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Road Safety Case Studies

SARSAI: Low Cost Speed Management Interventions around Schools – Dar es Salaam, Tanzania

Ayikai Poswayo[1], Jeffrey Witte[2]and Simon Kalolo[3]

[1]*Amend, Accra, Ghana*

[2]*Amend, New York, USA*

[3]*Amend, Dar es Salaam, Tanzania*

Corresponding Author: Ayikai Poswayo, P. O. Box AN 18933, Accra-North, Ghana, aposwayo@amend.org, +233262659855.

Key Findings

- Low cost road safety interventions have the potential to reduce speeds significantly and hence positively affect traffic injury rates on both paved and unpaved roads.

- Speeds continue to remain reduced a year after the implementation of low cost interventions on paved roads.
- On unpaved roads, vehicle speeds increase again for certain vehicle categories such as motorcycles.
- Motorcycles can potentially avoid speed reduction measures such as speed humps if they are installed at locations without a kerb.

Abstract

This paper looks at the change in speed around nine schools in Dar es Salaam, Tanzania after the introduction of low-cost road safety interventions. It compares the speeds 'before', 'two weeks after' and 'one year after' intervention at nine sites – five of which were on a paved road and four of which were on an unpaved road. The purpose of the study was to determine the levels of change in speed at the identified sites over time and establish what level speeds were at, one year post intervention. Average and 85th percentile speeds reduced two weeks after intervention and though to a smaller extent one year after intervention compared to baseline. Speeds were also analysed by vehicle category. Motorcycles on unpaved roads were found, after the initial drop in speeds immediately after intervention, to have a significant rise in speed after one year of initial intervention. The study identified the need for further work looking specifically at ways to reduce speeds of motorcycles on an unpaved road setting, and the need for more sustainable speed management methods on this road type in general.

Keywords

Speed management, children, school zones, Tanzania, road traffic injury, road traffic fatality

Introduction

Worldwide, road traffic injury is a leading cause of death among young people and the main cause of death for those aged 15 to 29 years (World Health Organisation, 2015). This has dire consequences for a continent such as Africa with a very young population which holds immense potential for the future of the region. Sixty percent of the population of Africa is below the age of 24, with 41% under fifteen and 19% between 15 and 24 (United Nation Department of Social and Economic Affairs, 2015). To compound this issue, the African region has the highest road traffic fatality rates, yet the lowest motorisation rates (World Health Organisation, 2015). Low and middle-income countries (of which almost all African countries are) have double the fatality rates of high-income countries and 90% of global road traffic deaths (World Health Organisation, 2015).

Amend, a road safety non-governmental organisation, which presently focuses its work in Africa, developed a programme – SARSAI – to help address the issue of road traffic injuries amongst young people. SARSAI stands for 'School Area Road Safety Assessments and Improvements' and was started in Dar es Salaam, Tanzania in 2012. The programme focuses on primary school age children (which in Tanzania can range from 6 years to 17 years). This group was a focus because it was found that the smaller frames and under developed perceptions of the younger children made them particularly vulnerable(FIA Foundation & Amend, 2016). In addition, most public primary school children walk to school, putting them in even more vulnerable positions (FIA Foundation & Amend, 2016).

According to the World Health Organisation, vulnerable road users – pedestrians, cyclists and motorcyclists – make up half of all fatalities (World Health Organisation, 2015). It is estimated that 500 children die each day from road traffic crashes on the world's roads and for every person that dies in a road traffic crash there are at least 20 others that sustain non-fatal injuries (World Health Organisation, 2015).

The SARSAI methodology involves identifying the highest risk primary schools for road traffic injury amongst pupils, carrying out assessments at these schools and implementing low cost infrastructure improvements which have the aim of separating pedestrians from vehicles, and where they do interact, reducing vehicle speeds in order to reduce the risk or severity of a crash. Speed is known to be a critical risk factor for Road Traffic Injuries, especially in areas of high pedestrian activity such as around schools. There is evidence supporting speed management to protect children on their way to school from other continents but not much research in relation to this from the African continent. An evaluation study of 820 locations in New South Wales, Australia where school zone speed limits were reduced to 40 km/h showed that casualties among pedestrians ages 5-16 decreased by 46%. The benefits extended to all road users, as the total pedestrian casualty rate decreased by 45% (Graham and Sparkes, 2010).

Between 2015 and 2016, Amend carried out an extensive study looking at the impact of the SARSAI programme in Dar es Salaam, Tanzania. There were two aspects to the study – a control population-based study which looked at the impact of SARSAI on road traffic injury rates at nine intervention schools vs nine control schools – and a secondary aspect of the study which looked at the change in speeds at the nine intervention schools before and after SARSAI was carried out.

The full results of the population-based control study are being published separatelyand only key findings are presented here. Some key findings of the pre-intervention study was that 85% of all pupils injured were pedestrians and 63% of all crashes occurred on a journey to/from

Figure 1. Speed measurement using speed radar

school. Also, 48% of those injured (the largest category) were hit by a motorcycle.This paper looks specifically at the speed surveys carried out in conjunction with the wider study.

The aim of the speed survey was to assess if speeds had indeed significantly reduced at the intervention schools and if so, if speeds continued to remain at their reduced level at set periods after SARSAI was carried out both on paved roads and on unpaved roads. It should be noted that in developing countries such as Tanzania, many roads remain unpaved, even in urban areas.

Methods

Eighteen schools idetified as being at high risk of road traffic injury amongst pupils were selected in Dar es Salaam. These schools were selected based on phone calls which were made to all the public primary schools within the city and the head teachers were asked about anecdotal road traffic injury rates amongst the pupil population. From this information and after visiting the highest risk schools, eighteen schools

Figure 2. Engaging with pupils during school road safety assessment

were short listed as the most suitable for the study. This short list was based on factors such as the location of the school and the type of road outside the school (as much as possible schools off local roads as opposed to highways were selected). Schools whose entrances opened directly off paved roads and those which opened directly off unpaved roads were both considered in the study.

As part of the population-based control study on road traffic injury rates, the set of eighteen schools were randomly

Figure 3. Low cost infrastructure measures – Zebra Crossing

Figure 4. Low cost infrastructure measures – Speed Humps

Figure 5. Low cost infrastructure measures – Bollards and Signage

Figure 6. Low cost infrastructure measures – Earth Hump (Unpaved Road)

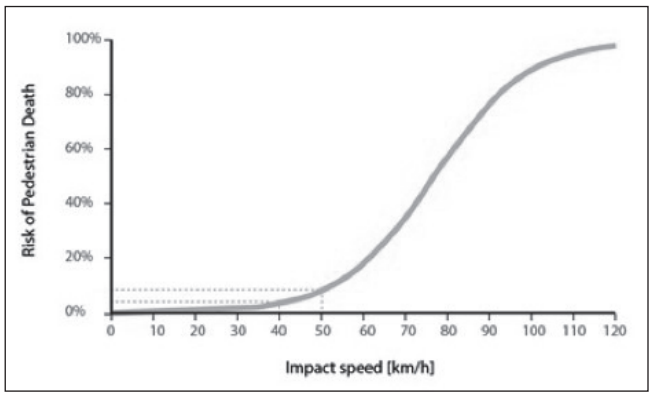

Figure 7. Relationship between impact speed and risk of pedestrian death in road traffic crash (Tingvall & Haworth, 1999)

Figure 8. Road safety education

put into two groups – a 'control' school group and an 'intervention' school group. For this aspect of the study looking at speeds, speed data was collected at the nine 'intervention' schools. Of the nine schools, five of the schools had paved asphalt roads outside the school gate and four of the schools had unpaved natural gravel roads outside the school gate.

Speed measurements were taken outside the school gates of each of the nine schools in their existing situations, before any road safety infrastructureinterventions were implemented. This data served as the 'baseline situation'. The measurements were taken over a 60-minute periods at the times when children arrive and depart from school. For public schools in Dar es Salaam, this was 06:30 – 7:30, 11:00 – 12:00 and 14:00 – 15:00. For each school, mesurements were taken on two seperate days (Tuesday, Wednesday or Thursday) at two of these time periods. A schedule was set for each school based on a randomised selection of observation days and times.

A research assistant was trained to collect the speed data. The research assistant made use of a speed radar (Figure 1) and, as much as possible, blended into the surrounding area to avoid contributing to a change of driver behaviour as a result of the speed measurement exercise.

The data was collected for all vehicles passing in one direction outsidethe school gate, in free flowing conditions. The speed of each vehicle, as well as the types of vehicles were recorded.

Table 1. Achieved Sample Sizes for Speed Data

Sample	Sample Size (Vehicles Surveyed)		
	Pre-intervention	Post-intervention (2 weeks after)	Post-intervention (One year after)
All Sites (9 sites)	1,873	1,921	1,766
Paved Sites (5 sites)	1,535	1,468	1,112
Unpaved Sites (4 sites)	338	453	654

Table 2. Average speed & 85th percentile speed pre- and post- (2 weeks & 1 year after) intervention and the pre-post changes

Location	Speed (km/hr)			% Change	Speed (km/hr)		% Change
	Pre	Post (2 weeks)	Change		Post (1 year)	Change	
All Sites							
Average	27.1	19.7	-7.4	-26%	20.1	-7.0	-26%
85th Percentile	37.0	26.0	-11.0	-30%	26.0	-11.0	-30%
Paved Sites							
Average	28.6	20.3	-8.3	-29%	21.1	-7.5	-26%
85th Percentile	39.0	26.0	-13.0	-33%	26.4	-12.6	-32%
Unpaved Sites							
Average	20.5	17.6	-2.9	-14%	18.3	-2.2	-11%
85th Percentile	26.0	21.0	-5.0	-19%	23.0	-3.0	-12%

Subsequent to speed data collection, a road safety assessment was carried out at the nine schools (Figure 2). This assessment involved extensive observation of children arriving at school, pedestrian counts, student catchment area mapping, and interviews with teachers, children and the wider community. The purpose of this assessment was to determine particularly dangerous areas for children in relation to road traffic injury.

Based on the findings from this assessment, proposals for low-cost infrastructure improvements were put forward to the relavant Municipal authority. These improvements generally included speed humps, signage, zebra crossings and bollards, with the aim of separating vehicles from pedestrains and also reducing the speed of vehicles around schools to 30km/hr or less (Figures 3-6).

The reason for aiming for a reduction in speed is because the likelihood of a crash, and resulting injuries, decreases as speed is reduced (Elvik, 2009). This correlation is particularly strong among pedestrians, cyclists, and motorcyclists (Rosen, 2011). A 5% cut in average speed can result in a 30% reduction in the number of fatal crashes (World Health Organisation, 2015). This principle of reducing speeds around schools to 30km/hr or less is based on research that finds that at speeds of 30km/hr or less, the risk of a pedestrian sustaining serious injury or being killed when hit is less than ten percent; injury severity for speeds above 30 km/h rapidly increase until at 80km/h, crashes are nearly always fatal to pedestrians (Tingvall & Haworth, 1999). This is demonstrated in the graph in Figure 7.

In consultation with the relevant local authority, local contractors were sourced to implement low cost road safety infrastructure interventions. For unpaved roads, earth constructed speed humps were constructed and stabilised with cement. In the case of the earth speed humps, locally available labour from within the communities was utilised in their construction.

Subsequent to the implementation of the low cost infrastructure measures, road safety lessons were provided for the children at the schools receiving the interventions. The lessons were made up of a theoretical aspect within a classrom setting and a practical aspect carried out in the school yard (Figure 8). The lessons included some messages tailored to the improvements their school had received.

Within two weeks of the implementation of improvements, speed data was collected in exactly the same manner on the same days and times for each location. A year post implementation, the speed data was collected again.

Results

The speed data was analysed in aggregate form - first, for all sites but also separately for ‘paved’ sites and ‘unpaved’ sites because they each had peculiar characteristics. Table 1 shows the sample sizes for data collected ‘before’, ‘two weeks after’ and ‘one year after’, intervention.

The average speed was calculated for each group as well as the 85th percentile speed. The 85th percentile speed is the speed at or below which 85% of vehicles passing a particular point travel at, and is generally referred to as the ‘operating speed’ at a particular location.

Based on the results (Table 2), it can be seen that at all sites, with speed data analysed in aggregate, there was a reduction in average and 85th percentile speeds both two weeks after the interventions were introduced and within a year of their introduction. Before intervention, analysis of data from all sites, gave a 85th percentile speed of 37.0km/hr. This dropped to 26.0km/hr two weeks after intervention and remained at that level one-year post intervention (a 30% drop in speed). There were some variations when vehicles were analysed by type of road and by vehicle category, as shown in Table 2 and Figures 9 - 11.

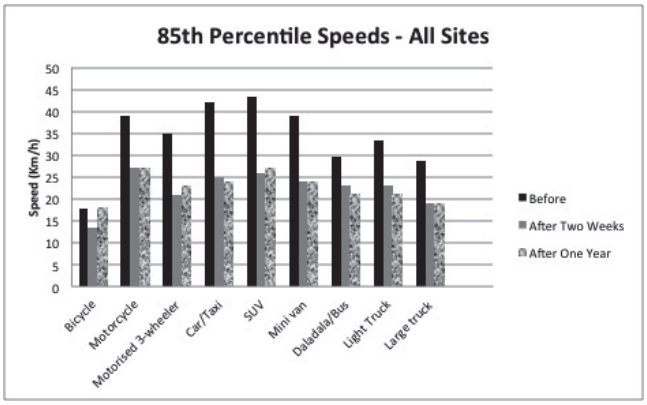

Figure 9. 85th Percentile Speeds by Vehicle Category (All Sites)

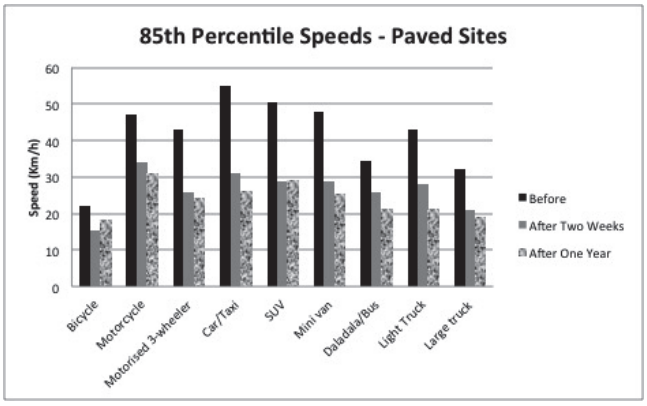

Figure 10. 85th Percentile Speeds by Vehicle Category (Paved Sites)

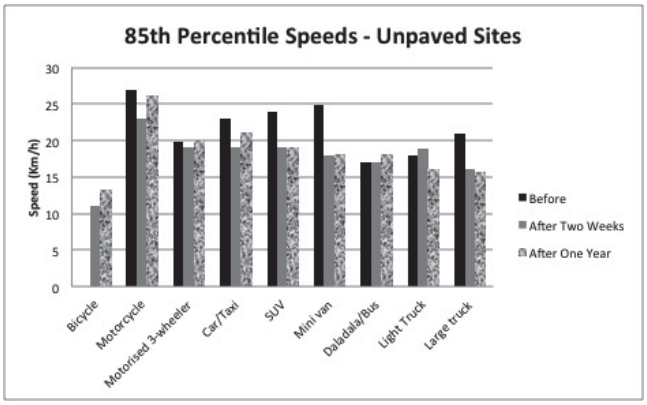

Figure 11. 85th Percentile Speeds by Vehicle Category (Unpaved Sites)

Discussion

From the results, it can be seen that the low cost infrastructure improvements caused a reduction in speeds around the schools (both average speeds and 85th percentile speeds). Speeds on paved roads generally started off higher than speeds on unpaved roads. It can be seen that after a year there was a slight increase in speeds around the schools though only very slight. It is significant to note, however, that the increase in speeds around schools after a year was more pronounced on unpaved roads compared to paved roads. This is not surprising as the measures introduced on unpaved roads generally do not last as long as those introduced at the paved sites.

In terms of vehicle categories, it is of note that motorcycles on unpaved roads tended to go faster and their speeds increased by the greatest amount a year after the interventions were introduced.As stated, the results of the population-based control study are being published separately, however, a key finding to highlight is the fact that at pre-intervention, the highest category of injuries was amongst motorcycles hitting pedestrian (48% of all injuries). Post-intervention, there was a 42% reduction in injuries related to walking to/from school, 25% reduction in injuries related to motorcycles and 26% "absolute reduction" in injuries.

Some of the challenges faced were that at some paved sites, where a kerb was not present, motorcycles tended to go off onto the shoulder to avoid having to travel over the speed humps. The communities in these locations stepped in and made use of old tyres placed next to the speed humps to prevent this from happening. Also, road marking paint for zebra crossings were found not to last very long and within a year, the zebra crossings in many cases had faded. This is thought to be as a result of a combination of the quality of the road marking paint available on the local market, the sandy nature of Dar es Salaam, and the lack of road maintenance through regular sweeping of the roads.

At the unpaved sites, as the speed 'humps' were constructed in a rather crude way and as they could not be marked with road markings, it could be argued that they could pose a hazard at night. This was mitigated by the use of warning road signs. Also, because of the existing unpaved and uneven surface of the road, vehicles travelling on these roads are generally doing so at lower speeds than they would on a paved road, reducing the risk. Another challenge related to the fact that in 'constructing' the earth humps, standard specifications in relation to height and slopes were more difficult to achieve.

Conclusions

In conclusion, it can be seen that there was a decrease in speed at both paved and unpaved sites after the introduction of speed reduction interventions, which could be confidently said to be what contributed to the reduction in injuries measured as part of the wider population-based control study. Speeds generally remained at their lower levels one year after intervention, except in a few cases such as that of motorcycles on unpaved roads. It is however of note that motorcycles pose a particular danger in a setting such as Dar es Salaam and further studies are needed to look into ways to control speeds of motorcycles and other vehicles in general on unpaved roads.

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Perspective on Road Safety

Promoting “Safe Speeds” behaviour by changing the conversation around speed and speeding

Ian Johnston[1] and Eric Howard[2]

[1]*Ian Johnston Transport Safety Pty Ltd*
[2]*Whiting Moyne*

Corresponding Author: Ian Johnston, irj111@bigpond.net.au

Key Findings

- The evidence establishing that speed moderation is an essential “holding measure” (and sometimes a long-term measure) in the implementation of a “Safe System” is overwhelming
- Community norms entrench low-level speeding
- Intense enforcement is critical but the community is antagonistic
- Effective enforcement changes behaviour but attitudes lag decades behind
- A new long-term strategy to address the community norms and support intense enforcement is proposed to sustain and extend compliance

Abstract

Traditional speed limit setting and speed enforcement practices created a community norm which historically accepted, indeed valued, low-level speeding. Public education strategies to date have largely focussed on conveying crash risk and casualty consequences and have lacked credibility. The approach required stems from preventive medicine and is analogous to promoting inoculation; something everyone needs to do to protect the community as well as themselves. Elements of a proposed new strategy are outlined.

Keywords

Speed; speeding; public education; behaviours; enforcement