THE EFFECTIVENESS OF SPEED HUMPS AS TRAFFIC CALMING FOR ACCIDENT REDUCTION

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ABSTRACT

eThekwini Municipality has been allocating millions of Rand each year for speed humps as a traffic calming measure, to curb rat-running and ensure pedestrian safety in the city. Since 2012, the City has spent R42.1 million of its capital budget on speed humps. Despite all traffic calming efforts, there haven't been significant changes in the city's total accidents. Between 2000 and 2015, the City's total crashes have never been below 50 000 per annum. In terms of injuries, the same trend can be observed. Person injuries have been increasing year-on-year since 2012. This research used information available to assess changes in specific roads, i.e. roads that have been traffic calmed. The study looked at accidents before and after the implementation of speed humps.

Speed humps have been proven to reduce speed of vehicles (Vanderschuren & Jobanputra, 2009). Dixon and Jacko (1998) conducted a before and after study in The Netherlands to investigate changes in driver behaviour due to implementation of speed humps. This research showed that there was a 40% decrease in travel speeds after speed humps were installed. Another study by Ponnaluri and Groce (2005) showed that speed humps reduce mean speeds, median and 85th percentile speeds. In Belgrade, Serbia a study showed that speed humps reduce speed and that the design (height) of the speed hump also affects the extent of this change (Antić et al., 2013).

This paper assessed the impact of reactive (responsive to requests) traffic calming in the form of speed humps using accident data. The assessment looked at changes relating to the number of crashes before and after implementation of speed humps, it will also focused on changes in the severity of accidents involved. The research analysed changes in relation to the types of accident involved, particularly pedestrians.

1. INTRODUCTION

In 2017, KwaZulu-Natal Province had 2800 road crash fatalities. This accounted for 20% of South Africa's annual road crash fatalities and cost the economy more than R14 billion (RTMC, 2016). The City of eThekwini is the most populous municipality and accounts for the highest road fatalities per municipality in the province. In the period 2000 to 2015, the City of eThekwini had more than 50 000 road crashes per year, with more than 500 deaths each year (eThekwini Transport Authority, 2016). eThekwini's strategic goal is to be "Africa's most liveable city by 2030" (eThekwini IDP, 2015).

To date, there hasn't been a study conducted by eThekwini Municipality to assess the effectiveness of speed humps implemented across the City. At the moment, despite the City's annual commitment to implement traffic calming, particularly in the form of speed humps, the City does not have any idea as to whether traffic calming measures that have been put in place are successful or not, or whether they are effecting any changes at all.

This research, therefore, used the information available to assess whether speeds humps that have been implemented in the city are serving their purpose. The question of speed humps efficacy was answered using accident statistics as a basis and a 6-year study period will be used. The research also answered questions related to road safety, particularly on pedestrians.

Table 1: Number of accidents in eThekwini

YEAR	NUMBER OF ACCIDENTS				
	Fatal	Serious	Slight	Damage only	Total Accidents
2000	496	2413	7750	42673	53332
2001	537	2624	10311	41037	54509
2002	637	2676	10310	41465	55088
2003	665	2832	9584	42968	56049
2004	724	2845	9475	43690	56734
2005	663	2526	9413	47169	59771
2006	647	3231	10641	50282	64801
2007	609	3694	13934	54115	72352
2008	508	3387	14991	51862	70748
2009	607	3086	11304	52646	67643
2010	596	2679	9499	50491	63265
2011	612	2380	8948	50197	62137
2012	596	2242	8313	51167	62318
2013	497	2342	8738	51437	63014
2014	478	2408	9351	50151	62388
2015	571	2650	9719	52474	65414

Source: Based on ETA, 2017

Table 2: Number of person injuries

YEAR	Person Injuries			
	Deaths	Serious	Slight	Total Injuries
2000	545	3188	11644	15377
2001	609	3719	17404	21732
2002	716	3880	16382	20978
2003	753	3925	14710	19388
2004	795	4072	14432	19299
2005	726	3358	13535	17619
2006	744	4219	15586	20549
2007	687	4826	20245	25758
2008	550	4487	22714	27751
2009	673	4133	15953	20759
2010	651	3672	13869	18192
2011	680	3253	12356	16289
2012	647	3065	11412	15124
2013	588	3197	11879	15664
2014	515	3212	12738	16465
2015	614	3498	13316	17428

Source: Based on ETA, 2017

From Table 1 and 2, in the past 20 years, the number of accidents in eThekwini has been high. With each of these accidents, at least one person is affected and, in some instance, two or more people are injured. The number of total accidents grew from just over 50 000 in the year 2000 to about 65 000 accidents in 2015. The number of people injured per year was just over 15 000 to about 17 000 people per year a decade later. In terms of deaths, the number of lives claimed from accidents was 496 people in 2000 and went up to 571 persons in 2015. This consistent increase is worrisome, and the impacts are far-reaching as these accidents are costly to the City and the economy in general. The cost of even a slight

accident is detrimental to the City as it results in delays and other inconveniences. With serious accidents that result in deaths, the cost is even more to the citizens, the city and the economy of the country.

2. AIM AND OBJECTIVES OF THE STUDY

The aim of this research was to assess the impact of reactive (responsive to requests) traffic calming in the form of speed humps using accident data.

The first objective of research was to look at changes relating to the number of crashes before and after implementation of speed humps, and the severity of accidents involved particularly pedestrians.

The second objective was to help authorities with decision making relating to continuing speed humps as a traffic calming measure or consider other alternative measures, and to inform policies related to traffic calming in the City. These results can also inform budget allocation to speed humps.

3. SCOPE AND LIMITATIONS

The study selected roads that were considered for traffic calming. Only Class 4 and Class 5 residential roads that were traffic calmed for their entire length were considered. Roads that were partially humped were excluded from the study. In this way, any impacts that predate the study period are excluded. Only 20 roads were considered. These roads had no pre-existing humps prior to implementation, and they were traffic calmed throughout their entire length. Roads that were traffic calmed using speed tables and other traffic calming measures other than speed humps were also excluded.

There are some factors that have an impact on travel behaviour in the broader road network that this study didn't investigate. The report also didn't consider how they could impact on traffic calming efficacy. Although changes in travel trends could affect traffic volumes and traffic volumes do have a direct impact on road safety, this research will not take into cognisance any change in travel trends that might have occurred during the period of the study. Traffic volume changes on these roads were not significant as they were below 3% annual growth in the study period. Changes in travel trends as a result of road network improvements or restraints are also not considered in this study.

None of the roads within the study area had major developments that could significantly affect traffic routing and trips within the study area. An example could have been, for an instance, construction of a shopping mall within the study area.

Drivers in eThekwini were assumed to be reasonably uniform and therefore their driving behaviour was assumed to be reasonably rational.

4. RESEARCH QUESTIONS

This study collected, analysed and critically evaluated accident data in eThekwini Municipality on 20 roads with speed humps as traffic calming measure to answer the following questions:

- What is the impact of speed humps on the total number of accidents, injuries and fatalities?

- What is the impact of traffic volume on accidents on roads with speed humps?
- What is the impact of speed humps on accidents on roads with different classifications?
- Can speed humps reduce the number of pedestrian accidents?
- Can speed humps reduce the number of accidents amongst school-going children?
- Can speed humps reduce accidents on roads where there are inadequate NMT facilities such as sidewalks?
- Can speed humps reduce public transport (minibus taxis and buses) accidents?

5. METHODOLOGY

In order to investigate the effectiveness of speed humps as a traffic calming measure to reduce accidents, eThekwini was used as a case study. A before-and-after study was then conducted using accident data from eThekwini Municipality. With the results of the before-and-after study, the study was able to assess if speed humps can reduce the number of accidents. A before-and-after study was first done at an aggregated level, using Equivalent Accident Numbers (EANs) and further disaggregated into other indicators as shown on Section 6 of the research. A qualitative assessment of the 20 roads was conducted to check for any visible defects on the roads. This was done to ensure that the study does not make incorrect conclusions. Lastly, T-tests were done on each of the before-and-after studies to check for statistical significance of the results.

Table 3: Capital Budget Traffic Calming for 2014/15 Financial Year

Road Name	Ward No.	No. of humps	Class	Road Name	Ward No.	No. of humps	Class
P Tshabalala	92	25	5	Tracy Watts Rd	18	5	5
Hurst Grove	31	2	5	Pridley Road	23	5	5
Sol Mahlangu Road	88	5	5	Wingate Road	64	7	5
Berkshire Drive	21	13	5	Kilburn Avenue	31	2	5
Silvertree Road	68	7	5	8th Avenue	27	3	5
Galloway Road	8	8	5	Donegal Road	66	3	4
Sofasonke Road	7	13	5	Fairlight Road	63	12	5
Sol Harris Crescent	26	6	5	High Street	60	6	5
Amical Cabral Road	90	6	5	Sizwe Mdlalose	19	6	5
Phambili Road	85	6	5	Dumakude Road	17	4	5
Total Cost Estimate @ R30,000.00 per hump		**R4,320,000.00**					

Each of the roads on Table 3 was assessed for traffic calming, using the municipality's traffic calming warrant (eThekwini Transport Authority, 2012). All 20 roads met the warrant traffic calming. All roads, except for Donegal Road, are Class 5 residential roads with less than 1000 vehicles per day. Donegal Road is a Class 4 low order collector street with less than 5000 vehicles/day.

The research also identified areas where there were no sidewalks or adequate verge. This is because where no sidewalks or adequate verges are absent; pedestrians tend to walk on the roadway, which increases pedestrian risk on the road. Signage and road marking were also observed. This was to ensure that all roads have adequate signage and road markings to help both drivers and pedestrians of prevailing road conditions, as well as to mitigate risk of crashes. The research also assessed the surfacing of the road to identify any visible deformations such as cracks. The assessment of the road for deformations was done because deformations are also a cause of distraction to drivers and compromise road safety.

Table 4: Qualitative Assessment of the roads

Road Name	Surfacing	Sidewalk	Lane markings	Signage	Visibility/Sight distance
P Tshabalala	Good	Present	Visible	Present	Sufficient
Hurst Grove	Good	Present	Visible	Present	Sufficient
Sol Mahlangu Road	Good	Present	Visible	Present	Sufficient
Berkshire Drive	Good	Present	Visible	Present	Sufficient
Silvertree Road	Good	Present	Visible	Present	Sufficient
Galloway Road	Good	Present	Visible	Present	Sufficient
Sofasonke Road	Good	Present	Visible	Present	Sufficient
Sol Harris Crescent	Good	Present	Visible	Present	Sufficient
Amical Cabral Road	Good	Present	Visible	Present	Sufficient
Phambili Road	Good	Present	Visible	Present	Sufficient
Tracy Watts Rd	Good	Present	Visible	Present	Sufficient
Pridley Road	Good	Present	Visible	Present	Sufficient
Wingate Road	Good	Present	Visible	Present	Sufficient
Kilburn Avenue	Good	Present	Visible	Present	Sufficient
8th Avenue	Good	Present	Visible	Present	Sufficient
Donegal Road	Good	Present	Visible	Present	Sufficient
Fairlight Road	Good	Present	Visible	Present	Sufficient
High Street	Good	Present	Visible	Present	Sufficient
Sizwe Mdlalose Road	Good	Present	Visible	Present	Sufficient
Dumakude Road	Good	Present	Visible	Present	Sufficient

6. RESULTS

6.1 Change in Total Accidents – EANs

The number of accidents before and after implementation of speed humps was presented using Equivalent Accident Number (EAN) which weighs accidents according to their severity, with fatal accidents scoring the highest.

Table 5: Comparison of accidents before and after implementation of speed humps

Road Name	EANs Before	EANs After	Change	Road Name	EANs Before	EANs After	Change
P Tshabalala	106	91	-15	Tracy Watts Rd	69	78	9
Hurst Grove	66	53	-13	Pridley Road	59	46	-13
Sol Mahlangu Road	267	229	-38	Wingate Road	28	19	-9
Berkshire Drive	61	38	-23	Kilburn Avenue	10	3	-7
Silvertree Road	75	38	-37	8th Avenue	27	19	-8
Galloway Road	35	35	0	Donegal Road	25	15	-10
Sofasonke Road	72	37	-35	Fairlight Road	85	81	-4
Sol Harris Crescent	115	89	-26	High Street	31	31	0
Amical Cabral Road	42	36	-6	Sizwe Mdlalose	3	1	-2
Phambili Road	167	124	-43	Dumakude Road	3	7	4

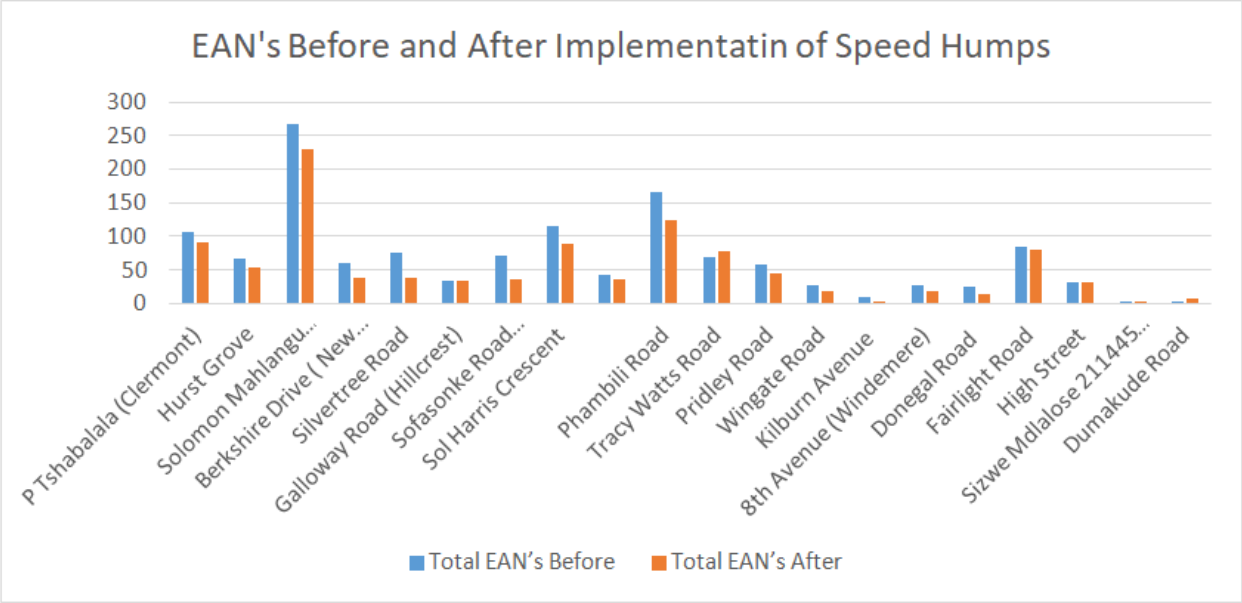

Figure 1: Graphical representation of accidents before and after implementation of speed humps

There was a total of 1346 EAN's in the three years before implementation of speed humps. The total number of accidents was reduced to 1070 in the three years after the implementation of speed humps on roads selected for study in Durban. This translates to 20.51% reduction in road accidents. Over and above this decline in total number of accidents, it can also be noted that 18 of the 20 (90%) roads under study had a decline in accidents. This affirms literature that speed humps reduce accidents. Only two roads were outliers, showing an increase in total accident numbers. The degree of change was different with each road. The highest EAN change was on Phambili Road, which had a score of 167 EAN's before implementation of speed humps and 124 EAN's after implementation.

6.2 Change in Pedestrian Accidents – Total Pedestrians

Another important objective of this research was to establish the effectiveness of speed humps in promoting pedestrian safety in the City of eThekwini in line with the municipality's strategic vision of making eThekwini the most liveable City in Africa by 2030 (eThekwini Municipality, 2015).

In the three years prior to implementation of traffic calming, there were 59 pedestrians involved in road crashes on roads under study. After implementation of speed humps, the number of pedestrians involved was reduced from 59 to 31, a 47.46% reduction. The highest change occurred on Phambili Road where there were 16 pedestrians that were victims of road crashes before speed humps were implemented. The number of pedestrians involved was reduced to 4 after implementation of speed humps. Another significant decrease was on Solomon Mahlangu road, where there were 14 pedestrian accidents before implementation of speed humps, down to 9 pedestrians after speed humps were installed. Only 4 out of 20 roads (Hurst Grove, Sofasonke Road, 8th Avenue and Sizwe Mdlalose Road) increased in the number of pedestrian incidents after speed humps were installed.

Table 6: Comparison of pedestrian accidents before and after implementation of speed humps

Road Name	Peds Before	Peds After	Change	Road Name	Peds Before	Peds After	Change
P Tshabalala	10	6	-4	Tracy Watts Rd	0	0	0
Hurst Grove	0	1	1	Pridley Road	2	0	-2
Sol Mahlangu Road	14	9	-5	Wingate Road	1	1	0
Berkshire Drive	4	2	-2	Kilburn Avenue	0	0	0
Silvertree Road	9	1	-8	8th Avenue	0	2	2
Galloway Road	0	0	0	Donegal Road	0	0	0
Sofasonke Road	0	2	2	Fairlight Road	0	0	0
Sol Harris Crescent	2	1	-1	High Street	0	0	0
Amical Cabral Road	1	1	0	Sizwe Mdlalose	0	1	1
Phambili Road	16	4	-12	Dumakude Road	0	0	0
Total pedestrians involved before implementation						**59**	
Total pedestrians involved after implementation						**31**	

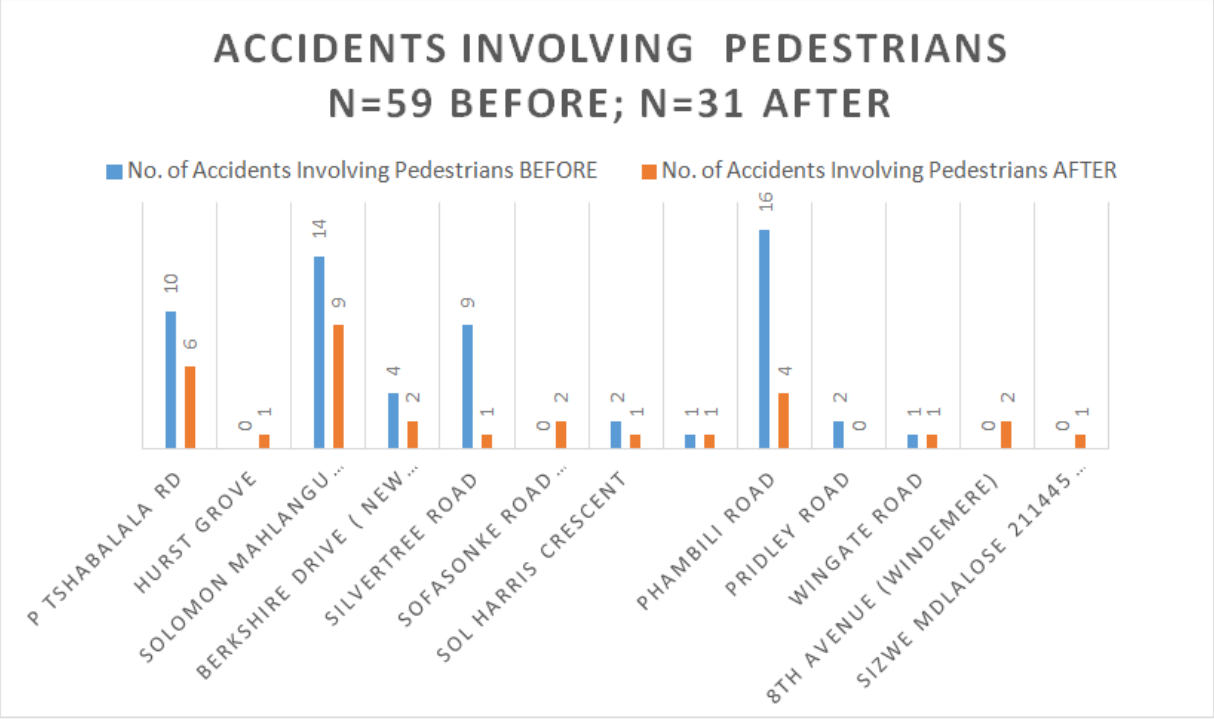

Figure 2: Change in pedestrian accidents – Total pedestrians

6.3 Change in Pedestrian Accidents – Pedestrians 18 Years and Below

People with limited cognitive abilities such as school kids are vulnerable road users. eThekwini has a lot of accidents amongst this group (Mhlanga, 2018). From the total number of pedestrian accidents, it was important to further dissect them further to establish the impact of speed humps amongst school-going population.

In the three years before the implementation of speed humps, there were 30 accidents involving pedestrians 18 years or younger. After implementation of speed humps, the total number of accidents amongst pedestrians 18 years old or younger was reduced from 30 to 5, an 83% decline in accidents. The biggest change between the number of accidents before and after implementation of speed humps, was observed on Phambili Road. There were 10 pedestrian victims before speed humps were installed with no pedestrian victims after speed humps were installed. Another notable change was on Silvertree Road. There were 6 pedestrian victims before speed humps were installed and no pedestrian victims after speed humps were installed.

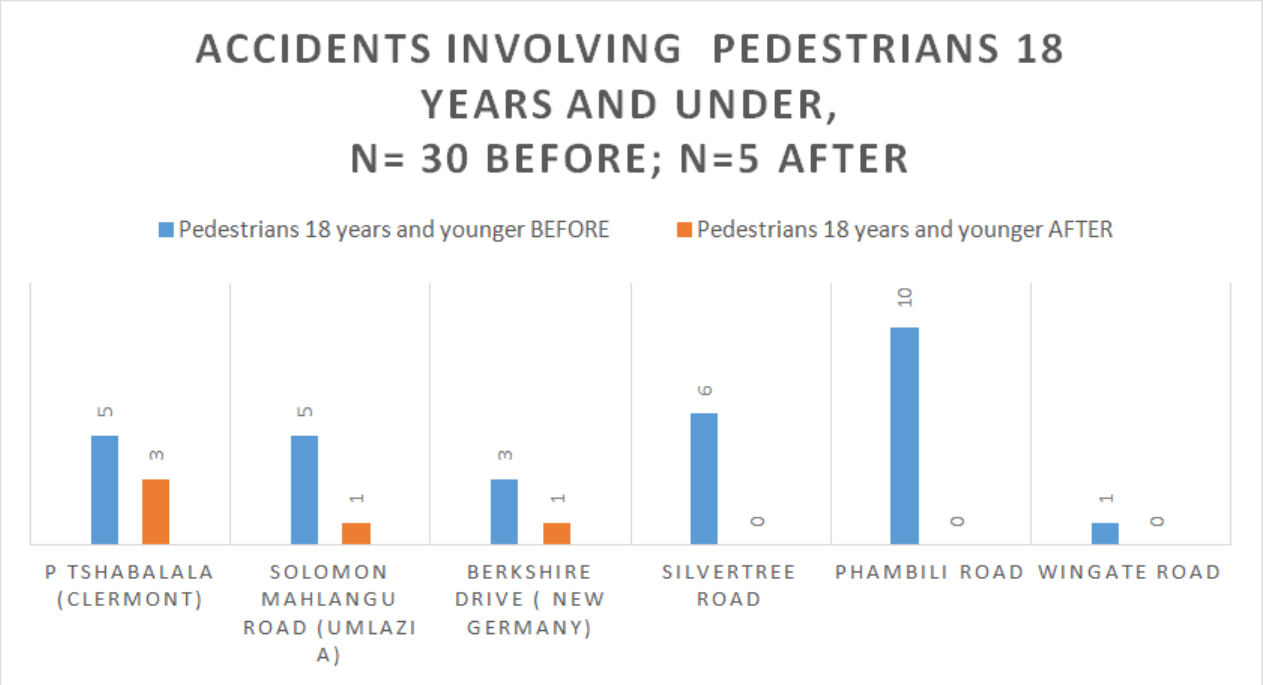

Figure 3: Accidents involving pedestrians aged 18 years and below

6.4 Change in Pedestrian Accidents – Pedestrians Walking on Roadway

The study further categorised pedestrian accidents by location and activity, particularly for pedestrians that were victims of crashes while they were walking on the roadway. It was important to understand if there was a change on the number of pedestrians that were knocked by vehicles after speed humps were implemented, and if this was the case, it was equally important to understand the extent, as well as the margin of statistical significance (if any).

After speed humps were implemented, there were 40 accidents of pedestrians walking on the roadway, a 40% reduction. The highest change was observed on Phambili Road, where the number of accidents was reduced from 11 before implementation of speed humps to 3, after speed humps were installed. P Tshabalala Road also had a significant change. The number of incidents was reduced from 8 to 4, a reduction by half. Only 5 roads had an increase in the number of pedestrian accidents.

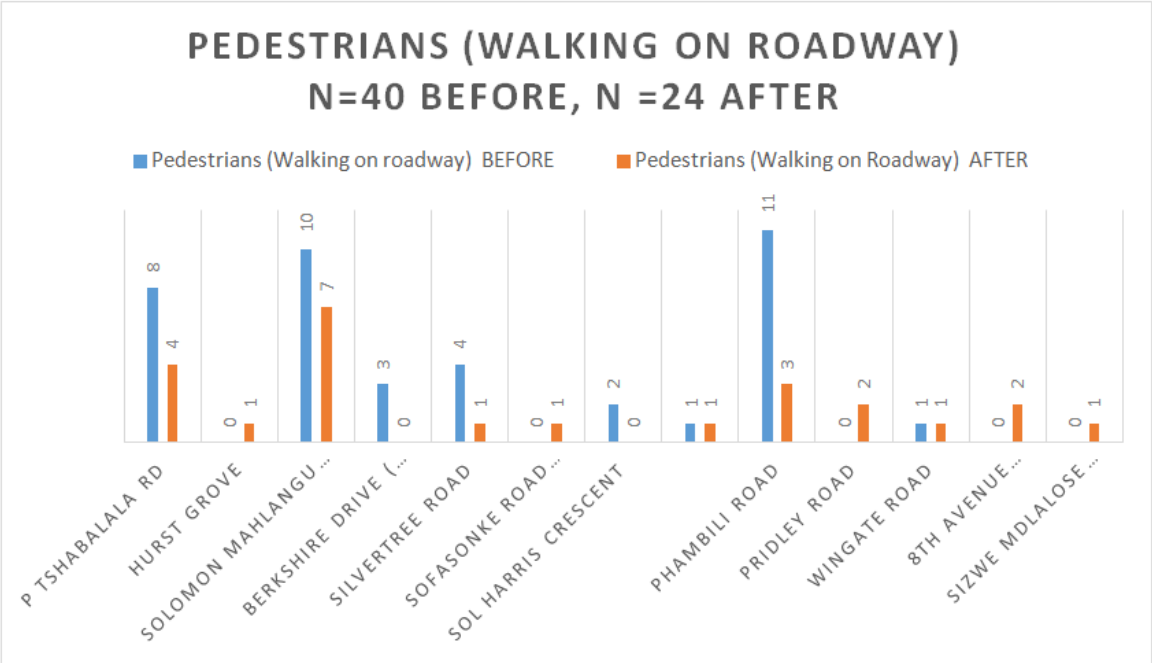

Figure 4: Accidents by pedestrian location/activity

6.5 Change in Accidents – Public Transport Vehicles

In 2017, there was a total of 12 128 088 vehicles on South Africa's roads *(eNATIS, 2017)*, and 65.09% of these were motor cars with only 3.44% of these being buses and taxis. The City of eThekwini municipality follows other South African cities in improving the use of Public Transport. The City's Integrated Public Transport Network (IPTN) project aims at ultimately provide up to 85% of all residents in eThekwini access to safe, affordable and good quality, scheduled public transport (GoDurban, 2013). It is against this backdrop that this research considered disaggregating accident data to further investigate the impact of speed humps in reducing public transport accidents.

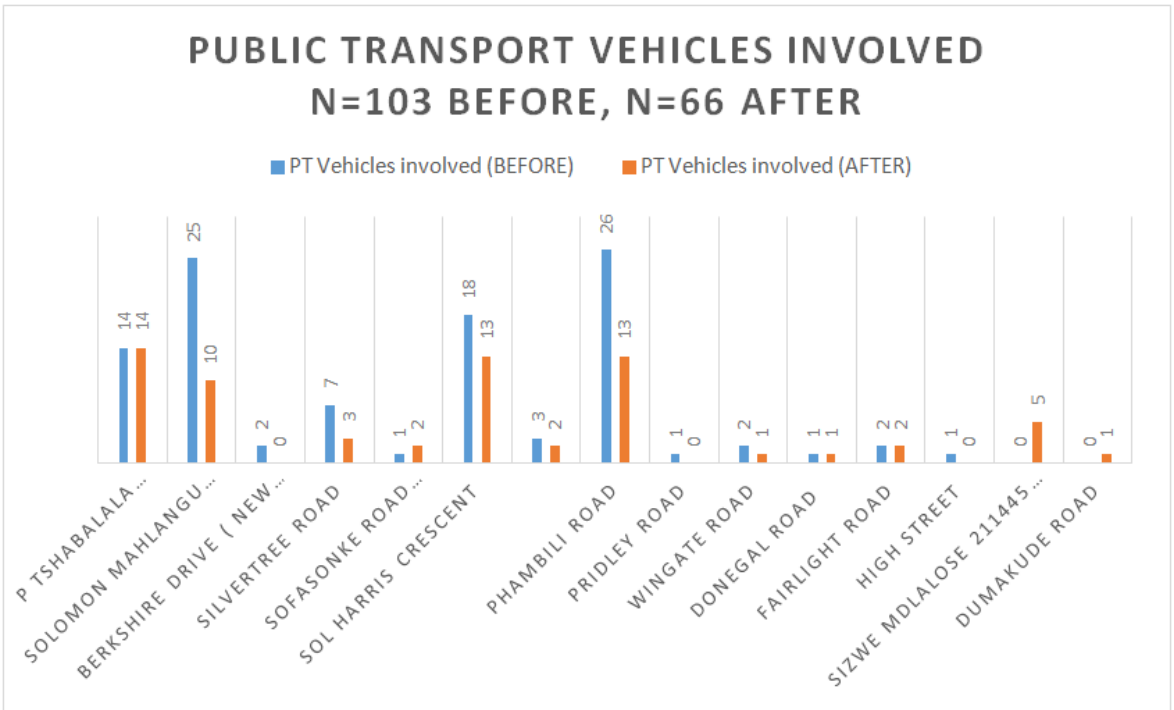

Figure 5: Change in accidents – Public transport vehicles

7. ANALYSIS OF FINDINGS

The findings from each of the investigations had to be checked if they are statistically significant or were simply not enough as conclusive results. T-tests were used to check if each the results obtained were statistically significant or not. The first T-test was done on total EANs before implementation of speed humps and after implementation of speed humps. The second T-test was conducted for change in pedestrian accidents and a third was for pedestrian location. The third T-test conducted was for pedestrians younger than 18-years and the fourth was for pedestrians walking on the roadway. The last T-test was done for minibus taxis and bus users. A summary of T-tests results is shown on Table 7.

Table 7: Summary of T-test results

Type of data	P-value	T-critical	Significant
Total EANs	0.006	-4.11	**YES**
Pedestrian incidents	0.8392	-1.82	**NO**
Pedestrians 18 years and below	0.2917	-30.3	**YES**
Pedestrians walking on roadway	0.15446	-1.52	**NO**
Public Transport users	0.09747	-1.74	**NO**

Although each of the five before-and-after studies showed reductions, it was important to understand the implications beyond absolute numbers. The research used a T-test to then assess if each of these changes was statistically significant or not. From the T-test, the only significant changes are on the total EANs and pedestrians 18 years and younger. No significant statistical differences were obtained for 'pedestrian incidents', for 'pedestrians walking on roadway' and for 'public transport users. From a road safety point of view, it is important to note that the total aggregated accident comparison (total EANs) yields significant T-test results.

8. DISCUSSION OF FINDINGS

What is the impact of speed humps on the total number on speeds and accidents?

Literature shows that speed humps are an effective traffic calming measure used to reduce speeds. This research has shown this to be true through results of a speed survey. The results of the survey proved that speed humps are effective in slowing down vehicular speeds. In the study, 85th percentile speeds were kept all below the design speeds of 40km/h. The study shows that even when operating speeds increase immediately after driving off a speed hump, the spacing between the two humps does not allow for extremely high speeds and vehicles slow down when approaching speed humps, thus keeping operating speeds at a level that allows for residential roads to preserve their primary functional classification of providing accessibility.

The effectiveness of speed humps in reducing accidents severity and probability of fatality during accidents is done in two ways, first by the speed survey and then secondly, by comparing accident counts before and after implementation of speed humps. In the first instance, the reduction of operating speeds that was proven in the study also proves another point in the effectiveness of speed humps. By proxy, this study can therefore conclude that speed humps do reduce the severity of accidents as crashes occur under low travel speeds. Secondly, the number of EAN's was reduced by 20% after

implementation of speed humps. Using these results, along with T-test results, it can be concluded that speed humps are effective in reducing accidents. However, since the study does not consider factors that could impact driver behaviour, it presents a limitation on the conclusiveness of the research as some drivers could have been impaired or in a state of mind that affected their driving abilities and reaction time.

What is the impact of speed humps on pedestrian safety? Is there a change in the number of pedestrians involved in accidents?

From the results, it is observed that speed humps reduce the number of accidents of pedestrians walking on the roadway. This affirms that speed humps help in promoting walking. This means pedestrians can walk relatively easier and are safer than walking on the roadway without speed humps. This is particularly important in roads where the road reserve is narrow and both pedestrians and vehicles use the same road space. This is also important in cases where there could be sidewalks in place but not usable due to poor maintenance or some materials obstructing the pedestrian sidewalk. With the reduction of speeds even in cases where road crashes involve pedestrians, this happens at lower speeds and the probability of fatality is reduced. However, it is important to note that T-test results show an insignificant change in pedestrians affected before and after implementation of speed humps. The reduction, however, is important for road safety and the economy in general as road fatalities are costing South Africa billions annually. A sense of safety to pedestrians translates into more trips (Dumbaugh & Rae, 2009), this making neighbourhoods liveable.

The study did not take cognitive abilities of pedestrians and vehicles into account. This is important to note as cognitive abilities do have an impact on how pedestrians and drivers make judgments, including on accidents. The absence of this information could affect the conclusiveness of this study on the effectiveness of speed humps in reducing accidents.

Do speed humps lower accident amongst young pedestrians?

The study was seeking to establish if speed humps were also effective in lowering the number of accidents that involve young pedestrians who are aged 18 and below. This finding was very important as the National Household Travel Survey revealed a lot of kids walking long distances to school, particularly in townships (StatsSA, 2013). In the study, the number of young pedestrians went down from 30 to 5. This clearly shows that speed humps do assist in lowering the number of accidents amongst young pedestrians. The margin of change was, proven to be significant according to the T-test, which makes this finding very important in this research.

What role do speed humps play in communities where there are inadequate NMT facilities such as sidewalks?

To answer the question about the role of speed humps in communities where there are no sidewalks, or, in some instance, no verge at all, the research used accidents that involved pedestrians walking on the roadway. From the results, there was a reduction in the number of pedestrians. This information is particularly important in neighbourhoods where, for some reason, pedestrians are forced to walk on the roadway. T-test showed an insignificant change in the before-and-after study, which is critical in deciding on the importance of the reduction. Notwithstanding results of the T-test, it is important to note the reduction of accidents involving pedestrians walking on the roadway.

Do speed humps have an impact in reducing public transport (minibus taxis and busses) accidents?

There were 103 public transport vehicles (buses and minibus taxis) involved in crashes before speed humps were installed and this dropped to 66 public transport vehicles after speed humps were implemented, a reduction by 35.92%. A T-test carried out on public transport vehicles indicated no significant change. Using results of this T-test, we can conclude that, speed humps, in this case, do not effect a significant change in reducing public transport crashes on the road. Although the reduction is statistically important, it is important to understand the change. Although the study looked at accidents involving minibus taxis and busses, it did not look at the state of roadworthiness of these vehicles. This is very important to note as some accidents could have occurred because of mechanical failures attributed to vehicles that are not roadworthy. This presents a limitation on the conclusiveness of the study.

9. CONCLUSIONS AND RECOMMENDATIONS

There are questions of interest within traffic calming and speed humps that this research fell short of investigating. This research is making recommendations on what researchers could expand on for more knowledge to be acquired and more refined conclusions to be made. Systemic deficiencies in both policy and implementation were noticed and further recommendations are made on actions policy makers and implementing agencies could take in improving the effectiveness of traffic calming.

Literature suggests evidence of a relationship between network configuration and travel behaviour. This relationship clearly shows how pedestrian and vehicle travel behaviour is influenced by network configuration and land use patterns in an area (Behrens, 2002b). However, this research did not investigate broader network configuration and land uses but only looked specifically on individual roads where traffic calming was implemented. The study area only included the 20 roads in the study. This means any potential impact of network configuration and land uses was ignored. Future research could investigate network configuration and land uses in the area of influence to the study area, not limited to the roads under this study. This data is important as it affects travel behaviour, which is equally important in accident studies. This information along with land use information before, during and after the study period could be used to study how travel patterns of pedestrians and vehicles are affected and then help improve the quality of results.

In future, researchers could also look at vehicle ownership statistics in the study area. This will assist and studying a possible relationship(s) between vehicle ownership in the area and its impacts on accidents. In doing so, authorities can make informed policy decisions when it comes to implementation of traffic calming. An example could be to put priority in areas where there are high pedestrian volumes or where there are is high vehicle ownership. The quality of road infrastructure could also be looked at as it affects how pedestrian and vehicles use the road. In cases where there are no sidewalks, or where sidewalks are in a poor state, pedestrians are forced to walk on the roadway, thus increasing potential risk for accidents on the road. On roads where there are potholes or some other distractive objects on the roadway, driver reaction could be affected, and this could have an impact on road safety as well as accidents on the road.

From a local network design point of view, South Africa is still largely living the legacy of apartheid spatial planning that resulted in longer trips for people in townships. Longer trips to commute to work are also a factor in driver behaviour and higher speeds. In this case,

speed humps are effective in curbing speeds around residential areas. However, South Africa still has an opportunity for improved designs in new Greenfields. This includes improving network design practices that will require a realignment of priorities in which networks need to be designed first to meet the travel needs of pedestrians, bicycles and public transport, and then to accommodate motor cars as Behrens (2005) argues. eThekwini Municipality only has information about implementation year of speed humps. Actual date (day and month) of installation of speed humps was not available. This limitation could have implications on the effectiveness of speed humps on some of the roads. It would be very helpful for authorities to keep record of actual dates of installation of speed humps. Other researchers could use this information to test other road safety variables.

Speed humps remain very popular as traffic calming measures in eThekwini and other cities in South Africa. This type of traffic calming might not be as expensive as speed tables or roundabouts, but it is still costly compared to most passive mitigating measures such as educational campaigns. The practice of using obstructions and active mitigating measures as a first point of addressing road safety is not a panacea to the problem of speeding. It also does not necessarily change how vehicle drivers perceive roads. The Municipality of eThekwini has an opportunity to allocate funds to educational campaigns to raise awareness amongst roads users. This is not mutually exclusive to implementation of speed humps and could be done while speed humps are being implemented.

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