LITERATURE REVIEW

Research on Improved Driver Behaviour on South African Roads

Phase A: SPEED & SPEED LIMITS IN SA

Road Traffic Management Corporation

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ACRONYMS

AAA	Automobile Association of America
ATSB	Australian Transport Safety Bureau
COTO	Committee of Transport Officials
CPI	Consumer Price Index
DUSL	Default Urban Speed Limit
ECMT	European Conference of Ministers of Transport
ECSA	Engineering Council of South Africa
GDP	Gross Domestic Product
iRAP	International Road Assessment Programme
ISBN	International Standard Book Number
ISO	International Organisation for Standardisation
MUARC	Monash University Accident Research Centre
NDoT	National Department of Transport
NMT	Non-Motorised Transport
NRSS	National Road Safety Strategy, 2016 – 2030
NRTA	National Road Traffic Act, 1996 (Act No. 93 of 1996)
OECD	Organisation for Economic Co-operation and Development
RAP	Road Assessment Programme
RTMC	Road Traffic Management Corporation
RTMCA	Road Traffic Management Corporation Act, 1999 (Act No.20 of 1999)
SA	South Africa
SANRAL	South African National Roads Agency SOC Limited
SANS	South Africa National Standard
SA-RAP	South African Road Assessment Programme
SARDS	South African Road Design System
SARTSM	South African Roads Traffic and Signs Manual
SMEC	Snowy Mountains Engineering Corporation
SRIPs	Star-Rated Roads and Safer Road Investment Plans
TMH	Technical Method for Highways
UN	United Nations
UNDA	United Nations Decade of Action
UNECE	United Nations Economic Commission for Europe
VRU	Vulnerable Road User
WHO	World Health Organisation

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PART A: SUMMARY AND RECOMMENDATIONS

A.1 There is overwhelming evidence of a strong relationship between speed and crash risk and outcome severity in the event of a crash. The World Health Organisation (WHO) states in its Global Status Report on Road Safety 2018 (based on 2016 crash data) that deaths from road traffic crashes[1] have increased to 1.35 million a year and is the 8th leading cause of death in the world. The report ranks South Africa 136th out of 175 participating countries regarding road safety in terms of its death rate of 25.9/100 000 population. South Africa is ranked 82nd out of 86 Group 1 countries, 83rd out of 98 middle-income countries and 15th out of 44 African countries, respectively.

A.2 The WHO best practice criteria recommend an urban speed limit of less than 50 km/h. When analysing the WHO data, there is a clear trend for urban speed <=50 km//h when considering best performing countries. There is no clear trend for rural highway speed <=80 km/h when considering best performing countries. There is also no clear trend for motorway speed <=100 km/h when considering best performing countries.

A.3 The following recommendations are made for further research to improve/intensify efforts in dealing with speeding and determining appropriate speed limits:

(a) Further research is required to develop models (e.g. the NetSafe Highway Road Safety Model developed by the South African National Roads Agency SOC Limited (SANRAL)) using road traffic crash statistics. Such research will only be possible once the crash reporting system in South Africa has been improved and all data captured, including the exact locations of crashes. Other provincial statistical data is also required for the improvement of the model.

(b) The Road Traffic Management Corporation (RTMC) crash data is based on fatal crashes only. There is a need for in-depth research to be conducted to collect scientific base facts to complement the administrative data.

(c) Research is required regarding fictitious road insurance claims for death and/or serious injuries against the Road Accident Fund.

(d) Research is required into whether short-term insurance claims have reduced since the implementation of driver behaviour incentive plans by short-term insurers.

A.4 Road safety interventions should be assessed according to the Technical Method for Highways (TMH) 20, Socio-Economic Analysis of road projects, Aug 2018. This manual sets out the following official requirements for the socio-economic analysis of road projects in South Africa, which apply in the national, provincial and municipal spheres of government:

(a) The testing of speed limits against operational speeds

(b) The establishment of Speed Limit Committees consisting of a multi-disciplinary team of professional engineers, traffic law enforcement officers and personnel in other relevant disciplines

[1] The expression "road traffic crash" is intentionally aligned with the definition in SANS/ISO 39001. The expression "road traffic crash" (or "crashes" in short) is used throughout this report and has the same meaning as the definition of "accident" in the National Road Traffic Act, 1996 (Act No. 93 of 1996) (NRTA).

(c) The reduction of urban speed limits from 60 km/h to 50 km/h
(d) The reduction of urban speed limits from 60 km/h to 40 km/h in high pedestrian areas
(e) The reduction of speed limits from 60 km/h to 30 km/h in school zones
(f) Effective law enforcement with effective prosecution
(g) Speed governors in heavy vehicles and public transport vehicles
(h) The improvement of road traffic crash statistics, including the exact locations of crashes.

PART B: REPORT

Human behaviour is a key factor in 80-90% of road traffic crashes (e.g. Rothengatter, 1997, Shinar, 2007). For the development of effective preventative measures, it is crucial to know which types of driving behaviour are problematic in the context of road safety and which sub-groups of drivers perform these types of behaviour. The WHO has identified speed as one of the key risk factors in road traffic injuries, influencing both the risk of a road crash as well as the severity of the injuries that result from crashes.

Human behaviour as major contributing factor to road traffic crashes in South Africa was an estimated 90% over the past few years with 'speed too high for circumstances' reported as the main cause in 23.7% of all fatal crashes. It could be argued that speed could be a secondary contributing factor in various other major human behavioural contributing factors such as 'Jay-walking pedestrian' (37.5%), "Hit-and-run' (15.2%), 'Overtook across barrier line' (5.6%), 'Overtook in face of oncoming traffic' (4.8%) and 'Followed vehicle too closely' (3.1%), which would increase the effect that speed has on crashes in South Africa drastically.

According to the WHO, research on effective speed management indicates that the speed limits on urban roads should not exceed 50 km/h. In addition, traffic calming measures that have shown to be very effective at reducing road traffic injuries can be implemented at the sub-national level as needed – for example, in residential areas or near schools. Globally, only 29% of countries have urban speed limits of 50 km/h or below and allow local authorities to reduce them further. In most countries, efforts to reduce urban speed limits are still needed. In South Africa, urban speed limits vary between 40 and 80 km/h with the speed limit in urban areas predominantly 60 km/h.

The National Road Safety Strategy, 2016 – 2030 (NRSS) states that speed limits are not tailored to road environment and not aligned to international best practice and proposes the need to investigate the extent to which factors such as speed limits are factored into road design, this not discounting that human behaviour remains the leading driving element for speeding. Internationally, speed limits have been reduced over the years in line with Safe System principles, yet in South Africa no such review has been officially carried out. The NRSS further sets the objective to intensify efforts to deal with speeding and determine appropriate speed limits.

With speed identified as one of the main human behavioural cause of road crashes internationally and in South Africa, a literature review is necessary that concentrates on the effect of speed and speed limits on road traffic crashes.

The Report serves as a reference document to inform road safety programmes towards safer roads in South Africa (Phase A – Speed Limits in SA).

The Report consists of five chapters; the first chapter contains an introduction to the global plan to address the road crashes. Chapter 2 discusses the relationship between speed and crash risk. Chapter 3 reviews international and local speed research regarding the impact of speed and speed limits. Chapter 4 compares speed and speed limit in the best performing United Nations Decade of Action (UNDA) countries. In Chapter 5, certain concluding and recommending remarks are made.

B.1 INTRODUCTION

The Global Plan for the United Nations Decade of Action for Road Safety to address road crashes sets out five pillars for action as shown in Figure 1 below. The Global Plan urges Member States to act on each of the five pillars within their own constitutional frameworks. Speed limits and speed related aspects are not limited to only one pillar, but form part of pillars 1, 2 and 4.

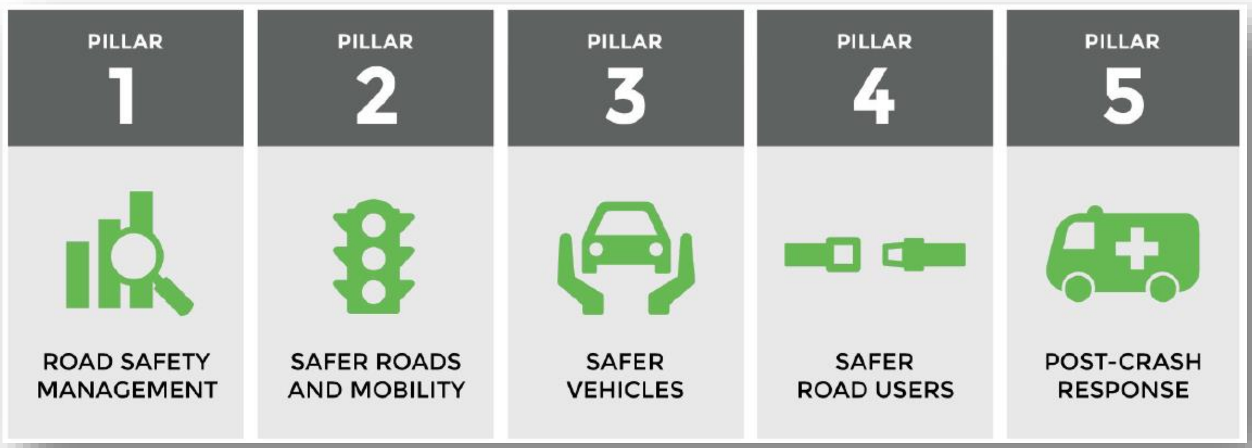

Figure 1: Five pillars of the Decade of Action for Road Safety

B.2 RELATIONSHIP BETWEEN SPEED AND CRASH RISK

There is overwhelming evidence of a strong relationship between speed and crash risk and outcome severity in the event of a crash. Moving vehicles is the source of kinetic energy that causes injury in motor vehicle crashes. Higher speed means more kinetic energy and more severe injury in the event of a crash, regardless of the cause. It is a given that injuries sustained from a high-speed crash will be more severe than at lower speeds. This relationship has been captured in various models, most notably Nilsson's "Power Model".[2]

The severity of a crash follows from the law of physics. At higher speeds, the kinetic energy released in a crash increases with the square of the speed. The changes of speed experienced by road users hit by or occupying the vehicles involved, increase with speed. Pedestrians are particularly at higher risk of experiencing severe to fatal injury if excessive or inappropriate vehicle speed is prevalent.

In recent decades, various research efforts have shown a close correlation between speed, road crash frequency and severity. The speed at which a vehicle travels directly influences the risk and severity of the crash increasing the risk of severe injuries and fatalities (indicated in Figure 2 below).

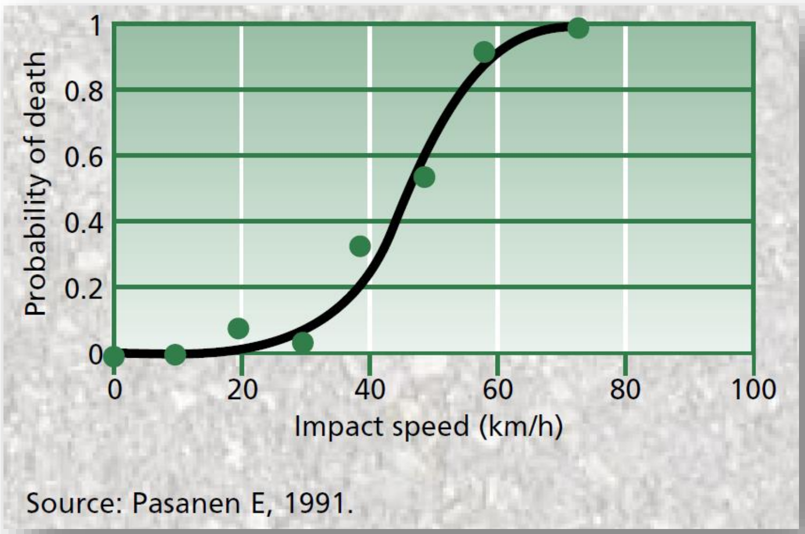

Figure 2: Pedestrian fatality risk as a function of the impact of speed of a car

Although not necessarily caused by high speed, it becomes more difficult to avoid a crash at high speed. The increase in crash risk is explained by the fact that when speed increases, the time to react to changes in the environment is shorter and manoeuvrability is less. In traffic, drivers on average need approximately one second to react to an unexpected event and choose an adequate response (i.e. the reaction time). When vehicles travel at higher speed, longer distances are travelled during the reaction time, longer distances are required to stop and controlling the vehicle becomes more difficult. High speed puts more strain on tyres and brakes, which increases the risk of a tyre burst or brake failure. It is not only high speed that leads to crashes, but speed that is excessive for the circumstances. The risk of a crash depends on various factors,

[2] Speed and Crash Risk, International Transport Forum, 2018.

such as day and night conditions, weather conditions, visibility, traffic, the road design as well as the road environment. Drivers need to adapt speed according to the conditions of the road, or a section thereof. Unfortunately, drivers do not always lower their vehicle speed in deteriorating conditions and increase the risk of a crash.

The question is whether there is more likelihood of a crash occurring if vehicles travel at higher speeds, which make the task of driving more difficult because drivers must perceive, interpret and respond to relevant stimuli at a faster rate. In complex driving environments, this may overwhelm a driver's perceptual or cognitive capacity, resulting in failure to recognise or respond to hazards. Even when the driver sees a hazard and responds appropriately, higher speed results in greater distance travelled by the vehicle during perception and reaction times, and requires exponentially greater braking distance. In addition, higher speeds make it more difficult to negotiate curves or manoeuvre around road hazards and faster vehicles are more difficult for other road users to avoid. The compelling question is whether a particular crash would have been avoided at lower speeds.

Significant worldwide progress has been made in attending to safety risk factors such as motorcycle helmets, safety belts, alcohol consumption and child restraints, but there has generally been less progress in adopting best practice on speed limits. Most research studies on lowering of urban vehicle travel speeds and speed limits are not merely investigating the impact on vehicle and pedestrian crashes (i.e. the safety issue) but also vehicle operating costs (e.g. reducing fuel consumption, less wear and tear and greater energy efficiency) as well as environmental impacts (e.g. less emissions, pollution and noise) and an increase in traffic flow and a consequent reduction in congestion and delays.

B.2.1 Worldwide Overview of Road Deaths

The WHO is a specialised agency of the United Nations (UN) that is concerned with international public health and as such is actively involved in studies concerning road safety. The WHO states in its 2018 Global Report on Road Safety that deaths from road crashes have increased to 1.35 million a year and is the 8th leading cause of death in the world. According to the data, based on 2016 road traffic crash statistics, every 24 seconds someone dies on the road. Globally, Vulnerable Road Users (VRUs) are disproportionally impacted by road related deaths, with pedestrians and cyclists representing 26% of all road related deaths (indicated in Figure 3 below).

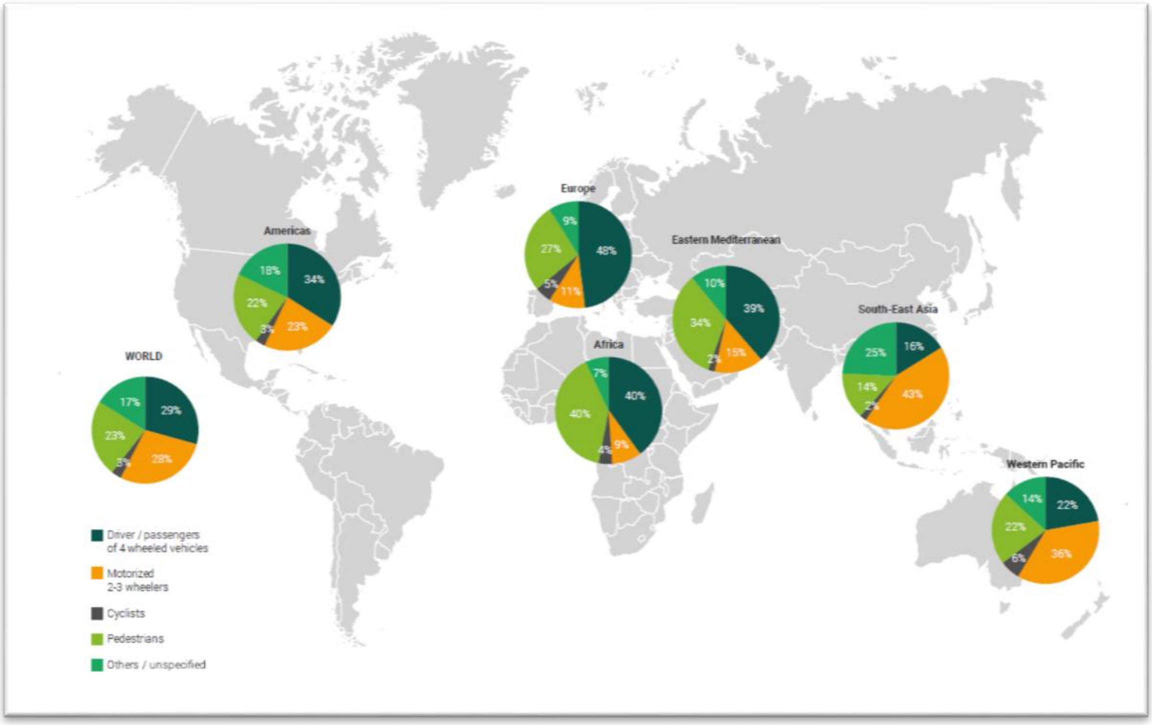

Figure 3: Distribution of deaths by road user type by WHO Region (2018)

Most (93%) of these deaths occur in low and middle-income countries, even though these countries have only approximately 60% of the world's vehicles. The highest crash risk is in the African Region with road traffic deaths much higher than other regions as indicated in Figure 4 below.

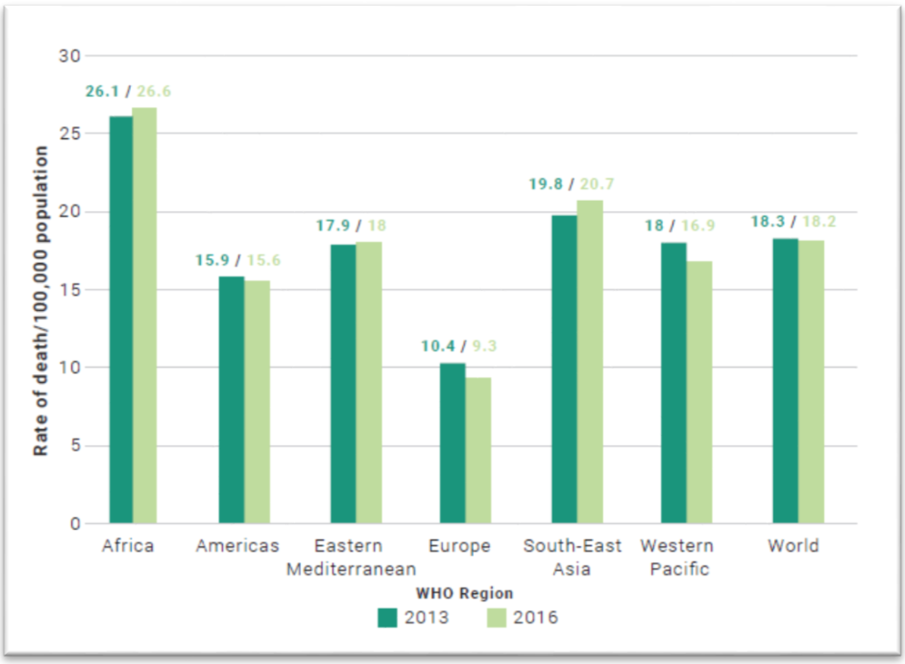

Figure 4: Rates of road traffic deaths per 100,000 population by WHO Region: 2013, 2016

The countries considered in the WHO Global Status Report on Road Safety 2018 are divided into 4 different groups where:

- Group 1 represents countries/areas with good death registration data
- Group 2 represents countries with other sources of cause of death information (only India, Thailand and Vietnam)
- Group 3 represents countries with populations of less than 150 000
- Group 4 represents countries without eligible death registration data.

Most African countries fall in Group 4, with only Mauritius and South Africa in Group 1.

B.2.2 South African Overview of Road Deaths

More than 40% of all road deaths in South Africa are amongst pedestrians, cyclists and motorcyclists. The total cost of road traffic crashes on South Africa's road network amounted to a staggering R142.95 billion – equating to 3.4% of the Gross Domestic Product (GDP)[3] in 2015; adjusted with Consumer Price Index (CPI), number of fatal crashes and fatalities to R166,71 billion in 2018 (RTMC). Additionally, road traffic crashes result in economic losses to victims and their families, weakening their economic position.

The WHO Global Status Report on Road Safety 2018 ranks South Africa at number 136 out of 175 participating countries regarding road safety in terms of its death rate of 25.9/100 000 population (based on 2016 crash data). This ranking implies that South Africa falls within 25% of the poorest performing countries in terms of relative risk to die during a road crash. According to the report, the African Region has the highest pedestrian fatality rate at 40% of all road fatalities, with South Africa at a pedestrian fatality rate of 38%.

South Africa is categorised as a middle-income country and falls within Group 1 (Countries/Areas with good death registration data). South Africa's ranking on fatality per 100 000 population is summarised as follows:

- South Africa is ranked 136th out of 175 of all participating United Nations Decade of Action (UNDA) countries
- Compared to all Group 1 countries, South Africa is ranked 82nd out of 86 countries
- Compared to all middle-income countries, South Africa is ranked 83rd out of 98 countries
- Compared to all African Region countries, South Africa is ranked 15th out of 44 countries
- Compared to other Group 1 middle-income countries, South Africa is ranked 39th out of 43 countries.

South Africa performs poorly in comparison to countries with good data and/or the middle-income group. Whilst South Africa has a higher ranking within the African Region, the latter should not be used as a benchmark since countries on the continent represent the poorest performers according to WHO statistics.

Mauritius (with a death rate of 13.7/100 000) and South Africa are the only two countries within the African Region that fall within Group 1. Due to a significant difference in the population and total kilometres of roads, the road fatality rate is not considered to be fully comparable.

[3] RTMC, 2016. Development of a Methodology for the Calculation of the Cost of Crashes in South Africa. Final Version 1.1.0.

B.2.3 Traffic Laws within the Context of Speed

The WHO considers whether the traffic laws of countries are aligned with speed and speed limits. Of the 175 participating countries, 123 or 70.3% of the assessed countries have road traffic laws that meet best practice for one or more key risks. The key risks considered are speeding, drink-driving, the use of motorcycle helmets, seatbelts and child restraint systems. The WHO has identified certain criteria within each key risk area. All criteria specified have to be met to be considered compliant with best practice laws.

South Africa complies fully with best practice for seatbelt laws. Criteria in some of the other key risk areas are only partially met and are therefore not considered compliant with best practice laws. A summary of compliance with key risk areas for South Africa is provided in Table 1.

Table 1 : Evaluation of South African road safety laws meeting the WHO best practice criteria

Key Risk	Safer Road Criteria to be met by WHO standards	South African Laws	Criteria met	Best Practice Laws[4] YES ✓ No X
Drink-Driving (45 countries meet best practice laws)	Law is based on a BAC limit of not more than 0.05g/dl for the general population.	BAC limit of < 0.05g/dl for the general population	Yes	X
	Law has a BAC limit of not more than 0.02 g/dl for young or novice drivers.	BAC limit of < 0.05g/dl 0.02 g/dl for young or novice drivers.	No	
Speed (46 countries meet best practice laws)	Law sets a limit of not more than 50 km/h in urban areas.	Maximum urban speed limit of 60 km/h.	No	X
	Law allows local authorities to modify national speed limits.	Law allows local authorities to modify national speed limits.	Yes	
Helmets (49 countries meet best practice laws)	Law mandates that helmets must be worn by all riders (drivers and passengers), on all roads and with all engine types. In addition, the law specifies that helmets need to be properly fastened.	National motorcycle helmet law applies to drivers and passengers.	Yes	X
	Law refers to a standard for helmets.	No helmet standards referred to and/or specified.	No	

[4] The WHO specifies that all criteria in a key risk should be met to be considered good laws within the key risk area.

Key Risk	Safer Road Criteria to be met by WHO standards	South African Laws	Criteria met	Best Practice Laws[4] YES ✓ No X
Seatbelts (105 countries meet best practice laws)	Law applies to drivers and front-seat passengers.	Law applies to drivers and front-seat passengers.	Yes	✓
	Law applies to rear-seat passengers.	Law applies to rear-seat passengers.	Yes	
Child restraint law (33 countries meet best practice laws)	Law requires children to use a child seat at least until 10 years /135 cm.	Law requires children to use a child seat up to 3 years.	No	X
	Law refers to a standard for child restraints.	Law refers to a standard for child restraints.	Yes	
	Law restricts children under a certain age or height from sitting in the front seat.	Law restricts children under a certain age or height from sitting in the front seat.	No	

Figure 5 below summarises an overview of the extent of compliance of South Africa's road laws with the WHO criteria for best practice laws.

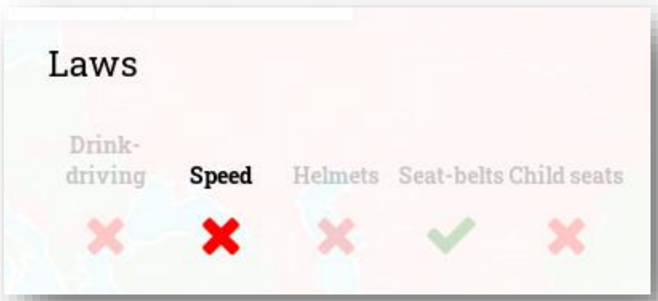

Figure 5: South Africa Safer Road criteria meeting the WHO standards for best practice laws

A country is considered to have a good speed law if both speed law criteria are met as indicated in Table 1. The reasons for the speed criteria are[5]:

[5]Global Status Report on Road Safety, WHO, 2018.

- Due to the increased risk in urban areas of high-speed traffic mixing with pedestrians and cyclists, urban speed limits should not exceed 50 km/h
- Pedestrians who are hit by vehicles at 65 km/h are nearly 5 times more likely to die than when they are hit by a vehicle travelling at 50 km/h
- Local authorities should also be given the (legislative) ability to further bring down speeds using a variety of measures adapted to local conditions (for example, reducing limits in residential areas to 30 km/h and installing speed humps).

The WHO presents the following other information on speed:

- The faster the speed, the more likely a crash will occur
- If a crash occurs, the risk of death and serious injury is higher at higher speeds
- In high-income countries, speed contributes to approximately 30% of roads deaths, while in some low and middle-income countries speed is the main factor in about half of road deaths
- A 5% reduction in average speed can reduce the number of fatalities.

B.3 LITERATURE REVIEW OF LOCAL AND INTERNATIONAL RESEARCH REGARDING THE IMPACT OF SPEED AND SPEED LIMITS ON ROAD SAFETY/CRASHES

B.3.1 International research

There have been numerous international research studies regarding the impact of speed and speed limits on traffic safety and road crashes. In the following section, international research relevant in this field is discussed.

B.3.1.1 Pedestrian Safety: CMarc Fact Sheet 6[6]

The Monash University Accident Research Centre (MUARC) put together a fact sheet on pedestrian safety, which is a culmination of years of research in this field. Relevant highlights in this document are listed below.

- For impacts between vehicles and pedestrians, impact speed is usually measured by estimating the distance over which the pedestrian was thrown (commonly referred to as the throw distance). Impact speed can also be estimated by measuring skid marks at the crash scene.
- Even at relatively low speeds, there is a high risk for serious injury or fatality for pedestrians who are struck by a vehicle.
- At collision speeds above 35 km/h, the probability that a pedestrian will be fatally injured rises rapidly, with death almost certain at impact speeds of around 55 km/h or higher, so moderation of vehicle speeds to not exceed 30 or 40 km/h is critical in areas with high pedestrian activity (residential, shopping areas and in school zones).
- Western Australia's Towards Zero road safety strategy includes a reduction of speed limits in areas of high pedestrian activity, but this measure has not yet been finalised.

Pedestrians are often referred to as VRUs since the severity of their injuries arising from a crash increases exponentially with vehicle speed – to a power of four for fatalities, three for serious injuries and two for casualties. Even small increases in speed can result in a dramatic increase in the impact forces experienced by crash victims. At collision speeds above 35 km/h, the probability that a pedestrian will be fatally injured rises rapidly, with death almost certain at impact speeds of around 55 km/h or higher (shown in Figure 6 below).

[6] Oxley, J. (2010). *Improving Pedestrian Safety.* Curtin – MUARC.

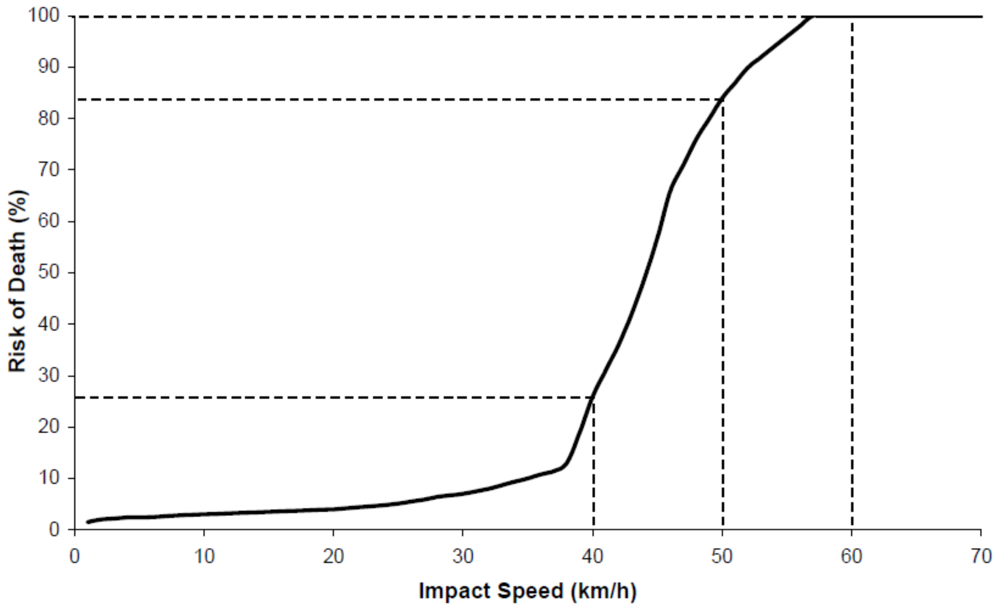

Figure 6: Risk of death as a function of speed

B.3.1.2 Managing Speed (WHO/NMH/NVI/17.7)[7]

This study is creating awareness of speeding vehicles and the many factors that contribute to drivers driving at speeds that are not appropriate to the road conditions.

The relationship between speed and road traffic crashes (& their severity) is well established, but there are numerous other factors which influence speed (other than posted speed limits), such as:

- The driver's age and sex (in most countries, male drivers and young drivers are more likely to speed – in SA this is also the case)
- The driver's blood/alcohol level
- The road layout and surface quality
- The power and maximum speed of the vehicle.

B.3.1.3 The Impact of Lowered Speed Limits in Urban/Metropolitan Areas[8]

Research studies in Australia in relation to an "across the board" reduction of speed limits to 50km/h on all types of urban and metropolitan roads that presently have a 60 km/h speed limit, indicate large benefits to society as a result of the reduction in crash trauma. The study by the MUARC attempts to quantify the various impacts of lowered speed limits.

In research reported by Snowy Mountains Engineering Corporation (SMEC) and Nairn (1999), the effect of reducing cruising speed on crashes (as well as travel time) was simulated for Melbourne traffic during

[7] WHO. (2017) *Managing Speed.*

[8] Archer J, Fotheringham N, Symmons M and Corben B. (2008) *The impact of lowered speed limits in urban and metropolitan areas.* Transport Accident Commission. MUARC Report No. 276. ISBN 0732623464.

morning peak hours. Results indicated that reducing the speed limit on all roads by 10 km/h would bring about a 13.5 % decrease in crashes and a 10.3 % decrease for roads other than freeways.

A major study conducted by the Organisation for Economic Co-operation and Development (OECD) and the European Conference of Ministers of Transport (ECMT) in 2006 confirms that speeding is the number one road safety problem in most countries around the world, and that a reduction in average speed of approximately 5% would yield a reduction in fatalities by as much as 20% (OECD/ECMT, 2006).

Australian researcher Taylor (2000) estimates that a 1 km/h reduction in average speed in normal traffic conditions would provide a 6% reduction in crashes on urban main roads and residential streets that already have low average speeds, and similarly, a 4% decrease on medium speed urban roads and a 3% decrease on high speed urban roads.

In 2000, the Australia's Victorian Government proposed a Regulatory Impact Statement regarding regulations to reduce the Default Urban Speed Limit (DUSL) to 50 km/h. and most Australian jurisdictions have now adopted this 50 km/h default speed limit for local residential roads in an attempt to reduce the severity of crashes. There is substantial research evidence to suggest that reductions in posted speed limits will have significant safety benefits (i.e. fewer crashes and reduced crash outcome severity) provided that a reduction in average speeds is achieved.

While caution is advised in determining the factors underlying road crashes, there has been a great deal of research to suggest the importance of maintaining correctly adapted speed. At lower speeds, there is a greater safety margin for any given time to collision, in other words more time for the driver to intervene and avoid the impending collision. Furthermore, drivers have less chance of losing control, particularly during heavy braking or swerving to avoid a collision. Loss of control at speed is a particular problem for heavy vehicles given their greater mass and instability (George, 2003). This is a matter of Newtonian physics where it is known that the kinetic energy dissipated in a crash increases with vehicle mass and the square of collision speed. Lowering vehicle speed therefore not only reduces the risk of crash involvement, but also dramatically reduces the risk of serious injury or fatality in the event of a crash.

In the mid-1990s, Finch and colleagues (1994) concluded that, for each 1 km/h change in mean speed, the best estimate of the change in accident risk was approximately 3%. More recent work has confirmed this relationship as a general rule.

This relationship has been captured in various models, most notably Nilsson's "Power Model" (1997), which concluded that:

- The injury accident rate changes with the square of a change in mean speed
- The severe injury (including fatal) accident rate changes with the cube of speed change
- The fatal accident rate changes with speed change to the power of four.

Nilsson (2004) has recently reviewed these statistical models on the basis of new data, which supported his earlier findings. However, a crash analysis by Elvik and colleagues[9] (2004), which covered 98 earlier studies, concluded that the exponents in Nilsson's power model could be refined by separating out the various severity levels more cleanly. The conclusion was that the exponent for fatal crashes was 3.6, 2.4 for serious

[9] Elvik, R., Christensen, P. & Amundsen, A. (2004). *Speed and road accidents; An evaluation of the Power Model*. Institute of Transport Economics TØI, Oslo.

injury crashes and 1.2 for slight injury crashes. The same study pointed out that reductions in traffic speed were the most effective means for reducing road crash fatalities, more effective in fact than other safety interventions such as reducing the amount of drink driving or night-time travel.

Studies in the late 1990s found that accident risk only increases if travel speeds exceed the speed limit. Kloeden and colleagues[10] investigated the relationship between speed compliance on urban roads and the risk of a vehicle being involved in a crash on a 60 km/h road in the Adelaide metropolitan area and found that with each 5 km/h increase in travelling speed, the risk of involvement in a crash involving injury doubles. A subsequent re-analysis of the same data, using logistic regression modelling, came to much the same conclusion about risk above the speed limit, but also concluded that vehicles travelling below the speed limit in free-flow conditions had a reduced risk.

B.3.1.4 Impact of speed differentials between vehicles

Many studies identified a relationship between mean speed and speed variation suggesting that increasing speed differentials between vehicles often lead to:

- An increase in passing manoeuvres and improper lane changing
- Tailgating (driving too close to a slower vehicle in front)
- Frustration among drivers who desire to travel faster
- The formation of platoons of traffic.

Reducing speed limits is often intended to make traffic flows more uniform by bringing slower drivers closer to the average speed of traffic, which has the effect of reducing traffic conflicts and crashes. Some early work in this area of study was conducted by Solomon (1964)[11] who demonstrated a parabolic relationship between speed deviation from the mean speed (faster or slower) and the frequency of crashes. The findings of Solomon have since been corroborated by other researchers:

- Harkey and colleagues (1990)[12] found a minimum risk of crash involvement at around the 90th percentile speed on urban roadways in the United States.
- Other studies have also supported the association between speed variation in the traffic streams and crashes, including Garber and Gadiraju (1998)[13], and Garber and Ehrhart (2000)[14].
- Generally, research has shown that speed dispersion plays an important role in increasing the crash risk on most road types.

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[10]Kloeden, C. N., Ponte, G. & McLean, A. J. (2001). *Travelling speed and the risk of crash involvement on rural roads*. Report CR 204. ATSB, Civic Square, ACT.

[11] Solomon, D. (1964). *Accidents on main rural highways related to speed, driver and vehicle.* Bureau of Public Roads, U.S. Department of Commerce, Washington, D.C.

[12] Harkey DI, Robortson DH, Davis SE (1990*). Assessment of Current Speed Zoning Criteria*. Transportation Research Record: Journal of the Transportation Research Board 1281, pp.40-51.

[13] Garber N, and Gadiraju. (1998) *Factors affecting speed variance and its influence on accidents.* Charlottesville, Virginia: University of Virginia, Washington, DC: Automobile Association of America (AAA) Foundation for Traffic Safety.

[14] Garber N, and Ehrhert (2000) *The effect of speed flow, and geometric characteristics on crash rates for different types of Virginia Highways.* Charlottesville, Virginia: Virginia Transportation Research Council.

B.3.1.5 Protection of VRUs

The relationship between driving speed and probability of pedestrian death is a major consideration in setting suitable speed limits and speed measures in the urban environment. For these reasons, there has been a move in Australia in more recent years to reduce the default speed limits in urban and built-up areas from 60 km/h to 50 km/h. In many other countries urban speed limits have been 50 km/h for some time, and are often reduced locally to 40 or 30 km/h in residential areas and in the vicinity of schools, age-care centres and shopping precincts where there is a large predominance of VRUs. In South Australia, the speed limit around some schools has been set to 25 km/h in recognition of pedestrian vulnerability. In some suburbs around Melbourne and Sydney, a 40 km/h speed limit has also been applied.

Other national traffic safety philosophies, such as the Swedish "Vision Zero", recognise the importance of restricting speed to appropriate levels to ensure that there are no serious or fatal injuries. As a first step in this direction, the DUSL on all residential streets in Stockholm, Sweden was been reduced to 30 km/h in 2007 and initial indications of the effectiveness of the restriction suggest that average speeds and traffic flow remain relatively unaffected while the maximum speed has decreased notably.

B.3.1.6 Crash Rates Before and After Changes in Speed Limit

International studies conducted in the 1970s following speed limit reductions, primarily to counter the oil crisis (TRB, 1998), were summarised by Fildes and Lee (1994)[15] who reported reductions in crashes, on rural roads and motorways, ranging from 8% to 40% in a number of countries, including Australia, Belgium, Finland, France, Germany, the UK and South Africa. The lower speed limits usually resulted in lower average speeds but generally much less than expected, e.g. a reduction in the speed limit in Queensland (Australia) from 60 km/h to 50 km/h saw a drop in travel speeds of only 5 km/h[16].

Of considerably more relevance are the findings on roads in urban and metropolitan areas relating to the introduction of the 50 km/h DUSL adopted in Australia, which was applied to many roads that previously had a 60 km/h limit, despite relatively small decreases measured in overall average speeds:

- In Queensland, the 50 km/h DUSL is believed to have brought about a reduction in casualty crashes of 8% and an 18% reduction in fatal crashes
- In Victoria, Horeau and colleagues (2006)[17] reported that the DUSL had resulted in an overall reduction of 12% in casualty crashes, along with a reduction in fatal and serious injury crashes involving pedestrians of approximately 25% to 40%. Average travel speed was reported to be only slightly lower (approximately 1%)
- In Western Australia, a metropolitan analysis indicated a 21% net reduction in casualty crashes with a 51% net reduction in crashes involving pedestrians
- In Australian Capital Territory, there was a non-significant 2.1% reduction in police reported crashes in the two years after the introduction of the DUSL

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[15] Fildes BN, and Lee SJ (1994) *The speed review: Road Environment, Behaviour, Speed Limits Enforcement and Crashes.* MUARC. Prepared for the Road Safety Bureau, New South Wales, and the Federal Office of Road Safety, Canberra.

[16] Walsh and Smith. (1999*). Effective speed management the next step forward: Saving lives by decreasing speeds in local streets*. Proceedings of the Research Policing Education Road Safety Conference, Canberra, 2, pp. 685-694.

[17] Horeau E and Newstead S. (2004). *An Evaluation of the default 50 km/h speed Limits in Western Australia.* MUARC Report No. 230, Clayton, Victoria.

- In South Australia, the 50 km/h DUSL was estimated to have been responsible for a 20% reduction in casualty crashes.

In Sweden, Vision Zero clearly points out that no single factor has as great an impact on safety as speed. It is stated that if everyone were to keep to the speed limit, 100 lives would be saved each year. Similarly, each reduction in average speed of 1 km/h is believed to save 25 lives. Of the safety targets stated in mid-2006, a reduction of 4 km/h on municipal streets is believed to save as many as 40 lives and a 6 km/h reduction on national roads as many as 60 lives.

On the basis of the literature reviewed in this report, the most important conclusions in relation to the potential impact of lowered speed limits in urban and metropolitan areas are:

- A significant reduction in all crashes
- VRUs (pedestrians and cyclists) are likely to benefit most from reductions in travel speeds.

B.3.1.7 Road Safety Impact of <u>*Increased*</u> Rural Highway Speed Limits in British Columbia, Canada[18]

There is a school of thought that increasing speed limits will level out the differential speed of vehicles on a road and improve road safety. This research was to evaluate the impact of a 10km/h speed limit increase on fatal crashes and associated consequences.

The main findings were significant <u>increases</u> in:

- Total insurance claims, 43.0%
- Injury claims, 30.0%
- Fatal crashes, 118% (nearly 100% increase in fatalities < 500m from position of speed limit change).

The doubling of fatal crashes on affected roads in rural British Columbia following the speed limit increases is partly explained by the unique environment. Travel in rural British Columbia is particular hazardous because of a harsh winter climate, mountainous terrain causing curvilinear alignments, and the fact that large regions of the province are remote with limited access to post-crash trauma care.

In Canada, vocal motorist groups continue to lobby for higher speed limits and reduced speed enforcement since modern vehicles are safer and handle better at high speed. They argue that increasing speed limits will reduce speed variance and therefore decrease risk dangerous encounters between vehicles. There is evidence that roads with higher speed variance have higher crash rates, however, instead of decreasing speed variance, this evidence suggests that higher speed limits either have no effect or increase the variance (Friedman 1992).

B.3.1.8 Previous evaluations of speed limit increases

US Department of Transportation results show:

- In 1989, a 22% increase in fatalities on rural interstates

[18] Brubacher FR, Chan H, Erdlyi S, Lovegrove G & Faghihi, F. (2018). Road Safety Impact of Increased Rural Highway Speed Limits in British Columbia, Canada.

- In 1990, a 15% increase in fatalities on rural interstates
- In 1991, a 19% increase in fatalities on rural interstates (a 12% decrease where speed limits were not increased)
- In 1999, a 15% increase in fatalities on rural interstates.

During this same period, speed limit increases were associated with more severe road crash injuries in Michigan, Illinois, New Mexico, Washington, Alabama and Utah, as well as in Israel, Australia, Sweden and across Europe.

This new evaluation of speed limit increases indicated:

- Increases in fatalities and total crashes
- Increases were larger than previously reported
- A marked deterioration in road safety following the increase in rural highway speed limits – in particular, the number of fatal crashes more than doubled.

It was recommended that speed limits revert to the previous (lower) levels.

Mitigating factors

The Minister of Transportation of Canada suggested that slower drivers, even those traveling at the posted speed limit, were as dangerous as excessively speeding drivers, therefor encouraging speeding.

It is possible that drivers chose to travel on roads with higher speed limits, resulting in relatively more travel on these roads and less travel elsewhere. In support of this theory a decrease in fatal crashes, albeit statistically non-significant, was found on nearby roads.

The above-mentioned factors were not considered to be significant.

B.3.1.9 Speed and Crash Risk: International Transport Forum[19]

This study documents the relationship between vehicle speed and crash risks based on an analysis of cases from 6 countries that have recently changed speed limits (Australia, Denmark, Hungary, Israel, Norway and Sweden). The analysis confirms the very strong relationship between speed and crash risk and that higher speed is associated with increased occurrence and severity of road crashes.

A traffic system adapted to the physical limitations of road users is recommended. Such an approach is often called "a safe system" and is exemplified by Sustainable Safety (Netherlands), Vision Zero (Sweden) and the Safe System approach (Australia). The aim of a safe system is to offer a road system that can accommodate the unavoidable human error without leading to death or serious injury.

[19] International Transport Forum. (2018). *Speed and Crash Risk.*

VRUs should always be given particular attention when it comes to speed limits, since the risk of being killed is almost five times higher in collisions between a car and a pedestrian at 50 km/h than at 30 km/h[20], which is a compelling argument to reduce speed in urban areas.

However, reducing speed limits is often not just as simple as following strict safety criteria developed for each road type. Politicians and engineers must consider several challenges when deciding on speed limits, such as balancing safety, mobility and environmental aspects. For example, in France where it was possible, speed limits on urban motorways were reduced for environmental reasons but not for safety reasons.

An approach called the “safe system” was introduced in the Netherlands, Sweden and Australia with the aim of providing a road system that can accommodate the unavoidable human error without leading to death or serious injury. Working towards a safe system, the following speed limits are reasonable:

- 30-40 km/h in urban areas where there is a mix of VRUs and motor vehicle traffic
- 50 km/h in areas with intersections and high risk of side collisions
- 70-80 km/h on rural roads without median barrier, presenting a risk of head-on collisions.

Higher speed limits are acceptable provided the pedestrians, vehicles, etc. are physically separated.

Discussions on changing speed limits in urban areas are mostly about lowering the speed in residential areas, with some countries (such as the Netherlands) considering adopting a 30 km/h default speed limit. The reformulation of Nilsson’s Power Model (which is an accepted exponential model) calculates the reduced risk of crash and severity for a 5km/h speed reduction on urban (50km/h) and rural (80km/h) roads and motorways (120km/h) to be:

- All injury crashes: between 15% (urban) and 16% (rural and motorways) reduction
- Serious injury crashes: 26% (all) reduction
- Fatal crashes: 28% (all) reduction.

Whilst it is widely recognised that differences in vehicle speed have an effect on crashes, there was insufficient data available to quantify this.

Seven (7) cases considered in this report involve a change in speed limit:

(1) Hungary: Decrease in speed limit inside built-up areas concerning 32% of the state road network (1993)
Speed limit reduced from 60 to 50km/h
Mean speeds decreased by 8% (57 to 52.5km/h)
Road fatalities decreased by 18.2%

(2) Hungary: Increase in speed limit on rural roads as a result of a political decision (2001)
Speed limit increased from 80 to 90km/h
Mean speeds increased by 2.5%
Road fatalities increased by 13.4%

[20] Kröyer et al. (2014). *Is 30 km/h a ‘safe’ speed? Injury severity of pedestrians struck by a vehicle and the relation to travel speed and age.*

(3) Australia: Decrease in speed limits in urban areas, but results only from New South Wales (1997 – 2003)
Speed limit decreased from 60 to 50km/h
Mean speeds decreased by 0.5 km/h (57.2 to 56.7km/h).
Crashes decreased by 25.3%
Injuries decreased by 22.3%

(4) Denmark: Increase in speed limit on part (half) of the motorway network (2004)
Speed limit increased from 110 km/h to 130 km/h
Mean speeds decreased markedly
Road fatalities increased by 36%

(5) Norway: Environmental speed limits on major roads in the City of Oslo to reduce air pollution (2004)
Speed limit reduced from 80 to 60km/h
Mean speeds decreased by 7.5% (76 to 71 km/h)
Injuries decreased by 28%

(6) Sweden: A fundamental change in speed limits on the rural roads (2008 and 2009)
Speed limit reduced from 90 to 80km/h
Mean speeds decreased by 3.1km/h (87.7 to 84,6 km/h)
Road fatalities decreased by 41%

Speed limit increased from 110 km/h to 130 km/h.
Mean speeds increased by 3.4km/h
Road fatalities did not change

(7) Israel: Increase in speed limits on selected rural roads and motorways (2013)
Speed limit increased from 100 km/h to 110 km/h
Mean speeds increased by 6.8km/h
Injuries increased by 11%.

Comment on results:

In Case 4 (Denmark), the mean speeds decreased markedly on all road types immediately after implementation of the increased speed limit, probably due to the introduction of a demerit point system at the time, but over the entire study period the mean speed gradually increased significantly on all road types.

The cases are based on evaluation studies that used different methods analyses, so the information should be seen as an illustration and not a strict analysis.

For all cases studied, a decrease in mean speed is associated with a decrease in fatalities. Although the size of the change differed, the pattern was consistent. On the other hand, an increase in mean speed was always associated with an increase in the number of fatalities.

This study recommended:

- To reduce the speed on roads as well as speed differences between vehicles
- That speed limits are reduced to 30 km/h in urban areas where there is a mix of VRUs and motor vehicle traffic
- That an increase in the speed limit must be accompanied with strict enforcement and an upgrade of the infrastructure to compensate for the increased risk from higher mean speed.

B.3.1.10 Road Safety Annual Report 2019: France[21]

An analysis of fatalities by road type shows that the rural network continues to be the deadliest and in 2018, 62% of deaths occurred on rural roads, 30% on urban roads and 8% on motorways. However, when rural speed limits were reduced the rural inhabitants were irate and protested.

Between 1900 & 2000 road fatalities decreased by 20%, attributed to many road safety measures, including a reduced speed limit in built-up areas to 50 km/h. Between 2000 and 2010 further, more austere, advances in road safety were implemented resulting in a 51% reduction in fatalities with speed reduction accounting for 75% of this improvement.

The number of traffic deaths per 100 000 inhabitants in France has fallen by 63% between 2000 and 2018. In 2018, 5.0 traffic deaths per 100 000 inhabitants were recorded, compared to 13.7 in 2000. By way of comparison, the average in the European Union is 4.9 deaths per 100 000 inhabitants in 2018.

A study of the reduction of the speed limit from 90 to 80km/h on two-way roads outside urban areas (for 12 months from July 2018), showed a reduction in average speeds for light vehicles of 3.9 km/h and a significant reduction in fatalities of 200 lives saved, over the 12 months' study period.

B.3.1.11 Long Term Effects of Repealing National Maximum Speed Limit in United States[22]

In 1995, the United States repealed the federal speed limit and most states have subsequently raised the limits. This study covers rural interstates between 1995 and 2005, and examines the long-term effects of these amended controls on road fatalities and injuries in fatal crashes.

Results showed the higher speed limit caused a 3.2% increase in road fatalities on all road types, with the highest increases on rural interstates (9.1%) and urban interstates (4.0%). This translates to 12 545 deaths and 36 583 injuries due to increases in speed limits across the United States.

The largest increases in fatalities on urban interstates occurred in states that retained the lower 55-mph speed limit. A plausible explanation for this finding is the spill over effect which occurred when drivers coming off high-speed roads continued to drive faster than those already on the same road.

[21] International Transport Forum. (2019) *Road Safety Annual Report FRANCE.*

[22] Friendman LS, Hedeker D, Richter ED. (2009) *Long Term Effects on Repealing the National Maximum speed Limit in the United States.*

B.3.1.12 Traffic Safety Effects of New Speed Limits in Sweden[23]

Sweden currently has a default speed limit of 50 km/h in built-up areas, unless otherwise posted, but speeding remains a major problem in Sweden, with speed limit compliance at an unacceptably low level. Reductions in road fatalities are usually seen as a result of ongoing improvements to the vehicle fleet and infrastructure, and not necessarily due to reduced speeds. However, this report attempts to quantify the impact that speed limits have on traffic safety.

Sweden has speed limits ranging from 30 km/h to 120 km/h. Outside schools and hospitals, the limit is often 30 km/h. Speed limits of 70, 80, 90 and 100 km/h are mainly used outside built-up areas where the speed limit depends on the standard and safety of the road. Speed limits of 110 km/h and 120 km/h are the main speed limits used on motorways.

In 2008, the Swedish Transport Administration reviewed the speed limits on the national rural road network and resulted in roads with a low traffic safety having reduced speed limits while others with a good traffic safety record increasing speed limits. This saw reduced fatalities by 14 *per annum* on rural roads with a reduced speed limit from 90 to 80 km/h and serious injuries increased by 15 *per annum* on motorways with a speed limit increased to 120 km/h (but no significant changes were found in fatalities). Regarding the change of mean speeds, a decrease in speed limit with 10 km/h led to a decrease of mean speeds of around 3 km/h and where the speed limit increased by 10 km/h the mean speed increased by 3 km/h.

There is currently a default speed limit of 50 km/h in built-up areas, unless otherwise posted. The clearest quantifiable positive effects are seen in the area of traffic safety, where speed is of decisive importance.

The following scenarios were modelled and the effect of a speed reduction calculated:

- Assuming all streets with a 50 km/h speed limit, have the speed limit reduced to 40 km/h - the model calculated the reduction of fatalities by five
- Approximately 80% of the streets (based on vehicle miles) with a 50 km/h speed limit have their speed limit reduced to 40 km/h while the remaining 20% stay at 50 km/h, reducing the number of fatalities by four
- Approximately 80% of the streets (based on vehicle miles) with a 50 km/h speed limit have their speed limit reduced to 40 km/h while the remaining 20% have their speed limit raised to 60 km/h, reducing the number of fatalities by three.

This study recommended that a new default speed limit of 40 km/h be implemented in built-up areas across Sweden. However, this study did show that a speed limit of 30 km/h yields greater positive effects in terms of, for example, traffic safety and security, which, in combination with an altered urban environment, could induce more people to bicycle and walk in the long term.

B.3.1.13 The WHO Global Status Report on Road Safety 2018

The number of road crash fatalities continues to rise. However, this rate has stabilised relative to the size of the world's population in recent years. Progress has been achieved in important areas such as legislation, vehicle standards and improving access to post-crash care, but not at a significant pace to compensate for the rapid motorisation of transport taking place across the world.

[23] International Transport Forum. (2019) *Road Safety Annual Report SWEDEN.*

Road crashes are now the leading cause of death for children and young adults aged 5–29 years, signalling a need for a shift in the current child health agenda, which has largely neglected road safety. Between 2013 and 2016, no reductions in road crash fatalities were observed in any low-income country, while some reductions were observed in 48 middle-to-higher income countries.

A key strategy to improve road safety has been strengthening legislation. While 123 of the 175 countries participating in this report have road traffic laws that meet best practice for one or more key risk factors (including drink-driving legislation, motorcycle helmet use, use of child restraint systems, and the use of seat-belts), less progress has actually been made on adopting best practice on speed limits, despite the importance of speed as a major cause of fatalities and serious injury.

The following review highlights the impact of speed limits on crash fatalities as recorded in the report:

a) International countries with 50km/h urban speed limits

Table 2: Fatality trend in International countries with 50 km/h urban speed limits

2016 STUDY				
COUNTRY	MAX SPEED (Km/h)		FATALITIES /100,000	TREND
	URBAN	FREEWAY		
Australia	50	130	5.6	---
Austria	50	130	5.2	↓
Belgium	50	120	5.8	↓
Canada	50	100	5.8	↓
Denmark	50	130	4	---
Finland	50	120	4.7	---
France	50	130	5.5	---
Germany	50	None	4.1	---
Ireland	50	120	4.1	---
Israel	50	110	4.2	---
Luxembourg	50	100	6.3	↓
Netherlands	50	130	3.8	---
New Zealand	50	100	7.8	↓
Nigeria	50	100	21.4	↓
Norway	50	100	2.7	↓
Portugal	50	120	7.4	↓
Spain	50	120	4.1	↓
Sweden	50	120	2.8	---
Switzerland	50	120	2.7	↓
Turkey	50	120	12.3	↓
UK	48	112	3.1	---
Uruguay	45	90	13.4	↓

b) International countries with >50km/h urban speed limits

Table 3: Fatality trend in International countries with > 50km/h urban speed limits

2016 STUDY				
COUNTRY	MAX SPEED (Km/h)		FATALITIES /100,000	TREND
	URBAN	FREEWAY		
Argentina	60	130	17.1	↓
Botswana	60	120	23.8	↑
India	100	100	22.6	---
Japan	60	100	4.1	---
Namibia	60	120	30.4	↑
Pakistan	90	130	14.3	↓
Qatar	100	120	9.3	↓
Korea	80	120	9.8	↓
Russia	60	110	18	↓
Saudi Arabia	80	None	28.8	↑
Seychelles	80	80	15.9	↑
Singapore	70	90	2.9	↓
South Africa	60	120	25.9	---
Thailand (very mixed traffic)	80	120	32.7	---
USA	60	128	12.4	---

*WHO Global Status Report on Road Safety 2018.

↑ Increased fatalities ↓ Decreased fatalities --- No change

Comment on Tables 2 and 3:

Table 2 has a much lower fatality rate (/100,000 population) – mostly well <10, a reducing or flat trend in fatality rate and Nigeria & Uruguay stand out with high fatality rates (but they are developing countries)

Table 3 has significantly higher fatality rates, has countries with increasing fatality rates and African countries have a poor record.

(c) The WHO best practice criteria (in respect of speeding, drink-driving, the use of motorcycle helmets, seatbelts and child restraint systems)

Since 2014, progress has been made in attending to these best practice criteria and 22 of the participating countries have amended their laws on one or more of these risk factors. However, the least progress has been made on adopting best practice on speed limits.

Current best practice: Urban speed limit ≤ 50 km/h.
An increase of 1 km/h in travel speed results in an increase of 4¬5% of fatal crashes.

The following three best practices apply to speed limits:

- The presence of a national speed limit law
- Urban speed limits not exceeding 50 km/h

- Local authorities having the power to modify speed limits, if required by conditions on the street.

B.3.1.14 Conclusions on International Research

To a large extent, the risk of dying on the roads depends on the region concerned. Africa has the highest number of road traffic deaths per 100 000 population while Europe has the lowest rate. In high-income countries, speed contributes to about a third of deaths on the roads. In the United Kingdom, speed is responsible for 28% of all road traffic crashes resulting in deaths, while this figure is 30% in Australia. In low- and middle-income countries, this proportion is likely to be greater, given the higher proportion of deaths among VRUs.

This review covers international studies where speed limits have been changed, and it is clearly evident that road crashes resulting in fatalities and serious injuries are reduced with a decreased speed limit and *vice versa*.

Australia established a DUSL of 50 km/h and recorded a reduction in fatal crashes of approximately 20%.

Sweden has speed limits ranging from 30 km/h to 120 km/h, but reduced their annual road crash fatalities by 14 on rural roads by decreasing the speed limit from 90 to 80 km/h. On the other hand, annual serious injuries increased by 15 on motorways when the speed limit was increased by 10 km/h (to 120 km/h).

Likewise, 40 Canadian states increased their speed limits on rural interstates, which resulted in a 15 - 20% increase in fatalities (whereas the States that did not increase speed limits had a 12% decrease in fatalities).

The WHO best practice criteria recommend an urban speed limit of less than 50 km/h.

B.3.2 Local research

Local research regarding the impact of speed and speed limits is very limited. This section also includes chapters on the NetSafe Highway Road Safety Model developed by SANRAL and a draft chapter on setting of speed limits scheduled to be included in the South African Roads Traffic and Signs Manual (SARTSM).

B.3.2.1 Speed limit zones at schools

According to the WHO, the African Region has the highest pedestrian fatality rate at 40% of all road fatalities, with South Africa at 38% pedestrian fatality rate during 2016 to 2018. Children are the most VRUs on our roads. High pedestrian volumes, of which most are scholars, are experienced during the start and end of the school day (i.e. between 07:00 – 08:00 and 15:30 – 15:00).

A research study was done to test the impact and feasibility of 30 km/h speed limit at schools (Figure 7 below refers) and the paper was presented at the 2015 South African Transport Conference.[24]

[24] Speed Limit Zones at schools (F. Lambert & C. Venter, SATC 2015).

Figure 7: 30km/h School Zone Traffic Sign

The objective of the study was to measure the effectiveness of introducing a 30 km/h speed limit zone strategy at schools with high pedestrian activity and Non-Motorised Transport (NMT). Three school sites in different areas in the City of Tshwane were selected as case studies. Before-and-after speed data were used to test the hypotheses that the 30 km/h speed limit zone has no effect on the mean and variance of speed. The results indicated that the speed decreased and varied between 30 km/h and 35 km/h at all sites after implementation of the 30 km/h speed limit school zone signs. A control site was also used to ensure that the result was not caused by spurious fluctuations and qualitative feedback from school showed widespread acceptance of the measure.

The conclusions from this study indicated 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 NRSS[25] to reduce the increasing trend on road traffic fatalities.

B.3.2.2 The South African Road Assessment Programme (SA-RAP)[26]

The International Road Assessment Programme (iRAP) is the umbrella programme for Road Assessment Programmes (RAPs) worldwide that are working to save lives. The iRAP is a proven programme that seeks to ensure the elimination of high-risk roads with the ultimate objectives of saving lives. The iRAP method gives consideration to both engineering and economic factors in road design by identifying risks, developing counter-measures and proposing investment plans. This is a sound quantifiable approach that enhances the quality of management and policy decisions. To this end, many countries have successfully implemented the iRAP and can show the impact of specific targeted interventions. The SA-RAP, which is one of the RAP

[25] Department of Transport Republic of South Africa, NRSS.

[26] Department of Transport of South Africa and RTMC (2019) *SA-RAP.*

partners under the iRAP, is yet to be institutionalised as a method of choice in network level road assessments in South Africa.

Collaborative efforts between the RTMC (so mandated by the Road Traffic Management Corporation Act, 1999 (Act No. 20 of 1999) (RTMCA) to manage road infrastructure audits) and the National Department of Transport (NDoT), resulted in a decision to jointly rollout the SA-RAP on the provincial strategic road network of South Africa. An iRAP accredited service provider was appointed in 2018 by the NDoT to conduct surveys and coding of the strategic road networks of the Kwa-Zulu Natal and Free State provinces as the first phase of the roll-out. Ultimately, approximately 3,000 km of provincial roads will be assessed per province, resulting in SRIPs proposals towards providing more forgiving roads in line with the “Safe System” approach.

B.3.2.3 NetSafe Highway Road Safety Model

The NetSafe Highway Road Safety Model is a crash prediction tool which includes the speed of the considered road or road section amongst other road and environmental factors. The NetSafe model is included in the South African Road Design System (SARDS) used for the assessment and cost-benefit analysis of roads and is currently exclusively used for SANRAL roads. The SA-RAP, previously discussed as one of the RAP partners under the iRAP is yet to be institutionalised as a method of choice in network level assessments in South Africa.

The NetSafe model is used to predict the number of crashes over a period of intervals of one year that can be expected over a particular road section. The crash rates are modelled in terms of various road and environmental characteristics. These are not the only factors that will affect crash rates, but for the purpose of highway evaluation and analysis, a proportion of the crash rates can be explained in terms of these road related factors.

Information to develop the prediction model was only obtained from crash data collected during the period 1995 to 2006 in two provinces, namely, the Northern Cape and the Free State. The severity model is used to estimate the following:

a) Persons injured or killed
   - Pedestrians
   - Vehicle occupants
b) Vehicles damaged per vehicle class.

The fitted relations are shown in Figures 8, 9 and 10 below.

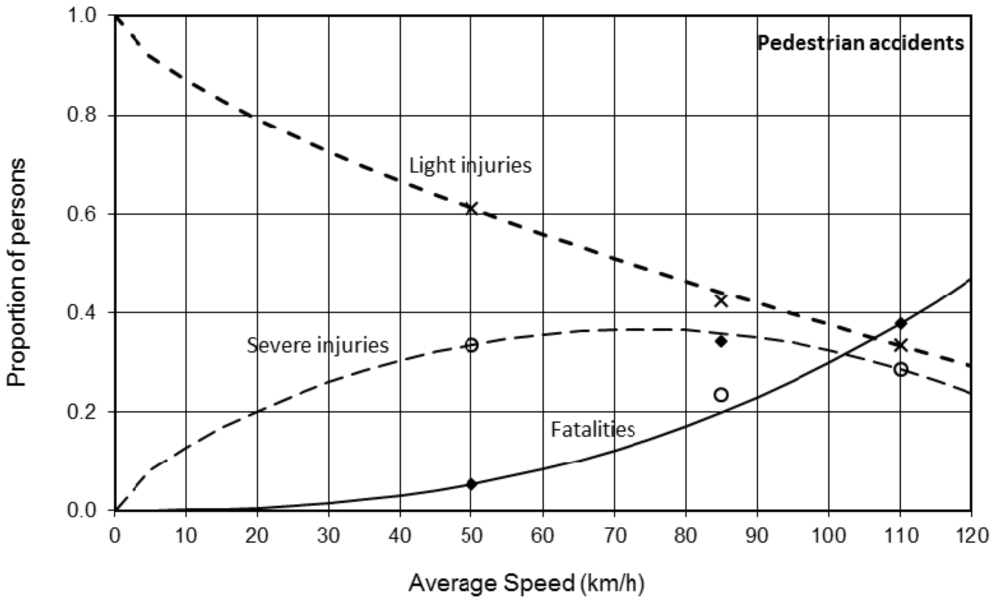

Figure 8: NetSafe Pedestrian accident severity model

The proportion of pedestrians on a road is assumed to be dependent on the land use and the protection level provided along a road. A higher proportion is used to land uses with a higher level of activity and where a lower level of protection is provided. No data were available for deriving a crash relationship and crashes at pedestrian crossings and are therefore not currently modelled by NetSafe.

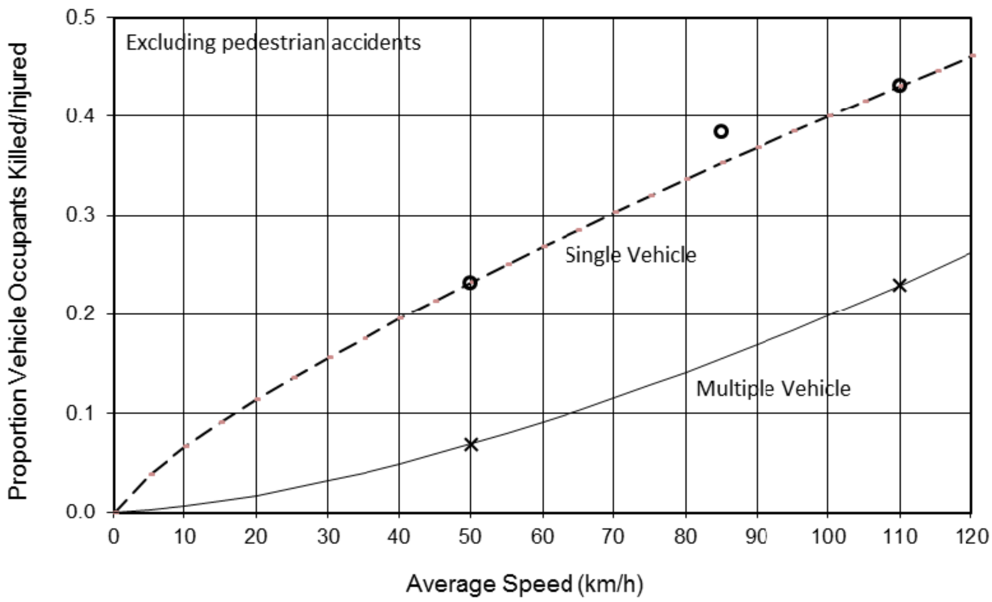

Figure 9: NetSafe Proportion of vehicle occupants killed or injured per accident

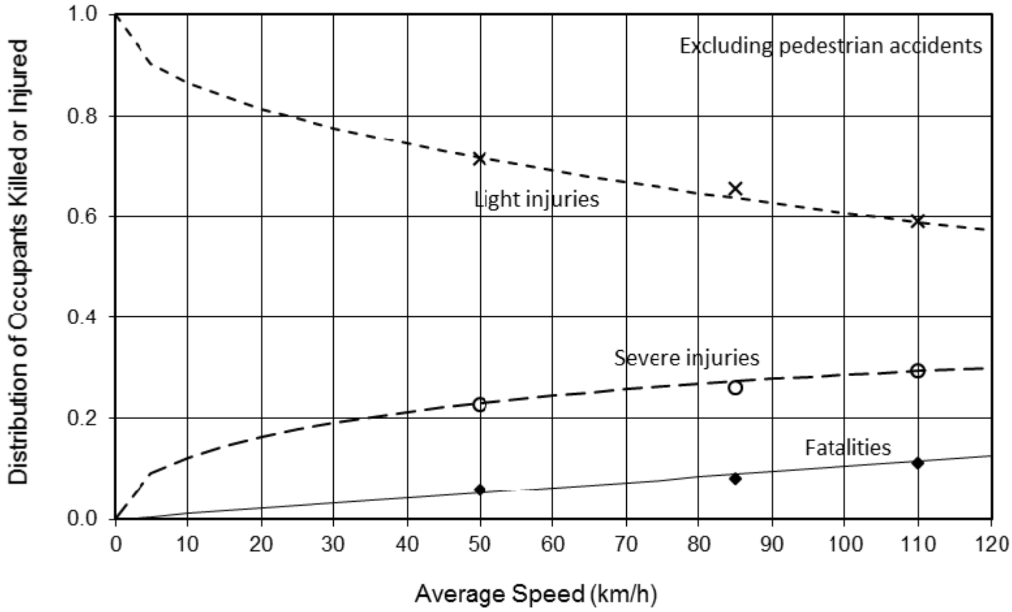

Figure 10: NetSafe Accident severity distribution for vehicle occupants

The fitted relations indicate an increase in the fatality rate and severe injuries with the increase of speed.

The NetSafe model is a valuable tool for predicting crashes and fatalities for South Africa. However, the information used to develop the model were only obtained from only two provinces. It is recommended to add the crash statistics of more provinces to improve the base on which the predictions are modelled.

B.3.2.4 SARTMS Volume 2 Chapter 20 Draft Report

A draft chapter addressing the setting of speed limits was prepared for the SARTSM. The final approval of this chapter is still required for inclusion as Chapter 20: Setting of Speed Limits in Volume 1.

All the requirements as discussed in Chapter 20 are intended to become mandatory in South Africa by 1 January 2026. All posted speed limits by and after this date must have been established or must be established by means of the procedures specified in Chapter 20. The following discussion is a short summary of the requirements addressed in this chapter.

Setting of Speed Limits

Only road authorities responsible for a road may post speed limits. A local road authority shall also have the authority for setting and posting speed limits on public roads in its area of jurisdiction, but which are not under the jurisdiction of another authority. Speed limits shall be subject to review and approval by the Speed Limit Committee of the road authority concerned.

Road authorities will have to establish Speed Limit Committees who will have the responsibility of overseeing the process of establishing speed limits. The functions of the Committee include the following:

- Review of speed limits as set out in Chapter 20
- Handling of appeals from authorities and the public

- Approval of speed limits on roads
- Administration and keeping of speed limit declarations.

Any other functions related to setting and law enforcement of speed limits that the Committee may consider appropriate.

Due to the specialised exercise, the setting of speed limits shall be undertaken by or under supervision of a professional engineer (Pr. Eng.) or a professional engineering technologist registered with the Engineering Council of South Africa (ECSA). Such professional must have the education, training and experience to render him/her competent to undertake the work.

The professional engineer or technologist will issue speed limit declarations for either a section of road, a full road or a number of roads and will be valid for 10 years, after which period the speed limit will be reviewed and a new declaration issued.

Basic Principles

Driving at excessive speed is often a contributing factor in crashes and particularly in the severity of crashes. The severity of crashes increases with speed due to the increase in kinetic energy at high speeds. Although crashes are not necessarily caused by high speeds, it becomes more difficult to avoid crashes at high speeds. Longer distances are travelled during reaction time, longer distances are required to stop and controlling of the vehicle becomes more difficult at higher speed. High speed also makes it difficult for other road users to estimate speeds, as well as distances. However, it is not only high speed that leads to crashes, but *speeds that are excessive for the circumstances*. The risk of a crash depends on various factors, such as day and night conditions, weather conditions, visibility, traffic, the road design as well as the road environment. Drivers should therefor adapt their speed in accordance with the prevailing conditions on a road or section thereof.

Speed limits are not an indication of safe speed. Speed limits are determined for favourable conditions and drivers are responsible for adjusting their speed when conditions become unfavourable. Circumstances under which a driver must reduce speed include, *inter alia*, the following:

- Sharp horizontal curves
- Junctions and crossings (even when the driver has sight of way)
- Limited sign distance due to horizontal and vertical curves or any other sight obstructions
- Poor visibility due to weather conditions or when travelling at night
- Increased density of traffic or when stopped or parked vehicles are encountered along a road
- Pedestrians, cyclists and other NMT are encountered.

Speed limit procedures are based on 85^{th} percentile speeds with adjustment for the law enforcement tolerance and is one of the most well-known methods for setting speed limits. The procedure for setting speed limits is therefore based on the 85^{th} percentile speed, but subject to maximum limits aimed at addressing community and road user needs. These limits were derived from speed limits that have typically been used in South Africa to accommodate these needs.

Design speeds of roads are conservative speeds used for road engineering to determine the geometric features of the roadway. Design speed incorporates considerable margins of safety in order to accommodate poor operating conditions. Under good conditions, it is possible to drive at higher speeds than the design speed. As previously mentioned, speed limits are set for good conditions and drivers are expected to reduce speeds when operating conditions are poor. Additionally, warning signs may be used to warn drivers of hazardous conditions, i.e. crossroads, junctions, sharp curves, concealed driveways, etc. Intersection sight distances may, however, require locally reduced speed limits.

The procedure to determine the speed limit consists of the following:

- *Consultation* of the responsible road authority and law enforcement authorities
- Identifying the *speed limit zones* taking into account factors such as topography, land use and road geometry
- Determine the *maximum speed limit* per zone and apply *the 85th percentile speed* method to confirm the appropriateness of the maximum speed
- Investigate the *intersection sight distances* and reduce speed limit or introduce physical or access management measures where necessary
- *Select and review speed limit zones*
- Determine the required *speed limit signs*. It may be necessary to change the position and sizes of existing signs
- Complete and submit the *speed limit declaration* and report
- The road authority is responsible to *implement all required measures*, such as the installation of speed limit signs, other road traffic signs and markings. Additional measures, such as the implementation of physical or access management, may also be required.

The maximum speed limits for urban and rural roads are included in Figure 11 and Figure 12 below.

Table 20.1: Maximum speed limits – Urban roads

(a) Functional road classification – Urban roads		
	Urban road classes	**Speed limit (km/h)**
U1	Urban principal arterial	Maximum legal limit (120†)
U2	Urban major arterial	80 – 100 km/h
U3	Urban minor arterial	70 – 80 km/h
U4	Urban collector street	General urban limit (60†)
U5	Urban local street	General urban limit (60†)
U6	Urban pedestrian priority	30 – 40 km/h

(b) Gravel roads	Speed limit (km/h)
Gravel roads in urban areas	General urban limit (60†)

(c) Property access – Built-up areas(*)	Without Median	With Median
Buildings fronting directly onto road with direct vehicular and pedestrian access. Buildings are adjacent to the road reserve and separated by a paved sidewalk from the roadway. Typical of CBD areas.	General urban limit (60†)	General urban limit (60†)
Direct vehicular and pedestrian access provided to properties 1 ha and smaller. Buildings closer than 25 m to the road reserve. Average access spacing 100 m or shorter per side of road. Typical residential, commercial and industrial areas.	General urban limit (60†)	70 km/h

(*) Property accesses must occur over a distance of at least 250 m and must involve a minimum of five properties

(d) Pedestrians (walking adjacent to roadway(*))	Speed limit (km/h)
Medium to high volumes of pedestrians. Typical of holiday resorts (**)	40 – 50 km/h
High volumes of pedestrians. Typical of CBD areas and public transport termini.	General limit (60†)
Medium volumes of pedestrians. Typical of suburban areas.	80 km/h

(*) Walkways within 3 m from roadway and not separated by means of a barrier or guardrail
(**) Optional. Only on Class 4 and 5 roads.

(e) Other conditions	Speed limit (km/h)
On-street parking and loading provided	General urban limit (60†)
Parking areas and garages (when requested)	20-30 km/h
Residential areas declared as WOONERF	30 km/h
Traffic signals (junctions or pedestrian crossings)(*)	80 km/h
Toll plazas where vehicles are required to stop at or travel very slowly through plaza (*)	60 km/h

(*) Preferably not further than 200 m from the junction or toll plaza

(f) Time-limited speed limits	Speed limit (km/h)
Adjacent or near to schools where pupils are dropped off or picked up on the road or on the verge of the road.	30 km/h
Adjacent or near to schools at locations where high volumes of pupils walk adjacent to the road to the school.	40 km/h

† South African maximum legal and general urban limits in km/h as in 2019. Use latest limits if amended by legislation.

Figure 11: Maximum speed limits – Urban Roads - DRAFT Chapter 20 Setting of Speed Limits SARTMS

Table 20.2: Maximum speed limits – Rural roads

(a) Functional road classification – Rural roads		
	Rural road classes	**Speed limit (km/h)**
R1	Rural principal arterial	Maximum legal limit (120†)
R2	Rural major arterial	Maximum legal limit (120†)
R3	Rural minor arterial	General– Max legal limit (100-120†)
R4	Rural collector road	80 km/h – General rural limit (100†)
R5	Rural local road	60 km/h – General rural limit (100†)
R6	Rural pedestrian priority	40 – 60 km/h

(b) Gravel roads	Speed limit (km/h)
Gravel roads outside urban areas	General rural limit (100†)

(c) Property access – Built-up areas(*)	Without Median	With Median
Buildings fronting directly onto road with direct vehicular and pedestrian access. Buildings are separated by a paved sidewalk from the roadway. Typical of CBD locations in urban areas.	60 km/h	60 km/h
Direct vehicular and pedestrian access provided to properties 1 ha and smaller. Buildings closer than 25m from the road reserve. Average access spacing 100 m or shorter per side of road. Typical of urban areas (other than CBD).	60 km/h	70 km/h

(*) Typical of urban roads but could occur in rare situations on roads classified as rural
Property accesses must occur over a distance of at least 250 m and must involve a minimum of five properties

(d) Pedestrians(walking directly adjacent to roadway(*))	Speed limit (km/h)
Medium to high volumes of pedestrians. Typical of holiday resorts(**)	40 – 50 km/h
High volumes of pedestrians. Typical of CBD areas and public transport termini.	60 km/h
Medium volumes of pedestrians. Typical of rural residential areas.	80 km/h

(*) Walkways within 3 m from roadway and not separated by means of a barrier or guardrail
(**) Optional. Only on Class 4 and 5 roads

(e) Other conditions	Speed limit (km/h)
On-road parking and loading provided	60 km/h
Parking areas (when requested)	20 - 30 km/h
Residential areas in rural areas declared as WOONERF	30 km/h
Traffic signals (junctions or pedestrian crossings)(*)	80 km/h
Toll plazas where vehicles are required to stop at or travel very slowly through plaza (*)	60 km/h

(*) Preferably not further than 200 m from the junction or toll plaza

(f) Time-limited speed limits (*)	Speed limit (km/h)
Adjacent or near to schools where pupils are dropped off or picked up on the road or on the verge of the road.	60 km/h
Adjacent or near to schools at locations where high volumes of pupils walk adjacent to the road to the school.	80 km/h

† South African maximum legal and general rural limits in km/h as in 2019. Use latest limits if amended by legislation.

Figure 12: Maximum speed limits – Rural Roads - DRAFT Chapter 20 Setting of Speed Limits SARTMS

B.3.3 RTMC State of Road Safety Report

Speed-related crashes are considered as one of the major contributors of crashes caused by human factors. According to the 2018 RTMC Report, human factors contribute to 89.3% of fatal crashes, 4.2% due to vehicle factors and 6.5% due to roads and environmental factors. Although there could be more than one factor contributing to a crash, the main causes considered are presented in Figure 13 below. The human factors remain a challenge compared to other factors with 89.3% during 2018.

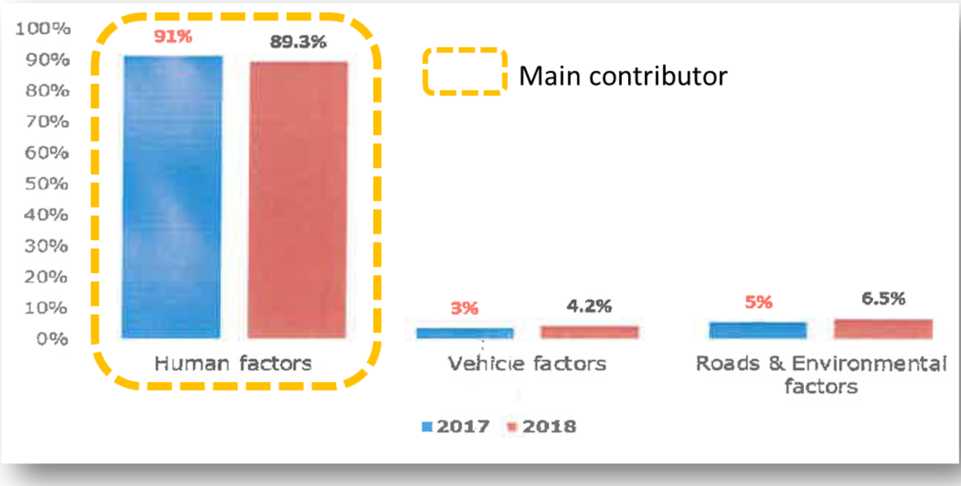

Figure 13: Factors contributing to the cause of fatal crashes

Jay walking contributes 32.7% to the main cause of fatal crashes, followed by hit and run with 14.2% and speed too high for circumstances with 10% during 2018. The high percentages for Jay walking and hit and run as depicted in Figure 14 below correlate to a high number of fatalities for pedestrians.

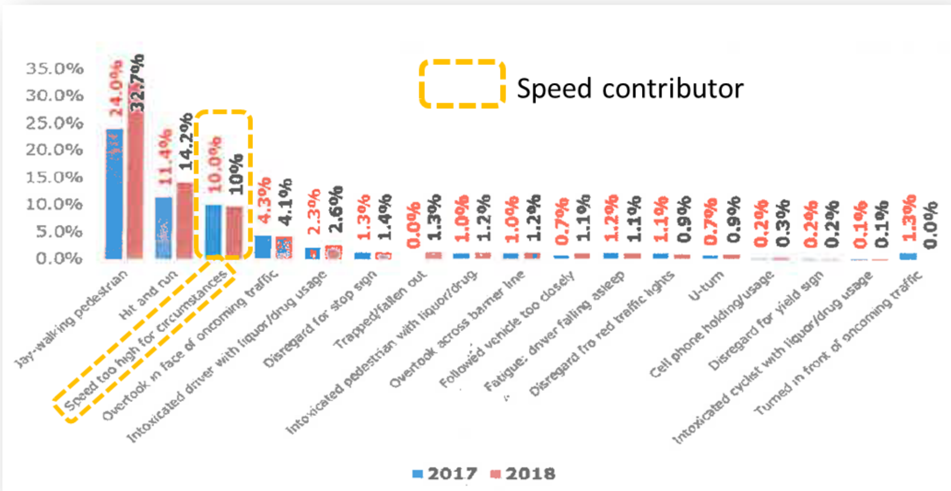

Figure 14: Human factors contributing to cause of fatal crash

The deaths by road user per category as presented in the WHO Global Status Report on Road Safety 2018 is indicated in Figure 15 below. Additionally, a comparison is summarised for 2016 – 2018 data in Figure 16 below. From 2016 to 2018, the percentage of deaths of drivers increased and passengers decreased. The percentage of deaths of pedestrians stayed constant at 38% from 2016 – 2018. The percentage of car occupants (drivers and passengers combined) also stayed fairly constant over the three-year period.

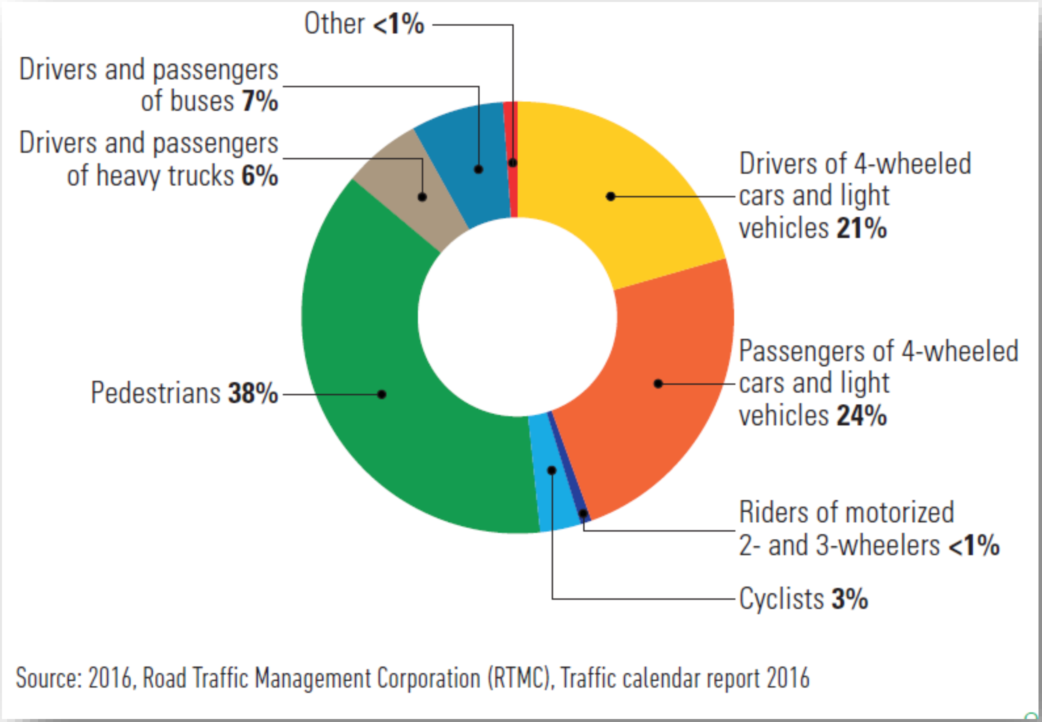

Figure 15: Death by Road Use Category, RTMC 2016 traffic calendar report

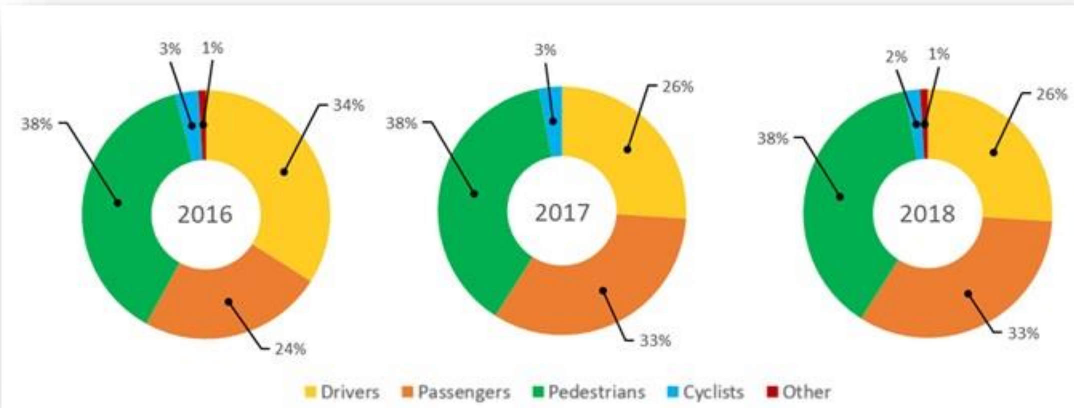

Figure 16: Death by Road Use Category, RTMC 2016 and 2018 calendar report

The downward trend in reported road fatalities since 2015 is indicated in Figure 17 below. The data is extracted from the WHO Global Status Report on Road Safety 2018, RTMC Fatal Statistics for 2010 – 2018 and the RTMC 2018 Road Safety Calendar Report. Preliminary RTMC recorded data shows a decrease from 2018.

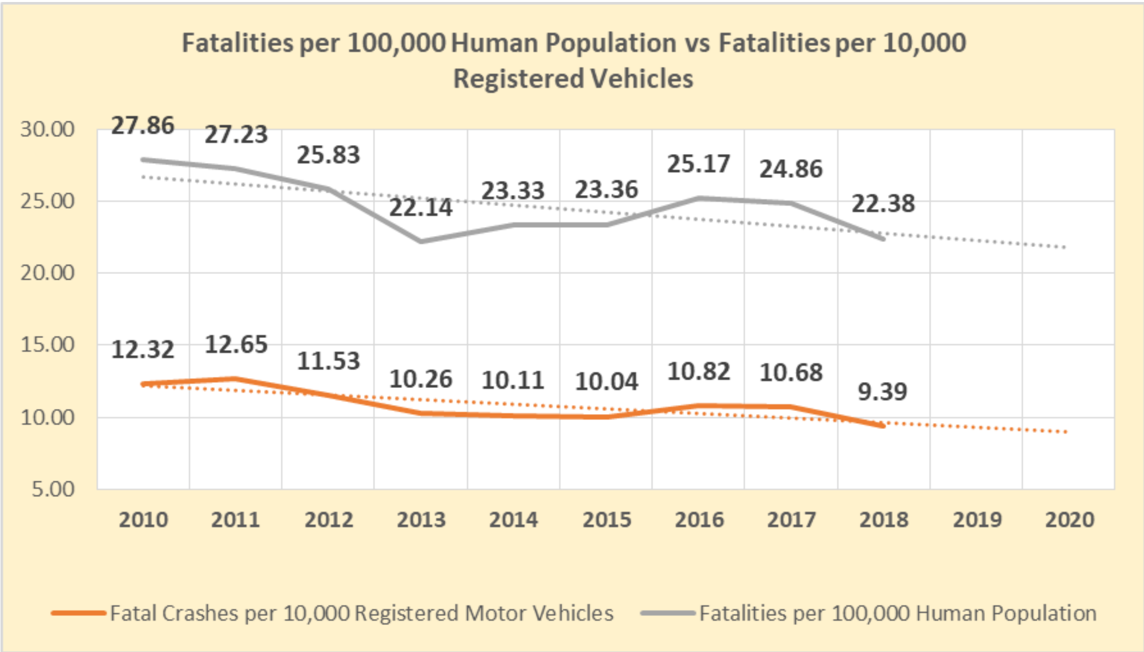

Figure 17: Trends in reported road fatalities for South Africa

B.4 LITERATURE REVIEW OF SPEED AND SPEED LIMITS IN BEST PERFORMING UNDA COUNTRIES

UNDA is a capacity development programme of the UN Secretariat. Through UNDA projects, the United Nations Economic Commission for Europe (UNECE), in collaboration with other UN agencies and programmes, supports and promotes joint interventions aimed at addressing development challenges, tackling transboundary issues and enhancing regional cooperation. The WHO reviews the UNDA participating countries on a continuous basis with regard to their traffic laws and road death statistics. This includes 49 high-income countries, 98 middle-income countries and 28 low-income countries. Data legislation and policies represent the country's situation as of 31 December 2017, while in most instances, 2016 data (although in some instances, 2017 or more recent data) on fatalities and vehicle registrations are used.

Table 4: Participation in the WHO Global Status Report on Road Safety 2018

Region	Number of participating countries	Number of countries in region	% population participating
African Region	44	47	93.7
Region of the Americas	30	35	98.2
Eastern Mediterranean Region	19	22	95.5
European Region	51	53	99.9
South-East Asian Region	10	11	98.7
Western Pacific Region	21	27	99.9
WORLD	175	195	98.1

The general speed limit for urban roads in South Africa is 60 km/h. South Africa does comply with the WHO criteria that local authorities should be able to modify national speed limits. In the South African environment, only authorities responsible for the provision of roads are authorised to set and post speed limits on roads that fall under their jurisdiction. No other authorities or persons are allowed to set or post speed limits on such roads, unless authorised by the responsible road authority[27].

The following section reviews the speed limits of South Africa in comparison to UNDA countries and focuses on the best performing countries (< 10 estimated death rate per 100 000 population) from the data published in the WHO Global Status Report on Road Safety 2018. The categories considered for comparison are:

- All countries Group 1-4 – all 175 participating UNDA countries
- Group 1 countries – countries with good death registration data
- Middle-income countries – countries with Gross National Income per capita between $1,026 and $12,475[28]
- African Region countries.

[27] SARTMS Chapter 20, Setting of Speed Limits, June 2019 DRAFT.

[28] World Bank Income categories.

Countries with variant speed data where the higher speed exceeds 50 km/h or undefined speed data were not incorporated in the graph analysis.

B.4.1 Urban Roads Speed Limits

B.4.1.1 All countries Groups 1 - 4

The WHO Global Status Report on Road Safety 2018 ranks South Africa at number 136 out of 175 participating countries in terms of its death rate of 25.9/100 000 population. This ranking implies that South Africa falls within the 25% of the poorest performing countries in terms of relative risk to die during a road crash. Figure 18 below indicates South Africa's estimated death rate in comparison to all other UNDA countries (countries with an urban speed <=50 km/h are indicated in green and countries with an urban speed > 50 km/h are indicated in red).

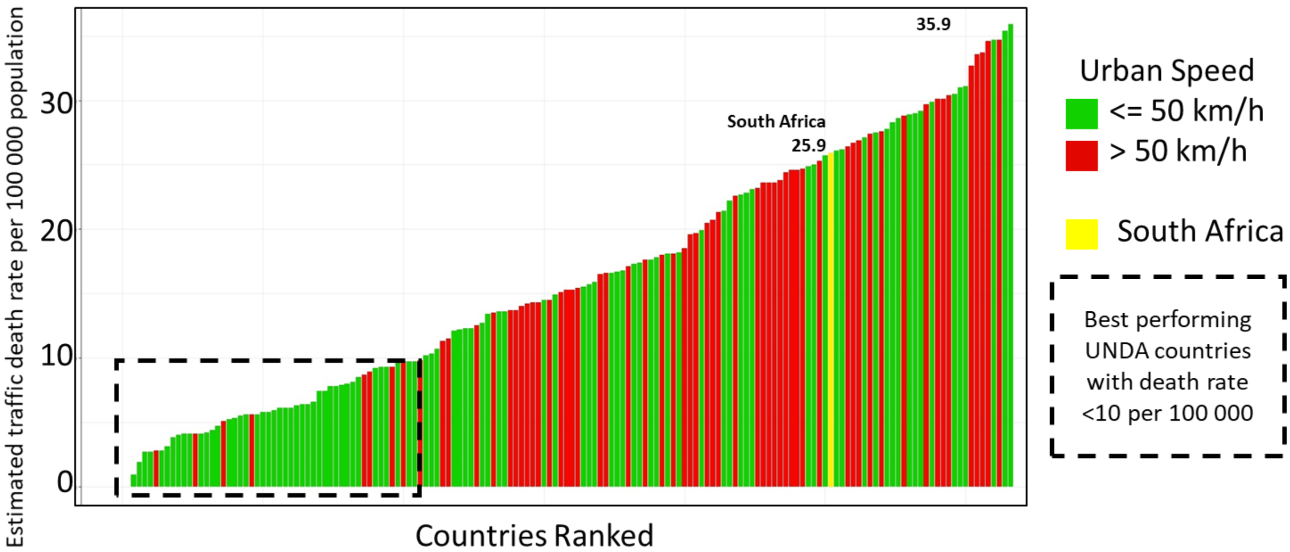

Figure 18: Fatalities per 100 000 people – SA compared to all UNDA countries with urban speed indicated

Figure 19 below shows the urban speed for the best performing UNDA countries in two categories <= 50 km/h in green and > 50 km/h in red. There is a clear trend for urban speed <=50 km//h when considering best performing countries.

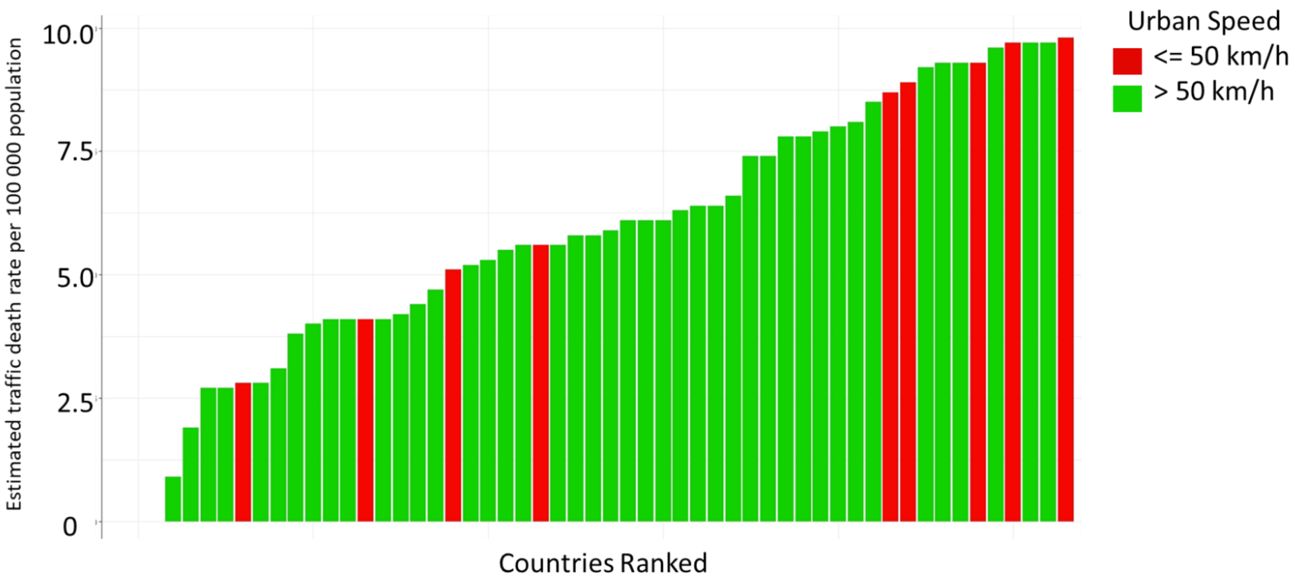

Figure 19: Fatalities per 100 000 people for best performing UNDA countries (Death rate <10/100 000) with urban speed indicated

The information on percentage of countries with defined urban speed is indicated in Table 5. Seventy-seven percent (77%) of the best performing countries (death rate < 10/100 000) has an urban speed limit <= 50 km/h, whereas forty-seven percent (47%) of the countries with a death rate > 10/100 000 has urban speed limits > 50 km/h.

Table 5: Countries with urban speed limit <= 50 km/h

Category within All countries Group 1-4	Number of countries with defined urban speed limit	Number of countries with urban speed limit <= 50 km/h	% of countries with urban speed limit <= 50 km/h
All countries	158*	94	59%
Countries with death rate <= 10/100 000	53*	41	77%
Countries with death rate > 10/100 000	105*	50	47%

* Countries with variant speed data where the higher speed exceeds 50 km/h or undefined speed data are excluded

B.4.1.2 Group 1 UNDA countries

This section compares South Africa's performance and speed limits to Group 1 countries. As mentioned previously, Group 1 countries are defined as countries with good death registration data. South Africa is ranked at number 82 out of 86 Group 1 countries regarding death rate per 100 000 people.

Figure 20 below indicates South Africa's estimated death rate in comparison to Group 1 UNDA countries.

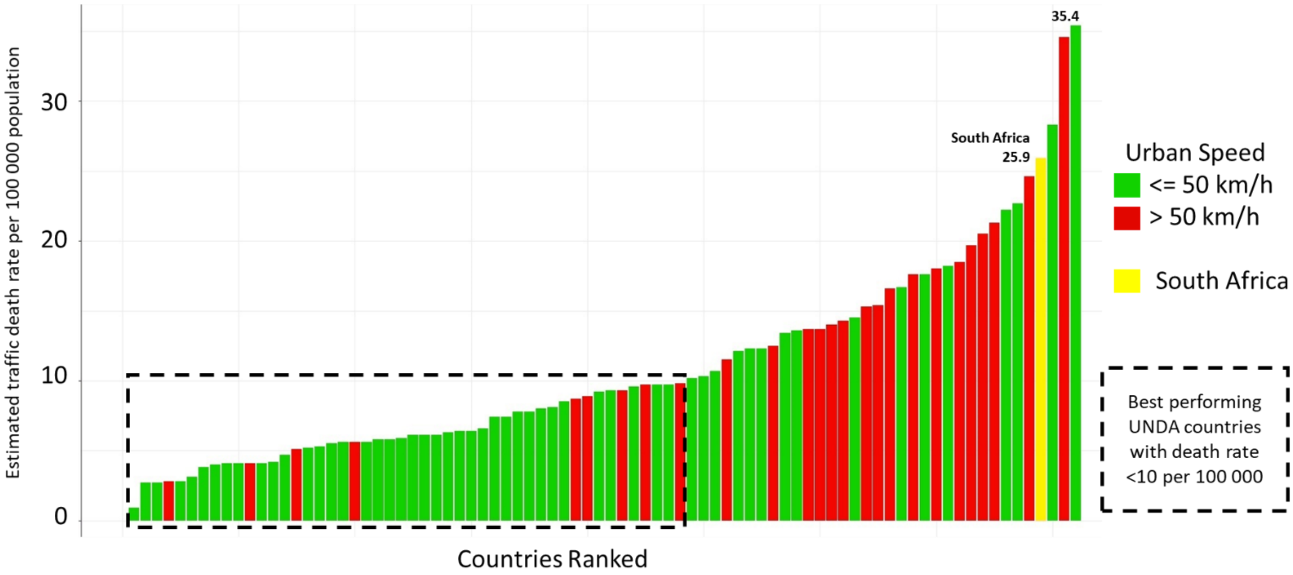

Figure 20: Fatalities per 100 000 people – SA compared to Group 1 UNDA countries with urban speed indicated

The percentage Group 1 countries with defined urban speed limits is included in Table 6. Eighty-one percent (81%) of the best performing countries (death rate < 10/100 000) has an urban speed limit <= 50 km/h, whereas forty-seven percent (47%) of the countries with a death rate > 10/100 000 has urban speed limits > 50 km/h.

Table 6: Group 1 Countries with urban speed limit <= 50 km/h

Category within Group 1 countries	Number of countries with defined urban speed limit	Number of countries with urban speed limit <= 50 km/h	% of countries with urban speed limit <= 50 km/h
All Group 1 countries	82*	55	67%
Countries with death rate <= 10/100 000	48*	39	81%
Countries with death rate > 10/100 000	34*	16	47%

* Countries with variant speed data where the higher speed exceeds 50 km/h or undefined speed data are excluded

B.4.1.3 Middle-income countries

Middle-income countries are defined as countries with Gross National Income per capita between $1,026 and $12,475[29]. South Africa's estimated death rate in comparison to Group 1 UNDA countries is indicated in Figure 21 below. South Africa is ranked at number 83 out of 98 middle-income countries regarding death rate per 100 000 people.

[29]World Bank Income categories.

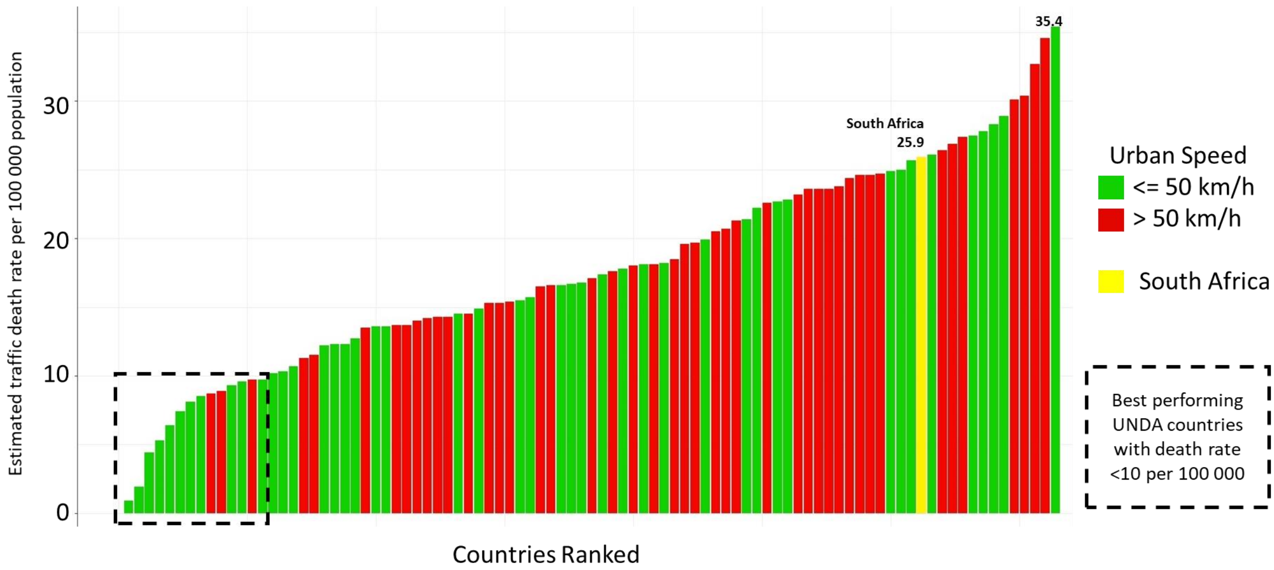

Figure 21: Fatalities per 100 000 people – SA compared to middle-income UNDA countries with urban speed indicated

The percentage middle-income countries with defined urban speed limits are included in Table 7 below. Seventy-nine percent (79%) of the best performing countries (death rate < 10/100 000) has an urban speed limit <= 50 km/h, whereas forty-four percent (44%) of the countries with a death rate > 10/100 000 has an urban speed limit > 50 km/h.

Table 7: Group 1 Countries with urban speed limit <= 50 km/h

Category within middle-income countries	Number of countries with defined urban speed limit	Number of countries with urban speed limit <= 50 km/h	% of countries with urban speed limit <= 50 km/h
All middle-income countries	91	45	49%
Countries with death rate <= 10/100 000	14	11	79%
Countries with death rate > 10/100 000	77	34	44%

* Countries with variant speed data where the higher speed exceeds 50 km/h or undefined speed data are excluded

B.4.1.4 African Region

This section compares South African road crash statistics against other countries in the African Region. Countries within the WHO African Region are indicated in Figure 22 below.

Figure 22: WHO African Region Countries

South Africa is ranked at number 15 out of 44 countries within the African Region regarding death rate per 100 000 people as indicated in Figure 23 below.

Countries with variant speed data where the higher urban speed exceeds 50 km/h or undefined speed data are excluded.

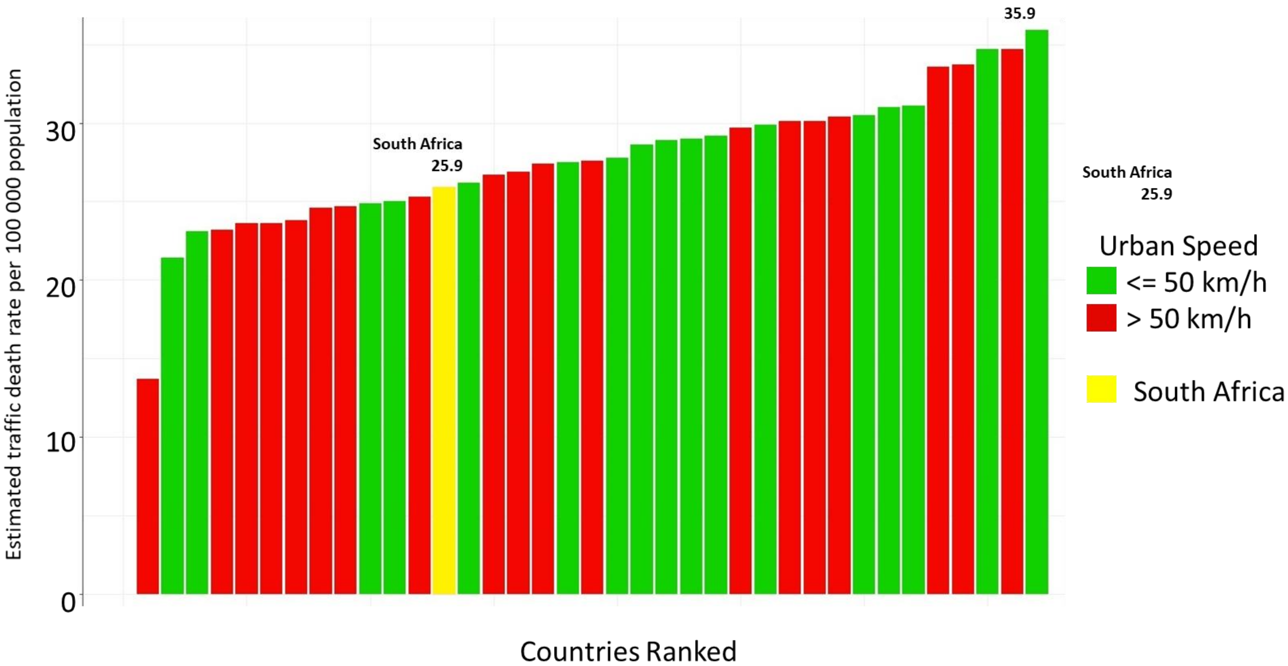

Figure 23: Fatalities per 100 000 people – SA compared to UNDA countries in the African Region with urban speed indicated

The percentage African Region countries with defined urban speed limits is included in Table 8. No countries within the African Region has a death rate < 10/100 000.

Table 8: African Region Countries with urban speed limit <= 50 km/h

Category within middle-income countries	Number of countries with defined urban speed limit	Number of countries with urban speed limit <= 50 km/h	% of countries with urban speed limit <= 50 km/h
All middle-income countries	37	17	46%
Countries with death rate <= 10/100 000	0	Not Applicable	Not Applicable
Countries with death rate > 10/100 000	37	17	46%

* Countries with variant speed data where the higher speed exceeds 50 km/h or undefined speed data are excluded

Mauritius and South Africa are the only two countries within the African Region that fall within Group 1. Mauritius is an island west of the African continent with a population of approximately 1,265 million people (2018 estimate) and a total road network of 2 066 km and a traffic road death rate of 13.7/100 000. South Africa has an estimated population of 57,8 million people and approximately 535 000 km of proclaimed roads and a traffic road death rate of 25.9/100 000.

B.4.2 Rural Highway Speed Limits

South Africa's estimated death rate on rural highways in comparison to all other UNDA countries is indicated in Figure 24 below (countries with a rural highway speed <=80 km/h are indicated in green and countries with a rural highway speed > 80 km/h are indicated in red). There is no clear trend for rural highway speed <=80 km/h when considering best performing countries.

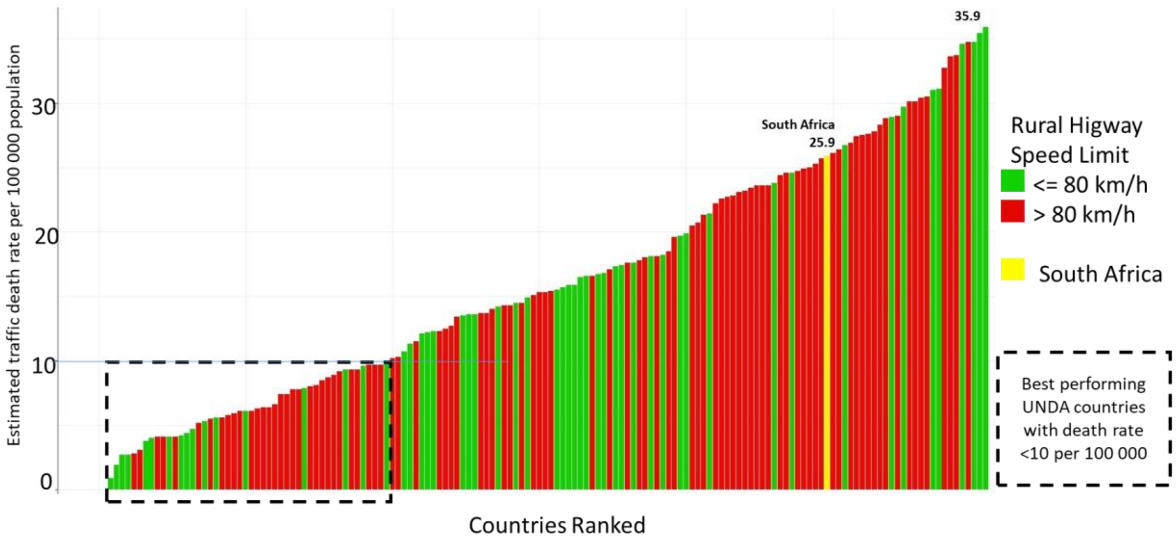

Figure 24: Fatalities per 100 000 people – SA compared to all UNDA countries with rural highway speed limit indicated

Table 9: Countries with rural highway d speed limit <= 80 km/h

Category within countries	Number of countries with defined rural highway speed limit	Number of countries with rural highway speed limit <= 80 km/h	% of countries with rural highway speed limit <= 80 km/h
All countries	128	56	44%
Countries with death rate <= 10/100 000	50	18	36%
Countries with death rate > 10/100 000	78	38	49%

B.4.3 Motorway Speed Limits

South Africa's estimated death rate in comparison to all other UNDA countries is indicated in Figure 25 below (countries with motorway[30] speed <=100 km/h are indicated in green and countries with motorway speed > 100 km/h are indicated in red). There is no clear trend for motorway speed <=100 km/h when considering best performing countries.

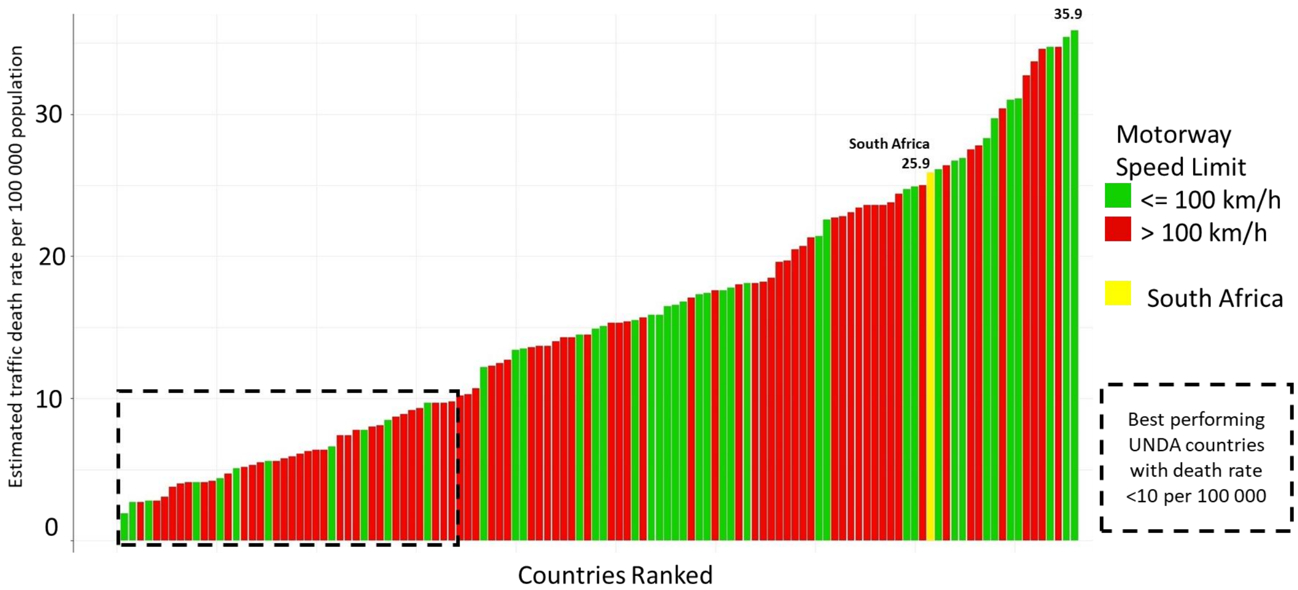

Figure 25: Fatalities per 100 000 people – SA compared to all UNDA countries with motorway speed indicated

Table 10: Countries with motorway speed limit <= 100 km/h

[30] A motorway is referred to as a freeway in South Africa. It is physically divided, grade separated, dual roadway with access via ramps and designated as such in terms of the NRTA (COTO (2012) *TRH 26 South African Road Classification and Access Management* Manual).

Category within countries	Number of countries with defined motorway speed limit	Number of countries with motorway speed limit <= 100 km/h	% of countries with motorway speed limit <= 100 km/h
All countries	122	43	34%
Countries with death rate <= 10/100 000	44	12	27%
Countries with death rate > 10/100 000	78	31	40%

B.4.4 Data Analytics and Statistical analysis

Extensive data analytics and statistical interference were applied to the WHO data. Analyses *inter alia* explored relationships between death rates and speed limits on urban and rural roads as well as motorways. Although some clear trends were observed, no statistically significant relationships between speed limits and death rate could be established.

B.5 CONCLUSION

Published research shows that there is an increase in risk of death with the increase of speed.

The African Region has the highest death rate/100 000 population and Europe has the lowest death rate.

South Africa is ranked number 136 out of 175 UNDA participating countries regarding road safety in terms of its death rate of 25.9/100 000 population (based on 2016 crash data) (the WHO Global Status Report on Road Safety 2018). The RTMC 2018 calendar report indicates a downward trend from 2015 to 2018. Preliminary RTMC recorded data shows a decrease from 2018.

With regard to international speed limit reduction and increase:

- Australia established a DUSL of 50 km/h and recorded a reduction in fatal crashes of about 20%
- Sweden has speed limits ranging from 30 km/h to 120 km/h, but reduced their annual road crash fatalities by 14 on rural roads by decreasing the speed limit from 90 to 80 km/h. Annual serious injuries increased by 15 on motorways when the speed limit was increased by 10 km/h (to 120 km/h
- Forty (40) Canadian states increased their speed limits on rural interstates, which resulted in a 15 -20% increase in fatalities (whereas the States who did not increase speed limits had a 12% decrease in fatalities).

The WHO best practice criteria recommend an urban speed limit of less than 50 km/h.

There is a clear trend for urban speed <=50 km/h when considering best performing countries.

There is no clear trend for rural highway speed <=80 km/h when considering best performing countries.

There is no clear trend for motorway speed <=100 km/h when considering best performing countries.

Effective law enforcement should not be done to earn income for a municipality or road authority but should be focused on improving road safety.

B.5.1 Recommendations for Further Research

Further research is required to develop models (e.g. the NetSafe Highway Road Safety Model developed by SANRAL) using crash statistics. Such research will only be possible if the crash reporting system in South Africa is improved and all data are captured, including the exact locations of the crashes. Other provincial statistical data is also required to improve the model.

The RTMC crash data is based on fatal crashes only. There is a need for in-depth research to be conducted to collect scientifically based facts to complement the administrative data.

Research regarding fictitious road insurance claims for death and/serious injuries against the Road Accident Fund.

Investigation into whether short-term insurance claims have reduced since the implementation of driver behaviour incentive plans by short-term insurers.

B.5.2 Recommendations regarding Road Safety Interventions to Improve/Intensify Efforts to deal with Speeding and to Determine Appropriate Speed Limits

Road safety interventions should be assessed according to the Technical Method for Highways (TMH) 20, Socio-Economic Analysis of road projects, Aug 2018. This manual sets out the following official requirements for the socio-economic analysis of road projects in South Africa and are applicable to National and all Provincial and Municipal spheres of government in the country:

- Speed limits should be tested against the operational speeds
- Establishment of Speed Limit Committees consisting of a multi-disciplinary team of professional engineers, traffic law enforcement officers and personnel in other relevant disciplines
- Reduce urban speed limits from 60 km/h to 50 km/h
- Reduce urban speed limits to 40 km/h in high pedestrian areas
- Reduce speed limits to 30 km/h in school zones
- Effective law enforcement with effective prosecution
- Speed governors in heavy vehicles and public transport vehicles
- Improved accident statistics, which include the exact locations of accidents.

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