THE IMPACT AND FEASIBILITY of 30 km/h SPEED LIMIT ZONES at SCHOOLS

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Overview

Introduction
Objective of the study
Methodology
Results
Conclusion

Introduction

I was given the opportunity to visit Lund University in 2008.

Attending a Advanced Traffic Safety Course.

Learned some best practices measures used by the Swedish and other European Countries

On of these best practices measures used by role-players was the introduction of 30km/h Speed Limit Zones at Schools and at other high pedestrianized areas.

Back in South Africa, I've enrolled for a Masters of Science Degree in Transportation Engineering. As part of the studies I had to submit a assignment which show how the South African road safety policy comply to international norms and policies.

To complete this assignment I've used the "National Road Safety Strategy, 2006 onwards" document.

The "National Road Safety Strategy, 2006 onwards" document also referred to 30 km/h Speed Limit Zones as a best practice measure which can be applied to enhance safety in areas of high vulnerable road users.

RESULT

I've decided to test and evaluate the introduction of 30 km/h Speed Limit Zones as partial fulfilment of the requirements for the degree of MASTER OF SCIENCE (TRANSPORTATION)

Objective of the Study

The objective of this study was to measure the effectiveness of introducing a 30 km/h speed limit zone strategy at schools, where high pedestrian activity and non-motorised transport are present which are endangered by vehicular traffic.

Problem Statement

- Local Authorities are confronted on a daily basis with road traffic safety challenges.
- Authorities assisting to address unlawful drivers behaviour and implement remedial measures to enhance the safety of scholars.
- Despite these measures, affected parties around the school continue to approach the authorities to implement further measures to curb the dangerous driving behaviour.
- The practice of 30 km/h speed limit zones are not commonly applied in South Africa to improve pedestrian safety on lower order roads around schools.
- Very little before-and after data are available to understand and evaluate the effectiveness of 30 km/h speed limit zones, once installed.

Objective of Experiment

To quantitatively measure the impact of 30 km/h speed limit zone at schools.

- On average speed
- On speed variances, and
- The odds of change in speed

Assess the acceptability to the community (qualitative feedback)

Research Hypotheses

Two variables were measured:

- Before-and-After Mean Speeds
  - (Two-Tailed Hypothesis Test) – Equal Population Means
  - H0: μ = the 30 km/h speed limit zone has no effect on the mean speed
  - H1: μ ≤ the 30 km/h speed limit zone will result in a change in the mean speed

- Before-and-After Population Speed Variances around the Mean
  - (Standard Deviation Test)
  - H0: μ = There has not been a change in the variances of two populations' speeds as a result of the 30 km/h speed limit zone.
  - H1: μ ≤ There has been a change in the variances of two populations' speeds as a result of the 30 km/h speed limit zone.

SCHOOL SITES IDENTIFICATION

The following criteria were used to select the three school pilot sites:

The schools were selected through a judgment and convenience sampling method.

- High pedestrian volumes and activity
- Complaints by pedestrian / community to address safety
- Vehicle/ pedestrian conflict
- School location related to road classification

Site visits were conducted to determine if they would be suitable as pilot project sites.

The three school sites are located in Atteridgeville, Lukasrand and Soshanguve, namely:

- Phelindaba Secondary School, Atteridgeville – Maboea Street Section between Sehloho Street and Moroe Street
- Crawford College, Lukasrand – Sibelius Street section between Lente Street and Dr Lategan Road
- A Re Thabeng Primary School, Block L, Soshanguve – Road A19528

CONTROL (COMPARISON) SITE IDENTIFICATION

The following criteria were used to select the control site:

The control site was selected through a judgment and convenience sampling method.

- Close proximity from one of the school sites
- Similar road classification
- Similar traffic use and traffic volume

The site is located in Groenkloof, near Lukasrand.

The site that was used as the control site is Totius Street - not to far from Sibelius Street. (Crawford College)

DESCRIPTION AND LOCATION OF SCHOOL SITES

PHELINDABA SECONDARY SCHOOL, ATTERIDGEVILLE – MABOEA STREET SECTION BETWEEN SEHLOHO STREET AND MOROE STREET

CITY OF TSHWANE
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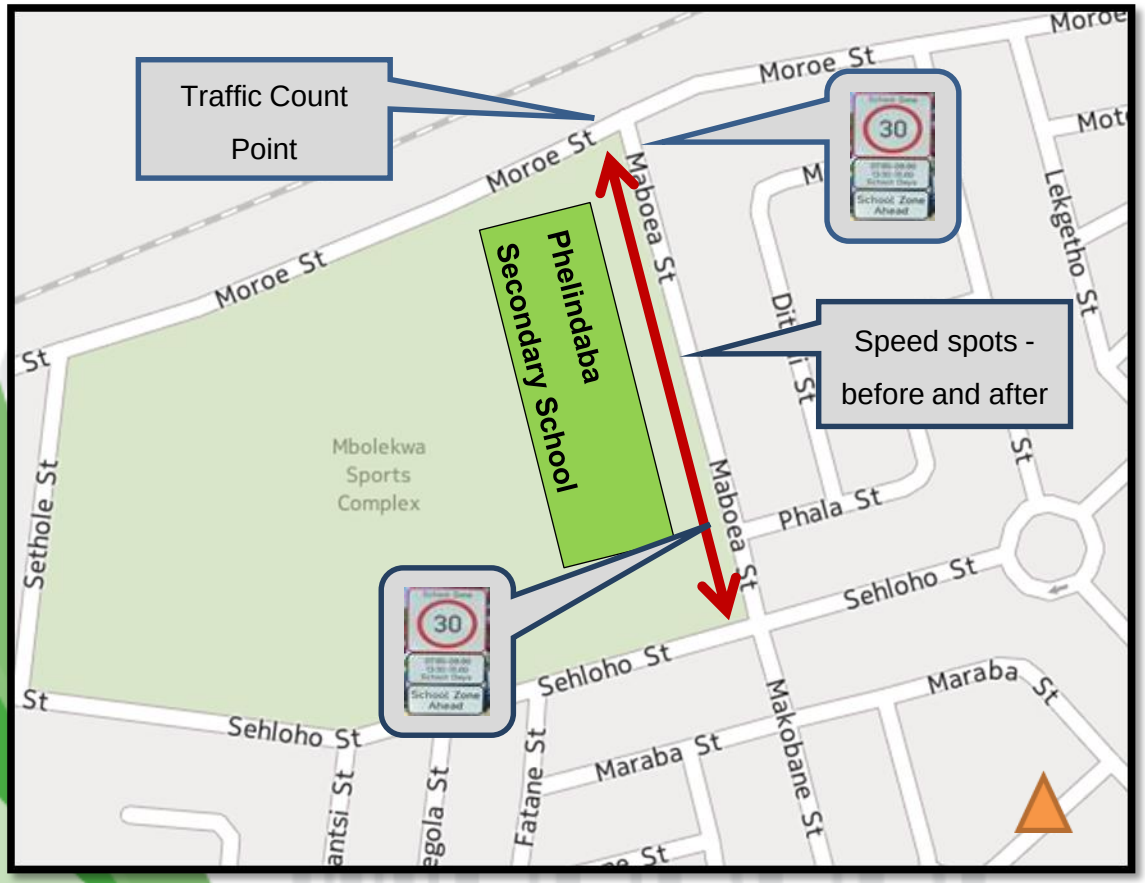
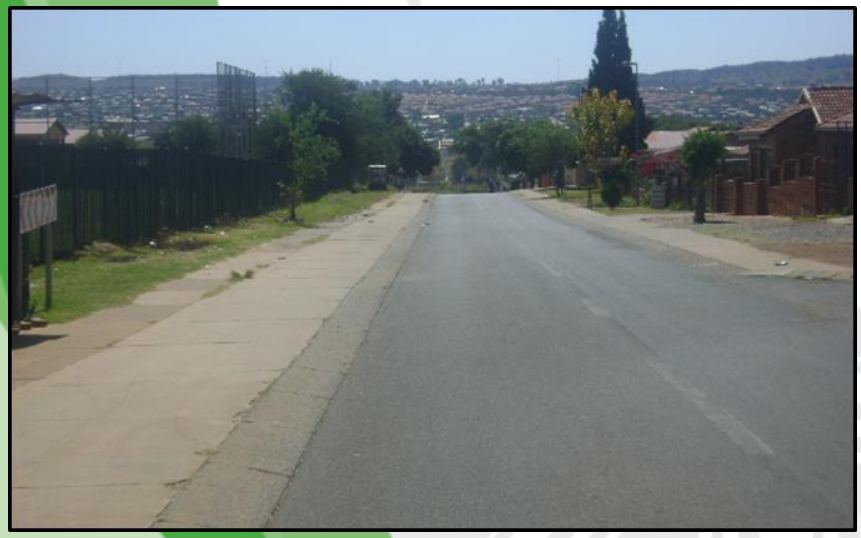


DESCRIPTION AND LOCATION OF SCHOOL SITES (2)

CITY OF TSHWANE
IGNITING EXCELLENCE

Maboea Street – Direction North – Before



Maboea Street – Direction North – After

Data Collection

Sampling Strategy

Stratified Random Sample

Population of Interest

Through Traffic : Private Passenger Vehicles

Public Transport Vehicles

Sample Size Requirement

vs

Population

Survey Methodology
Quantitative Data

- Gained knowledge from sites
- Population for each site – 12 hour traffic count / and the time period display on sign
- Speed of vehicles were measures randomly
- “free vehicles” – un interrupted flow
- First vehicle in queue
- Hand-held laser gun was used to measure vehicle speeds
- Dates – Collect Data
  - “before” – March 2011
  - “after” – August 2011
  - “after” – April 2013

ODDS RATIO TEST – QUANTITATIVE DATA

- An additional method, namely the “Quasi-Experimental Method” (Odds Ratio Test) was applied to test the treatment sites against the comparison site.

- The odds ratio (OR) is one of several statistics that have become increasingly important in research and decision-making. It is particularly useful because as an effect-size statistic, it gives clear and direct information about the research results.

The question that must be addressed by the Odds Ratio Test is:

- How many more times the average “before” speed is likely to be exceeded before the erection of the 30 km/h speed limit signs, and then after the erection of the signs?

Survey Methodology
Qualitative Data

Some formal public feedback were obtained.

- Headmasters and scholars

The following questions were put to the school representatives:

- What is your experience since the implementation of the 30 km/h speed limit zone signs?
- Will you say that the safety of the scholars has improved?
- Was there a change in attitude or behaviour in the motorists since the signs were installed?
- Have you had any feedback from scholars and parents?
- Will you say these 30 km/h speed limit zones can be considered at other schools in Tshwane too?

The interviews do not form part of the statistical evaluation but the feedback from the interviews were included in the conclusion of the dissertation.

DATA ANALYSIS AND FINDINGS

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Descriptive Statistics for Speed

School	Arathabeng School
Street	Road A19528
Suburb	SOSHANGUVE - Block L
Direction of Travel	Eastbound
Vehicle Type	Passenger vehicles

Traffic Flow Data

	Daily Traffic	Peak Hour Traffic
Before	177	91
After	115	80

Group Statistics - Speed Data

	Average Speed	Standard Deviation	85th Percentile	Minimum Speed	Maximum Speed	Sample Size	Std. Error Mean	Levene's Test for Equality of Variances: Significance p-value	Levene's Test for Equality of Variances: Hypothesis F-value
Before	42.6	9.4	51.0	25.0	63.0	69	1.1326		
After	34.3	10.8	45.0	18.0	62.0	68	1.3125		
%Change	-19.3%	15.0%	-11.9%	-28.0%	-1.6%			0.230	1.4550

Independent Sample Test - Equal Variances Assumed

t-test for Equality of Means

Pooled Std Error Degrees of Freedom	t-value	Confidence Intervals of the difference at 95%		Mean Difference	Significant (2-tailed)
		Lower	Upper		
1.73 135.00	4.742	4.787	11.638	8.2125	0.0000

DATA ANALYSIS AND FINDINGS (2)

CITY OF TSHWANE
IGNITING EXCELLENCE

Descriptive Statistics for Speed	
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The F-test is used to compare the variances (standard deviations) of the two groups for equality.

The null hypothesis tested in this case is that the variances are the same in the population for the "before" and "after" groups. With F=1.455 and the corresponding p-value = .230 > .05, the null hypothesis cannot be rejected and therefore it can be assumed that the variance in the two groups is the same in the population.

The independent samples t-test revealed a significant difference in the mean speed before the introduction of the 30 km/h speed limit and the mean speed thereafter (t(135)=4.742, p<.001).

Thus, at the 0.1% level of significance, the mean speed before the introduction of the 30 km/h speed limit (M=42.6 km/h, SD=9.41) is significantly higher than the mean speed after the introduction of the 30 km/h speed limit (M=34.3 km/h, SD=10.82).

Generalizing this highly significant result to the population under study, it can be concluded that the reduction in speed after the introduction of the 30 km/h speed limit can be expected to range from 4.8 km/h (11.3%) to 11.6 km/h (27.4%) with a confidence level of 95% interval.

The null hypothesis: "that in the population there is no difference in the mean speed before and after the introduction of the 30 km/h speed limit", can be rejected as a result of this highly significant result.

DATA ANALYSIS AND FINDINGS (3)
Graphic Presentation

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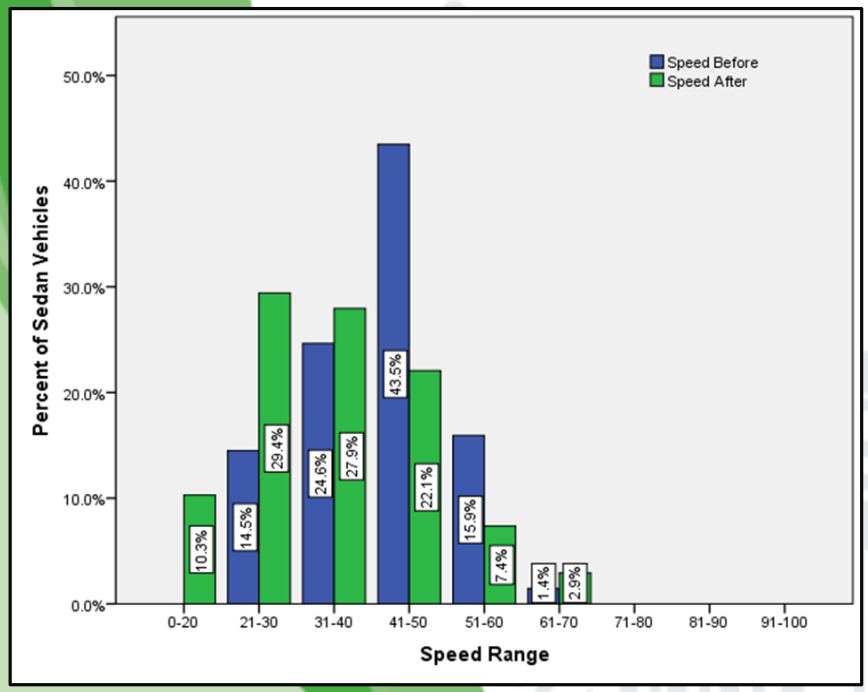
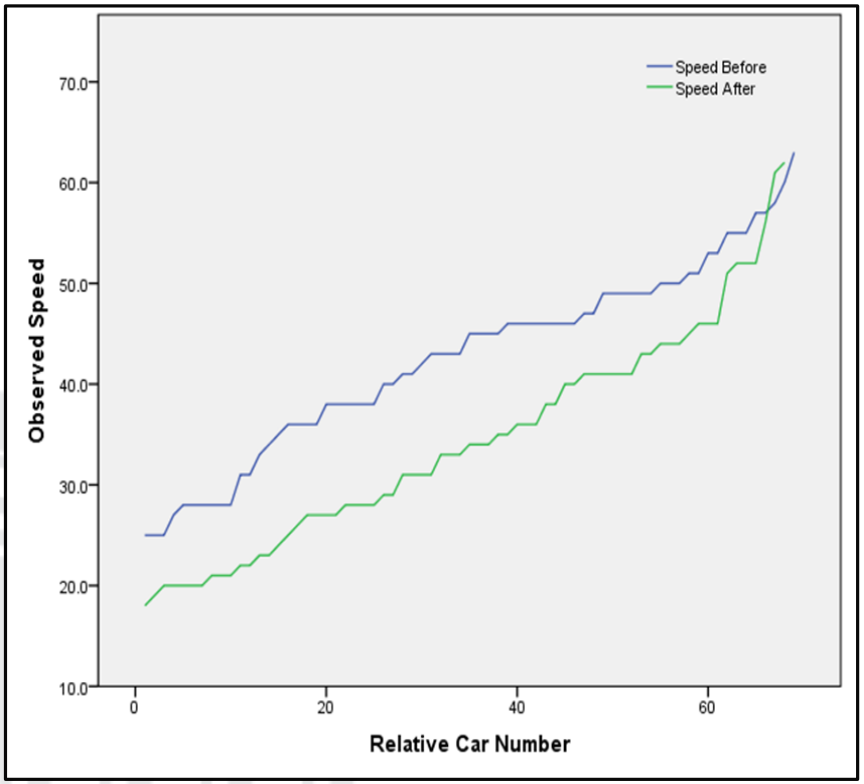
Comparative Before-and-After Bar Chart for Speed Range



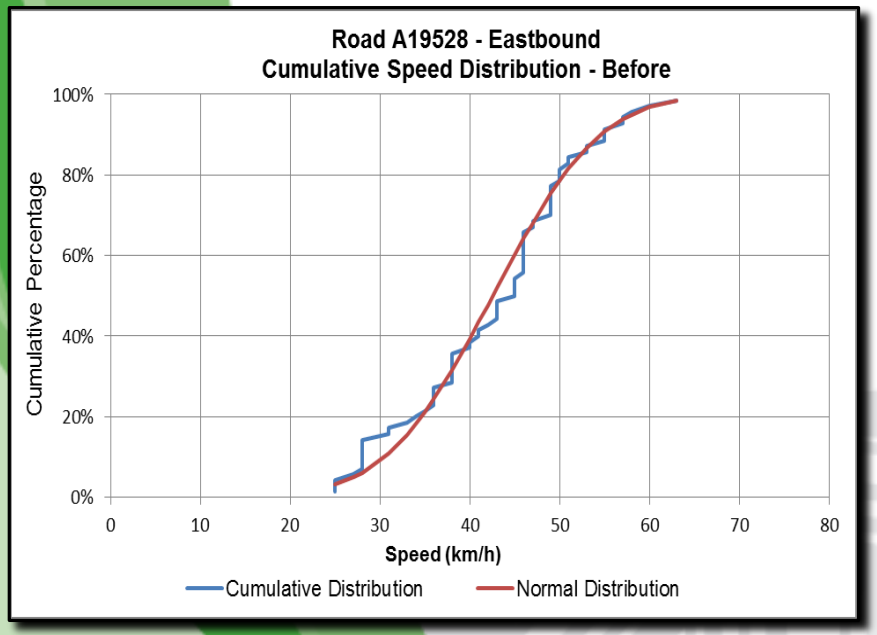
Observed speed relative to car numbers

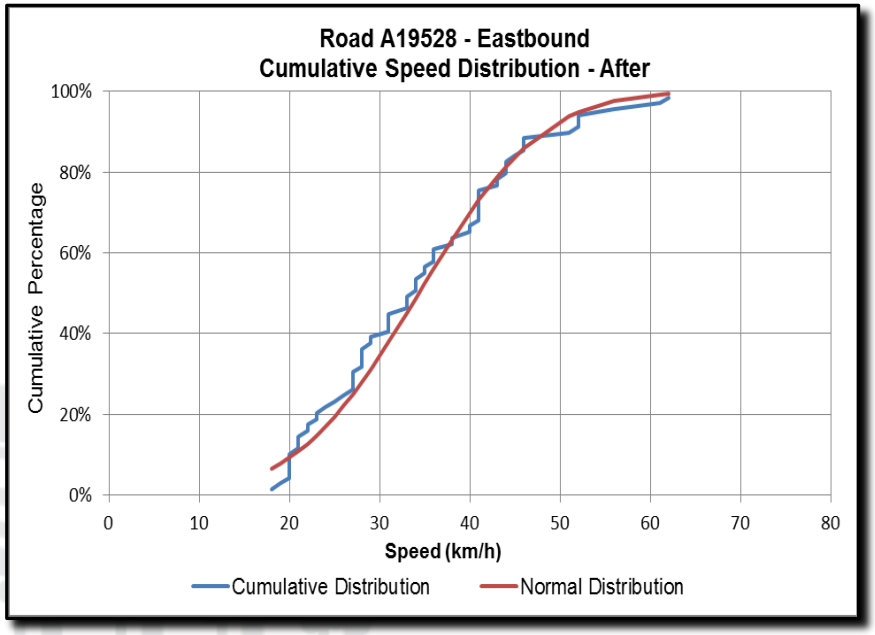


DATA ANALYSIS AND FINDINGS (4)
Graphic Presentation

Before" Cumulative Speed Distribution – Road A19528 – Eastbound – Passenger Vehicles

"After" Cumulative Speed Distribution – Road A19528 – Eastbound – Passenger Vehicles





DATA ANALYSIS AND FINDINGS
ODDS RATIO TEST

CITY OF TSHWANE
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Vehicle Counts Exceeding Average Speed Cross Tabulation

Before/After 30 km/h
Vehicle Counts Exceeding Average Speed Cross Tabulation

		Exceed Average Speed		Total
		Exceeded Average Before Speed	Did not Exceed Average Before Speed	
Before/ After (30 km/h speed Limit)	Before	39	30	69
	After	16	52	68
Total		55	82	137

Only 16 vehicles exceeded the average "before" speed after the erection of the 30 km/h speed limit school zone sign. An additional 22 vehicles drove slower than the average "before" speed after the erection of the 30 km/h speed limit school zone sign.

Risk Estimate

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Before/After 30 km/h (Before / After)	4.225	2.026	8.813

The odds of exceeding the average "before" speed before the erection of the 30 km/h speed limit sign are 4.225 times the odds of exceeding the average "before" speed after the erection of the 30 km/h speed limit sign, with a 95% confidence interval of between 2.026 and 8.813.

SUMMARY OF RESULTS
QUANTITATIVE DATA

For the purpose of this report the following two elements are of importance.

- The Average Speed
- 85th Percentile Speed
- Odds Ratio Risk

The following tables depict the differences between the before and after average speeds and 85th percentile speeds for the respective sites and also the percentage change between the before and after speeds.

SUMMARY OF RESULTS (2)
QUANTITATIVE DATA

CITY OF TSHWANE
IGNITING EXCELLENCE

Palindaba Secondary School - Atteridgeville – Maboea Street Section between Sehloho Street and Moroe Street

Passenger Vehicles: Northern Bound

	Average Speed (km/h)	85th Percentile Speed (km/h)
Before	38.7	48
After	33.7	43
% Change	**-12.9%**	**-10.4%**

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Before/After 30 km/h (Before / After)	1.544	.772	3.087

Passenger Vehicles: Southern Bound

	Average Speed (km/h)	85th Percentile Speed (km/h)
Before	47.8	56.3
After	30.9	41.0
% Change	**-35.3%**	**-27.2%**

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Before/After 30 km/h (Before / After)	51.000	6.412	405.665

Public Transport: Northern Bound

	Average Speed (km/h)	85th Percentile Speed (km/h)
Before	53.2	59.2
After	34.9	41.0
% Change	**-34.3%**	**-30.7%**

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Before/After 30 km/h (Before / After)	28.966	3.692	227.270

Public Transport: Southern Bound

	Average Speed (km/h)	85th Percentile Speed (km/h)
Before	53.8	65
After	34.0	41
% Change	**-36.8%**	**-36.9%**

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Before/After 30 km/h (Before / After)	8.458	1.773	40.359

SUMMARY OF RESULTS (3)
QUANTITATIVE DATA

Re Thabeng Primary School– Roads A19528, – Block L, Soshanguve

CITY OF TSHWANE
IGNITING EXCELLENCE

Passenger Vehicles: Eastern Bound

	Average Speed (km/h)	85th Percentile Speed (km/h)
Before	42.3	51.0
After	34.3	45.0
% Change	**-19.3%**	**-11.9%**

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Before/After 30 km/h (Before / After)	4.225	2.026	8.813

Passenger Vehicles: Western Bound

	Average Speed (km/h)	85th Percentile Speed (km/h)
Before	42.7	54.0
After	34.3	45.0
% Change	**-19.5%**	**-16.8%**

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Before/After 30 km/h (Before / After)	**3.545**	**1.585**	**7.933**

Public Transport: Eastern Bound

	Average Speed (km/h)	85th Percentile Speed (km/h)
Before	42.1	47.2
After	30.2	35.4
% Change	**-28.3%**	**-25.1%**

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Before/After 30 km/h (Before / After)	18.750	3.710	94.763

Public Transport: Western Bound

	Average Speed (km/h)	85th Percentile Speed (km/h)
Before	41.3	48.0
After	32.1	41.0
% Change	**-22.1%**	**-14.6%**

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Before/After 30 km/h (Before / After)	8.458	1.773	40.359

SUMMARY OF RESULTS (4)
QUANTITATIVE DATA

CITY OF TSHWANE
IGNITING EXCELLENCE

Crawford Collage - Lukasrand – Sibelius Street section between Lente Street and Dr Lategan Road

Passenger Vehicles: Eastern Bound

	Average Speed (km/h)	85th Percentile Speed (km/h)
Before	42.6	51
After	34.3	45
% Change	**-19.3%**	**-11.9%**

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Before/After 30 km/h (Before / After)	4.225	2.026	8.813

Passenger Vehicles: Western Bound

	Average Speed (km/h)	85th Percentile Speed (km/h)
Before	47.3	52.9
After	33.0	40.0
% Change	**-30.3%**	**-24.4%**

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Before/After 30 km/h (Before / After)	33.116	7.582	144.637

FEEDBACK ON THE QUALITATIVE DATA FOR THE SCHOOL ZONE SITES

Feedback was received from all three school representatives. The overall responses were very positive towards the implementation of 30 km/h speed limit school zones. The feedback ranged from:

- Traffic is much calmer
- Change in speed is quite adequate

- The recommendation made by the representative of A Ra Thabeng School in Soshanguve is *"that signs like these be put at most schools since this would save lives of our children".*

CONCLUSION

- Although the objective of this study was not purely to evaluate the effectiveness of a road sign, the results clearly show that if road signs are placed in a correct manner and where the message is relevant to the location, a large proportion of motorists are willing to adhere to the instruction given by the sign.

- The results arising from this study further show that international best practice initiatives can be applied with great success and that 30 km/h speed limit school zones can contribute to safer roads, which again add to the National Road Safety Strategies to reduce the increasing trend in road traffic fatalities

RECOMMENDATION

It is therefore recommended that authorities introduce 30km/h speed limit zones at schools and other high-volume pedestrianized areas, to improve road safety, if warranted.

It is recommended that further research be done into the effectiveness of 30 km/h speed limit zones on higher order roads where pedestrian activity is high, which aspect was not addressed by this research.

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Thank you

Sample Size Calculation

- The question that should be asked is whether the sample is representative of the population that it is intended to represent?

- The following calculation was used to determine the sample required for a difference of 5 km/h from the 30 km/h in the mean speed to be statistically significant at the 5% level of significance.

The margin of error: 5% of the average speed (which is expected to be 2.5 km/h).

- $(1 - \alpha)$ = Level of confidence = 95%. a = 5%
- a = Significance level = 5%

z = Standard normal random variation – large random sample from a population with a mean μ and standard deviation σ, the sample mean $\bar{X}$ is approximately normally distributed. - Z has a 0.95 probability of being between the ranges of values.

With:

- m = Sample mean
- s = Sample standard deviation *(determined from measured sample)*
- s^2 = Sample variance
- α = Population mean/variance.
- E = Margin of error
- Z = 1.96

- A minimum sample size for each site was calculated by using the calculated sample mean speed and standard deviation.

- The required sample sizes (n) were calculated as follows:

- $n = \frac{(S)^2 * Z^2}{E^2}$ **example:** $n = \frac{(9)^2 * 1.96^2}{(0.05 * 56)^2}$ = 39.7 (40)