacious, in good condition and safe from invasion by *matatus* and other motorized vehicles had a majority (40%) disagreeing and 48% strongly disagreeing, with no respondents agreeing (see figure 10).

The above notwithstanding, the cyclists strongly agreed that the corridor offers fast travelling for cyclists (37%) and for *matatus* (27.5%). There were very few cyclists who disagreed. Most cyclists at present experience high levels of traffic induced stress. The survey indicated that about 62% of cyclists sometimes are stressed while 18.5% reported having never experienced stress while riding on this road; 17.5% reported that they were always stressed (17.5%). A total of 2 percent did not respond to the question.

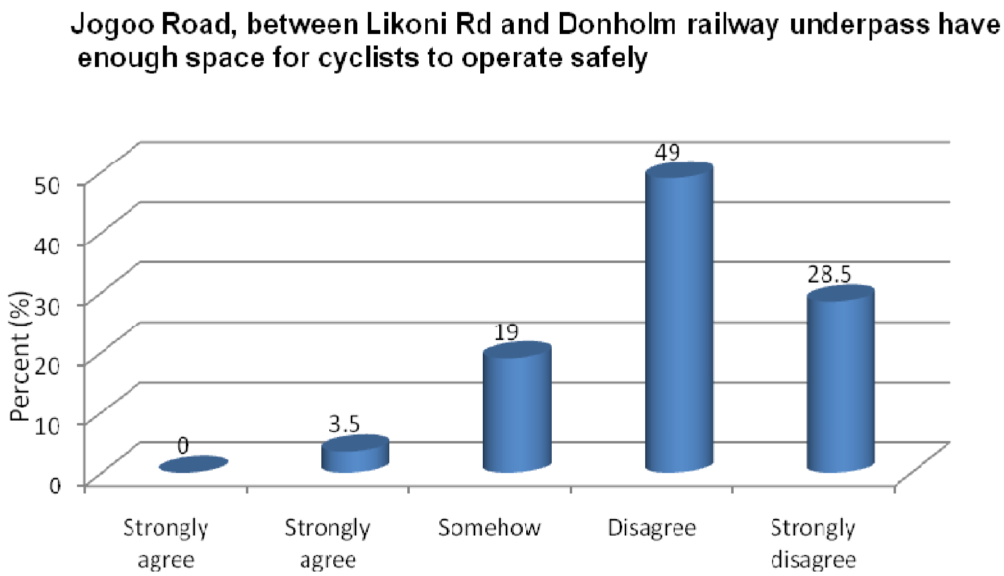


Figure 8: Availability of adequate cycling space on Likoni Rd and Donholm Underpass section

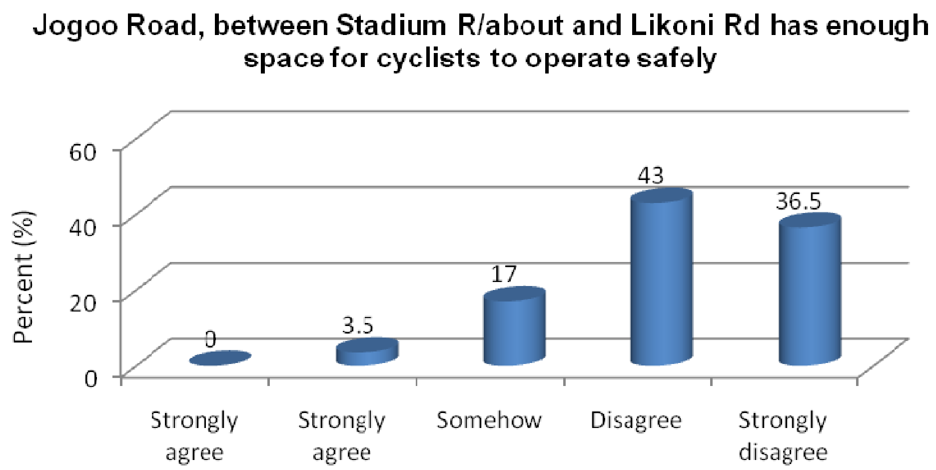


Figure 9: Availability of adequate cycling space on Stadium R/about and Likoni Rd section

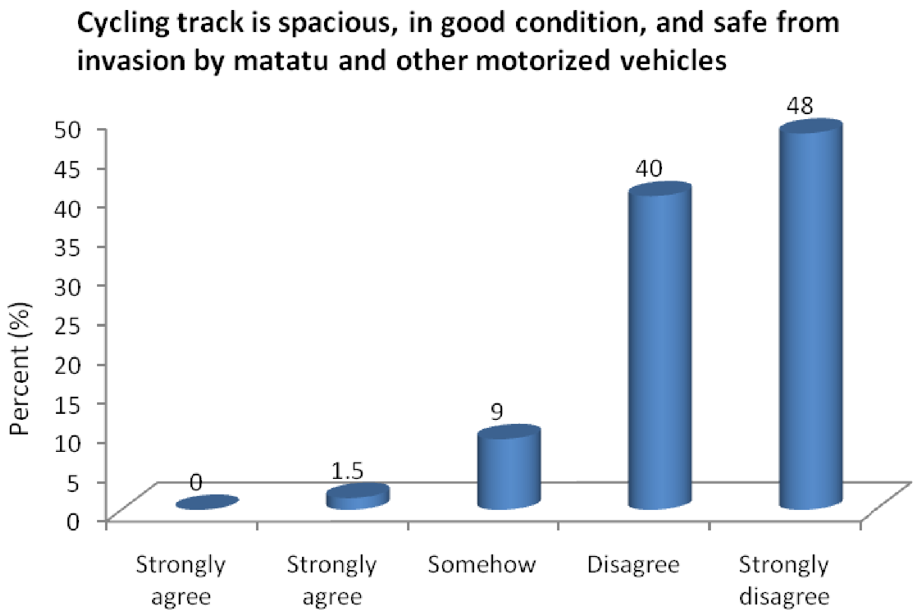


Figure 10: NMT Infrastructure Condition on Jogoo Road corridor

The most dangerous accident spots on the corridor were mentioned as the Hamza area followed by the Makadara crossing point. The worst problems they face as cyclists on the corridor or elsewhere in Nairobi are represented in Figure 11. The problems of insecurity and accident risk cover the whole corridor, and since the other areas mentioned are scattered along the corridor, it is thus appropriate to deduce that the Jogoo Road corridor as a whole is unsafe for cyclists, and equally unsafe for pedestrians. Lack of cycle paths and harassment by *matatus* took the lead followed by poor track conditions, invasion of paths by *matatus*, narrow paths and overcrowding of paths by pedestrians, as reflected on Figure 11.

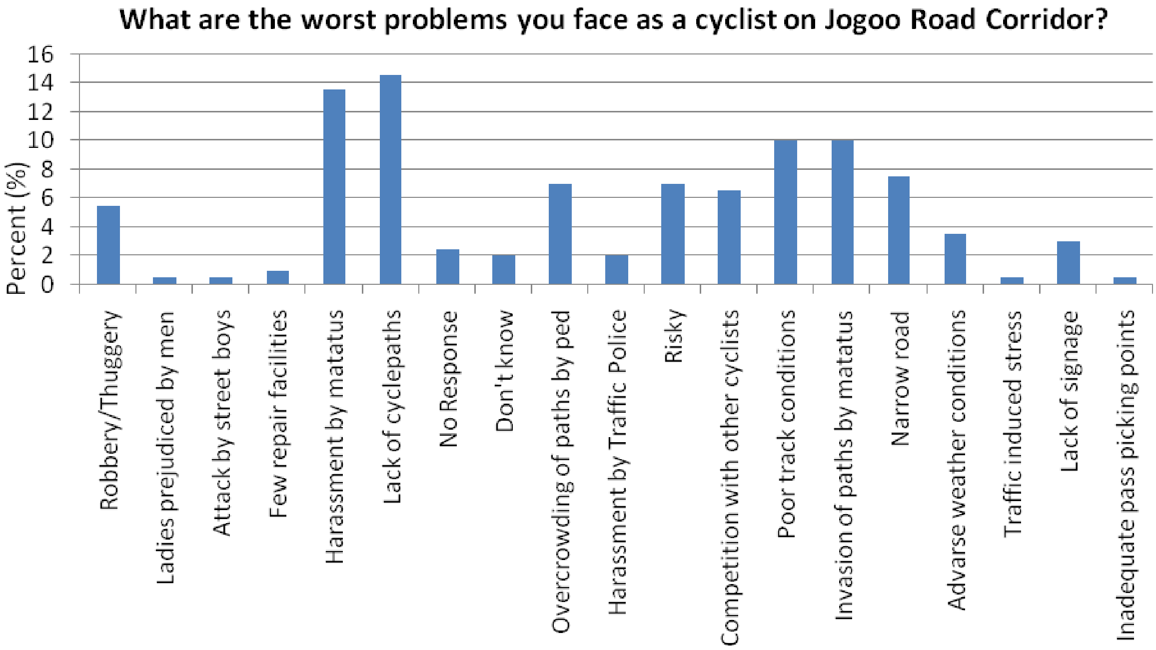


Figure 11: Worst problems cyclists face on Jogoo Road

4. CONCLUSIONS

The documentation of operating conditions experienced by NMT on Jogoo Road has brought to the fore worsening levels of service experienced on this corridor. The road environment is far from supportive for NMT. This could be attributed to inadequate funding or inadequate attention, due to lack of awareness of the role NMT plays in widening the accessibility of non drivers. It appears that agencies involved in infrastructure development have not given NMT infrastructure the necessary attention and as such need to be sensitized by involvement in research initiatives like this through workshops and seminars.

The results given by the tested alternative survey methods for NMT studies have given consistent performance indicators with the attitudinal survey on a number of aspects. The pedestrian observation method is a low-cost method for evaluating the severance imposed on pedestrians as a result of high speed roads in urban centres. It could also serve as a method for identifying hazardous locations along a road. However, it would require some level of training even to an average city traffic engineer for good results.

The pedestrian count methods are still useful low-cost methods that could be used in evaluating pedestrian flows and subsequent sizing of facilities. The current methods for evaluating the level of service do not take into cognisance the entire environmental factors that determine the overall walking experience as perceived by pedestrians. A framework thus needs to be developed that determines indices for the total pedestrian corridor experience. This would assist practitioners in assessing the suitability of other existing transport corridors for footpath and cycle track retrofit construction to enhance equity in corridor designs. An inclusive roadway environment is fundamental to broadening transport diversity in the creation of productive neighbourhoods.

5. ACKNOWLEDGEMENTS

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