ROAD SAFETY COMPARISON IN SOUTH AFRICA – HOW DO THE DIFFERENT PROVINCES COMPARE?

M VANDERSCHUREN[1] and D ROUX[2]

[1]University of Cape Town, Private Bag X3, Rondebosch, 7701, Cape Town, South Africa
[2]Road Traffic Management Corporation, NaTIS Facility, Waterfall Office Park, 13 Howick Close, Midrand, South Africa

ABSTRACT

South Africa is known for its high level of road fatalities, which continues to hamper socio-economic development and impact the well-being of all South Africans. Road traffic and fatal crash information are reported on a national level, for country reporting purposes, to the United Nations Decade of Action (UN, 2010), as well as to record and analyse annually on the whole spectrum of data collected for road safety interventions. In 2018 the World Health Organisation ranked South Africa at number 136 of 175 of participating countries regarding road safety. This ranking implies that South Africa falls within 30% of the poorest performing countries in terms of the relative risk associated with dying, due to a road traffic crash. What is not well known, is the road safety burden faced within various provinces in South Africa, and that the success to reduce the fatality numbers varies around the country. This has implications for the associated risk, creating a need for appropriate tailor-made interventions for each province.

Fatality data for the years 2015 to 2017 were analysed at a provincial level. Absolute fatalities, as well as the fatalities per 100 000 population, are compared. The analysis has a closer look at the influence age has on various aspects. The detailed analysis revealed significant differences per province in fatality rate per 100 000 population (between 18 and 35 fatalities per 100 000 population), age and gender (males between 20-39 are most at risk), day of the week (weekends are dangerous), time of day (late afternoon and early evenings carry a high risk) and transport mode (heavy and public transport vehicles cause more fatalities per registered vehicles).

The cost of crashes per province was also analysed over the study period and compared per province with the average annual cost burden; the lowest in the Northern Cape (R4.6 billion) and the highest in Gauteng and KwaZulu-Natal (more than R30 billion).

1. INTRODUCTION

The number of road traffic crashes[1] and associated deaths continues to increase worldwide, reaching a staggering 1.35 million in 2016, according to the World Health Organisation's Global Status Report on Road Safety 2018 (WHO, 2018). The rates of death relative to the size of the world's population has, however, stabilised in recent years. It is further stated that progress has been achieved in important areas, such as legislation, vehicle standards and improving access to post-crash care, however, its progress did not

[1] The term 'crash' is intentionally aligned with the definition as in SANS/ISO 39001 and is used throughout this report. 'Crash' imparts the same meaning as 'accident' noted in the National Road Traffic Act, Act 93 of 1996.

occur at a pace fast enough to compensate for the rising population and rapid motorisation of transport taking place in many countries. In addition, it is acknowledged that, at this rate, the target to halve road traffic deaths by 2020, as proclaimed by the UN in its 'Decade of Action for Road Safety 2011-2020' declaration (UN, 2010), will not be met.

It is estimated that road traffic injury is now the leading cause of death for children and young adults aged 5–29 years, with an urgent need for a shift in the current child health agenda, which has largely neglected road safety (WHO, 2018). Road traffic fatalities is now the eighth leading cause of death for all age groups and the burden of road traffic injuries and deaths is disproportionately borne by vulnerable road users and those living in low- and middle-income countries, where the growing number of deaths is fuelled by transport that is increasingly motorised. From 2013 to 2016, no reductions in the number of road traffic deaths were observed in any low-income country, but some reductions were observed in the 48 middle- and high-income countries, while the number of deaths increased in 104 countries during this period (WHO, 2018).

According to WHO (2018), Vulnerable Road Users (VRU) are disproportionately impacted by road related deaths, globally, with pedestrians and cyclists representing 26% of all road related deaths (Figure 1). WHO (2018) further states that 29% of all deaths are car occupants, with 23% pedestrian fatalities globally.

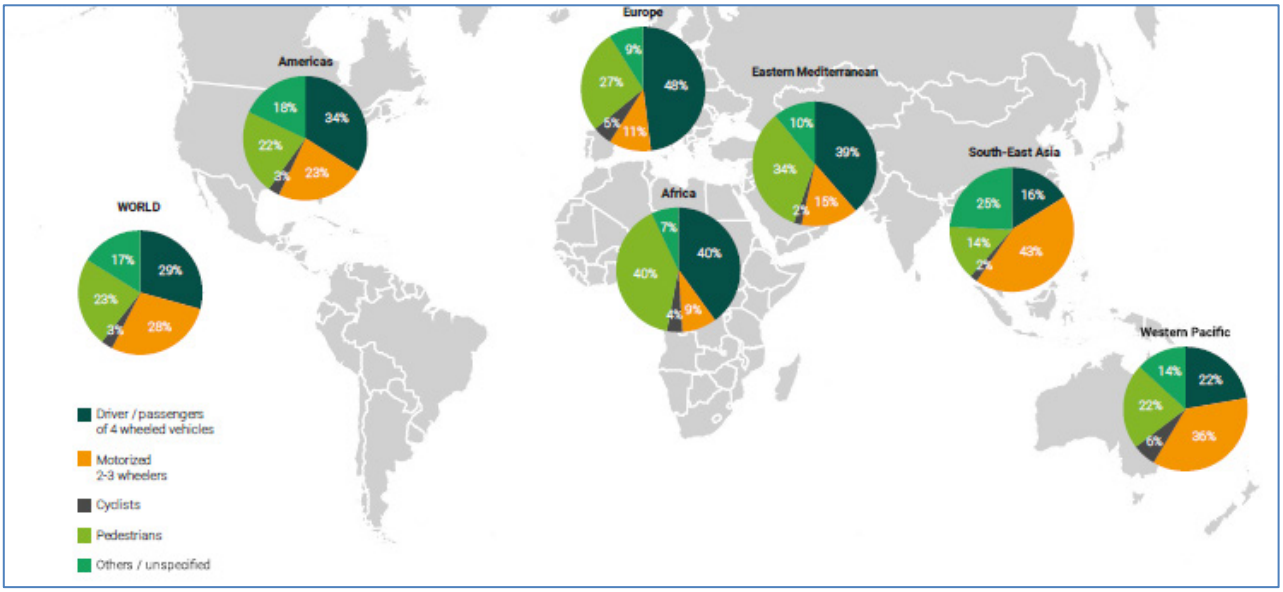


Figure 1: Distribution of Deaths by Road User Type by WHO Region (WHO, 2018)

The African Region has the highest pedestrian fatality rate, a staggering 40% of all fatalities, followed by the Eastern Mediterranean Region having a pedestrian fatality rate of 34% with the lowest pedestrian rate recorded in the South East Asian Region with only 14% pedestrian fatalities.

With the vehicle population ever increasing, especially in middle and low income countries, such as in the African and the Eastern Mediterranean Region, where a large proportion of road users are pedestrians, it could be argued that pedestrian fatalities are expected to increase in these regions.

South Africa is categorised as a Middle Income Country and falls within Group 1, i.e. Countries / Areas with good death registration data (WHO, 2018.) If compared with the other 98 Middle Income Countries, South Africa is ranked 83rd on fatality rate per 100 000

population and ranked 80th out of 84 for Group 1 countries. There are only two countries in the African Region categorised as Group 1 countries, viz. Mauritius and South Africa, with fatality rates per 100 000 population 13.7 and 25.9, respectively. It can be argued that with other African Region countries not categorised as having good death registration data, or falling outside Group 1, that South Africa is one of the two leading countries in the African Region relating to road safety traffic data.

South Africa, with a fatality rate per 100 000 population or the relative risk of dying, due to road crashes of 25.9, is ranked 136 out of 175 countries (WHO, 2018). Out of the 44 participating African Region countries (of 47), South Africa is ranked 15th on fatality rate per 100 000 population. South African road safety rates per 100 000 population, or the relative risk of dying due to road crashes, has decreased from 31.9 fatalities per 100 000 in 2010 (Peden et al., 2013). It is, however, not proposed that the 2016 fatality rate per 100 000 population of 25.9 for South Africa is acceptable; ways need to be found to drastically decrease this rate in the short, medium and long term.

2. METHODOLOGY

In this study, fatal crash data, recorded by the RTMC for the years 2015 to 2017, were analysed and compared on a provincial level. Absolute fatalities, as well as the fatalities per 100 000 population, are compared. The RTMC is the lead road safety agency in South Africa, mandated by the Department of Transport (DoT) to capture, process and verify all road fatality statistics (RTMC, 2016). Consequently, this data source provides the best available information, to understand the vulnerability of all age groups, on a national scale. The analysis interrogates the influence that aspects, such as age, gender, road user, modal split, day of the week and time of day, have on road fatalities.

Due to a lack of information, the fatality or crash rate per distance travelled could not be determined for the purpose of this study. A million vehicle kilometres travelled needs to be established for all roads in South Africa by the RTMC, in conjunction with road authorities, so that more accurate analysis is possible in the future.

The road safety status quo, for each of the nine provinces in South Africa, is determined and compared in line with the fatality rate per 100 000 population to compare the relative risk of dying, due to road crashes (WHO, 2018).

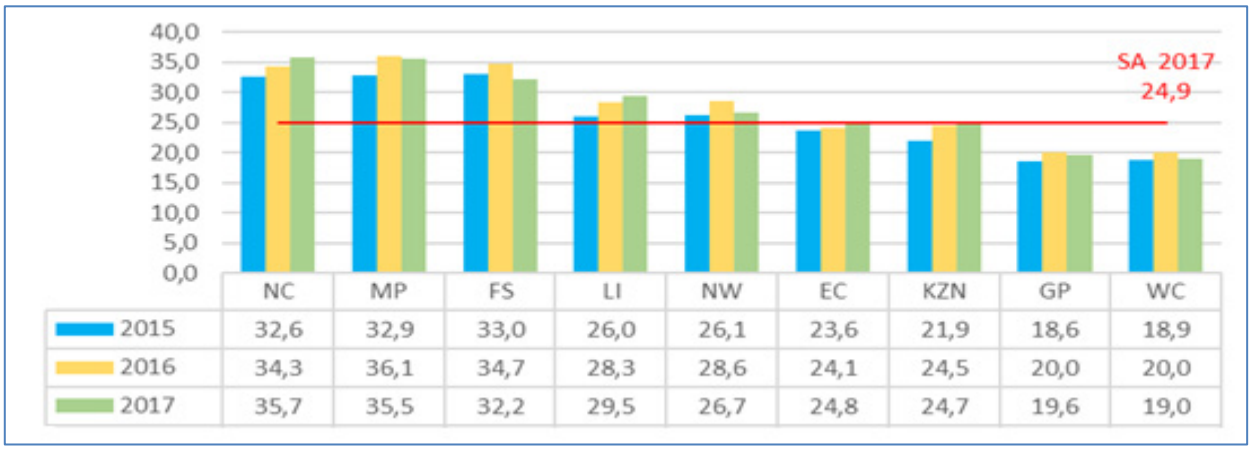
The risk for each age group is further deduced, based on percentage fatalities per time of the day. Unfortunately, the data did not provide information on the vulnerability of the three age groups, based on gender or vehicle, involved in the accident. However, an overall analysis is performed to determine whether males or females are at more risk on the Province's roads and which vehicle is involved in the majority of the fatalities.

The synthesis of findings was classified into seven areas for analysis: road fatalities per province; road fatalities and gender; road fatalities and age; road fatalities per road user; road fatalities per mode of transport and road fatalities and time of day per province.

3. ROAD FATALITIES PER PROVINCE

In absolute terms, Gauteng and the KwaZulu-Natal have the largest number of road fatalities and, during the period of investigation between 2015 and 2017, the fatalities have increased in both provinces from 2 472 to 2 800 and 2 411 to 2 734 fatalities, respectively. In relative terms, Gauteng and the Western Cape are safer than other provinces, with

fatality rates of less than 20 fatalities per 100 000 population, during the investigation period. KwaZulu-Natal and Eastern Cape follow with less than 25 fatalities per 100 000 population. All other provinces have fatality rates that are higher than 25 fatalities per 100 000 population (See Figure 2).



	NC	MP	FS	LI	NW	EC	KZN	GP	WC
2015	32,6	32,9	33,0	26,0	26,1	23,6	21,9	18,6	18,9
2016	34,3	36,1	34,7	28,3	28,6	24,1	24,5	20,0	20,0
2017	35,7	35,5	32,2	29,5	26,7	24,8	24,7	19,6	19,0

Figure 2: Fatalities per 100 000 Population (RTMC, 2015-2017)

In terms of the definition of fatalities per 100 000 population (WHO, 2018), i.e. the relative risk of dying due to road crashes, the Northern Cape has the highest risk of dying in a crash of late (35.7 for 2017), while the Western Cape is considered the safest province (19.0 for 2017).

Road crashes cost the South African economy R162.045 billion in 2017, adjusted by annual Consumer Price Index (CPI) with relevant annual crash and fatality rates, from the estimated R142.9 billion in 2015 (Labuschagne et al., 2017). The differences per province are substantial, with the average annual cost burden lowest in the Northern Cape (R4.6 billion) and highest in Gauteng and KwaZulu-Natal (more than R30 billion). Understandably, the costs are related to the population size. Gauteng houses almost 25% of the South African population and is responsible for just over 20% of the road crash costs. Differences between population size and the contribution to the overall road crash costs, are less (to not) significant for other provinces (see Figure 3).

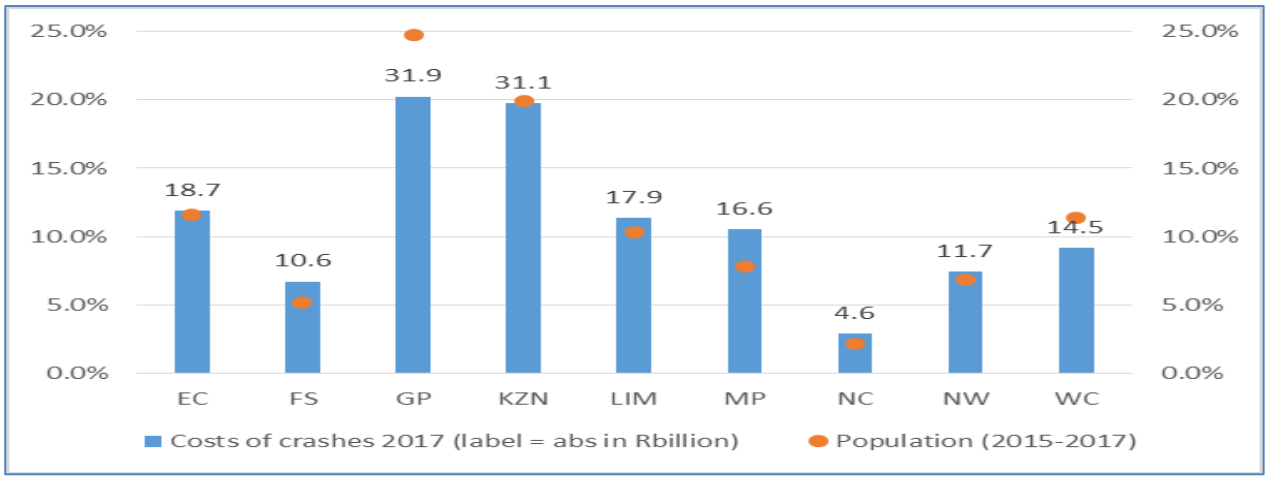


Figure 3: Road Crash Costs Share and Population Share per Province (RTMC, 2015-2017)

3.1 Road fatalities and age

Within South Africa, fatalities are the highest for citizens between 20 and 40 years old (38.7%), followed by the age group between 40 and 65 years old (21.8%). This is the economically active part of the population (see Figure 4).

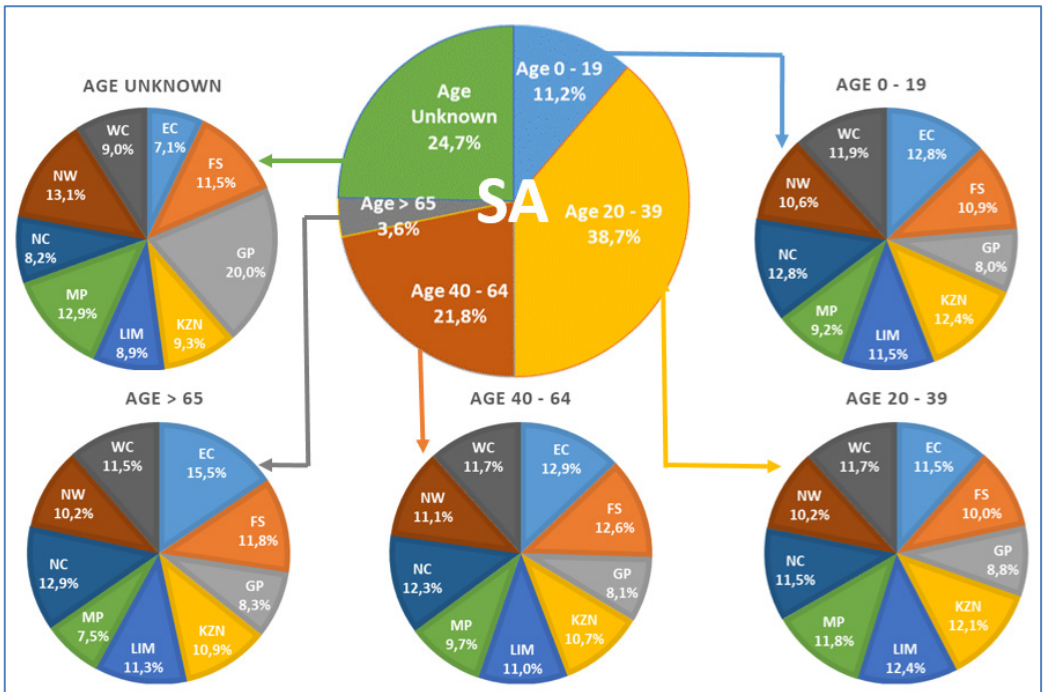


Figure 4: Road Fatalities per Age Group (RTMC, 2015-2017)

The age distribution of road fatality victims, for different provinces, does not vary significantly. However, the number of road fatalities, where the age has not been recorded, varies between the nine provinces with the Gauteng province having 20% unknown ages, followed by the North West province with 13.1%; the total records not recorded for all fatalities in South Africa is 24.7%. Fatalities are recorded via a quick response form submitted by the South African Police Services (SAPS) within 1-3 days after a fatal crash to the RTMC; there is poor follow-up by the SAPS in establishing and submitting victim ages, which were not known at the time of submitting the quick response forms to the RTMC. With only 75.3% of fatality ages known, micro-analysis of road fatalities versus age has severe limitations.

3.2 Road fatalities and gender

There is a major gender split regarding road fatality victims. In South Africa, 21.7% of fatality victims were female, between 2015 and 2017, with 76.2% male; only 2.2% of the gender of the victims could not be identified at the time of reporting (see Figure 4), most probably in crashes where vehicles caught fire and victims burnt. This finding suggests that for every female fatality on the road, there are at least 3 male fatalities. Similar results were found by Vanderschuren and Zuidgeest (2017), Jobanputra (2013), Ogendi et al. (2013) and Kopits and Cropper (2005).

The gender split of the various provinces shows some variation. The Gauteng province had the lowest female fatality rate of 18.3% with the Eastern Cape Province having the highest female fatality rate of 25%. The provincial gender split ranges from 72.5% to

79.5% for male fatality victims, and between 18.3% to 25% for female fatality victims (see Figure 5).

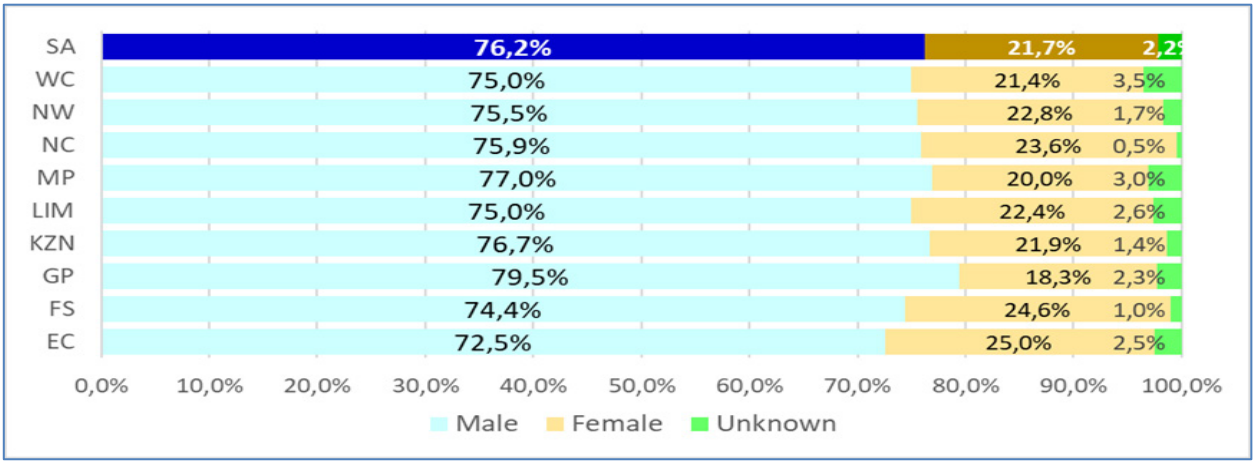


Figure 5: Percentage Fatalities per Gender per Province (RTMC, 2015-2017)

Fatality rates per 100 000 population provide interesting differences per province (Figure 6). The average South African male has a fatality rate of 33 fatalities per 100 000 population, while the value for females is a mere 9 fatalities per 100 000 population. In Gauteng and the Western Cape, the risk for males and females are significantly lower than the South African average while, especially males, face a much higher risk level in Mpumalanga (45.1), the Northern Cape (44.6) and the Free State (42.7).

The gender split for active driver's licenses within the study period (NaTIS, 31 October 2017) was 37.0% Female and 63.0% Male. The number of fatal crashes with male/female split could, however, not be determined from the available data and needs to be further investigated to determine the relationship of the gender of drivers involved in fatal crashes versus the gender of the driver population.

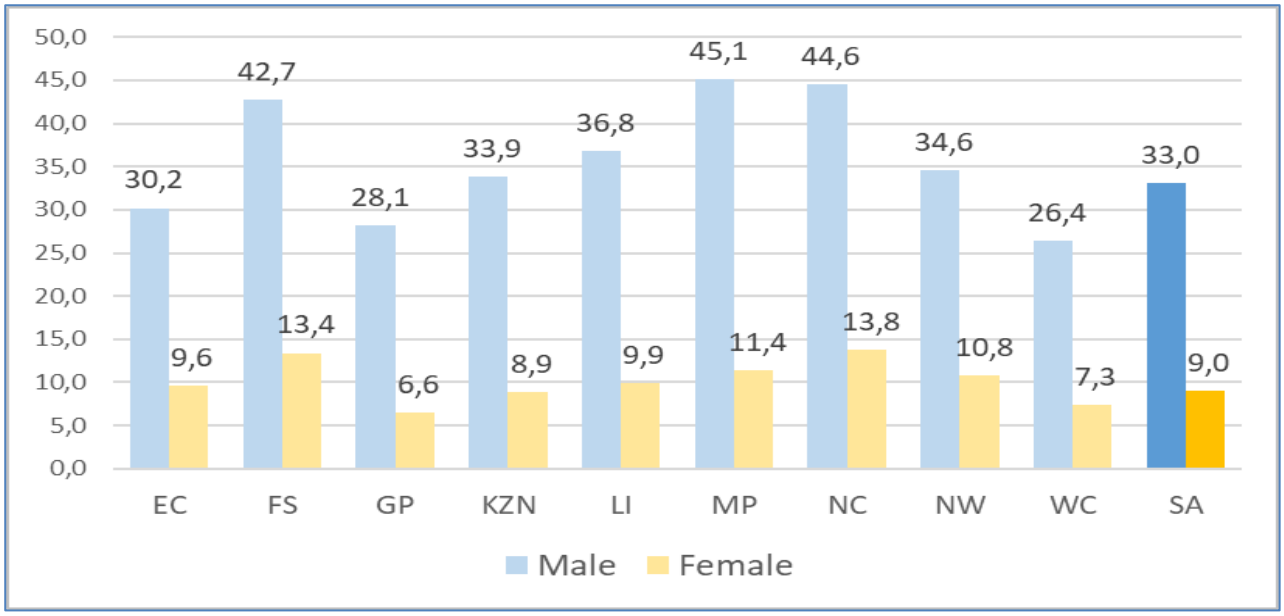


Figure 6: Fatalities per 100 000 Population per Province and Gender (RTMC, 2015-2017)

3.3 Road fatalities per road user

The annual trends over the study period per road user type do not vary significantly. The majority of road fatality victims in South Africa are pedestrians (between 37.6% and 38.4%, depending on the year), closely followed by passengers (between 32.6% and 32.8%) as can be seen in Figure 7.

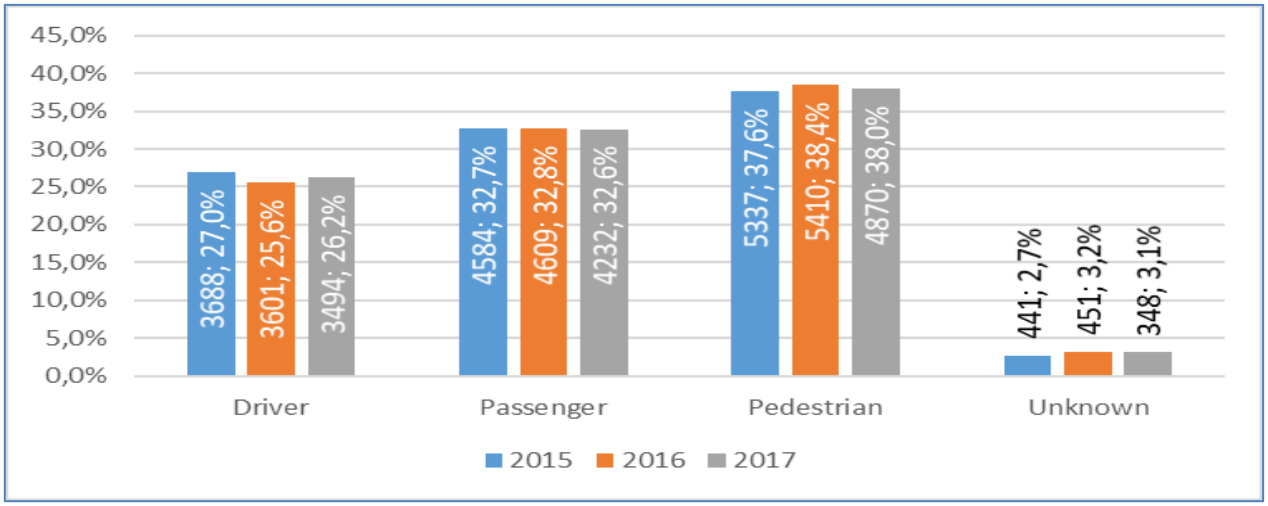


Figure 7: Road Fatalities per Road User Type (RTMC, 2015-1017)

There are significant differences in the road user fatalities per province (see Figure 8). In KwaZulu-Natal and Gauteng, more than 46% of the fatalities are pedestrians, while the Western Cape follows closely with 44.3%. The lowest pedestrian fatality rate was in the Northern Cape (24.9%), while the Free State followed closely with just over 25,9%. This is, most likely, due to lower pedestrian activity caused by low population densities. The Northern Cape accommodates only 2.1% of the South African population, followed by Free State with 5.1% of the overall South African population (STATSA, 2017).

Passenger fatalities are the lowest in Gauteng (23.5%), followed by the Western Cape with 25.7%. Gauteng and the Western Cape have the highest congestion levels in the country. Lower speeds, due to congestion and/or large proportions of single occupant vehicles, travelling to and from work, are most probably the reason for lower passenger fatalities, as can be witnessed in Figure 8.

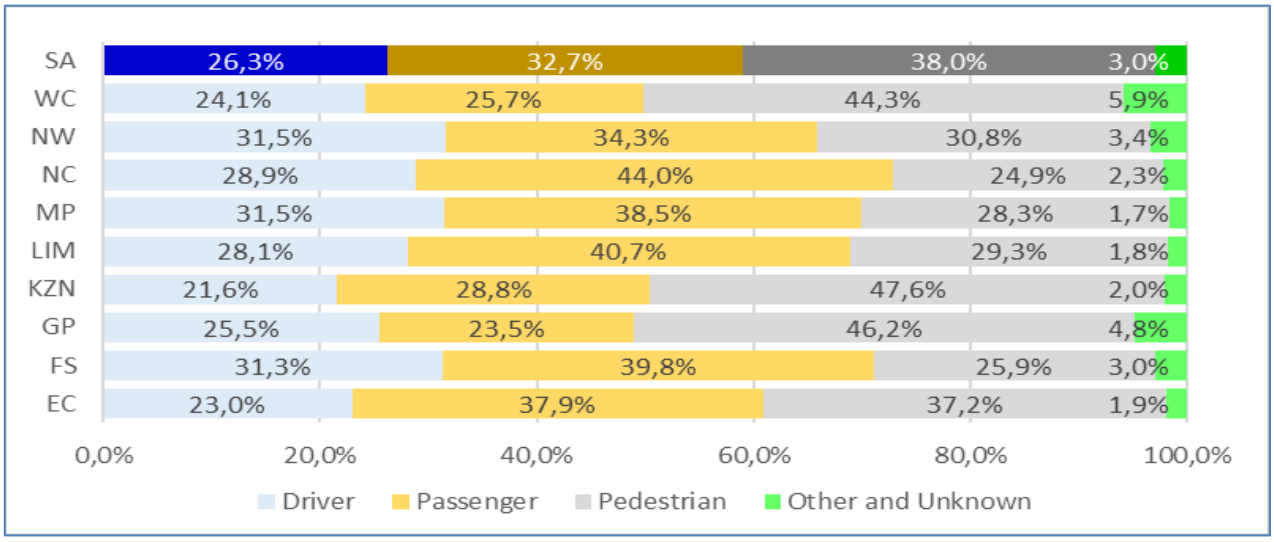
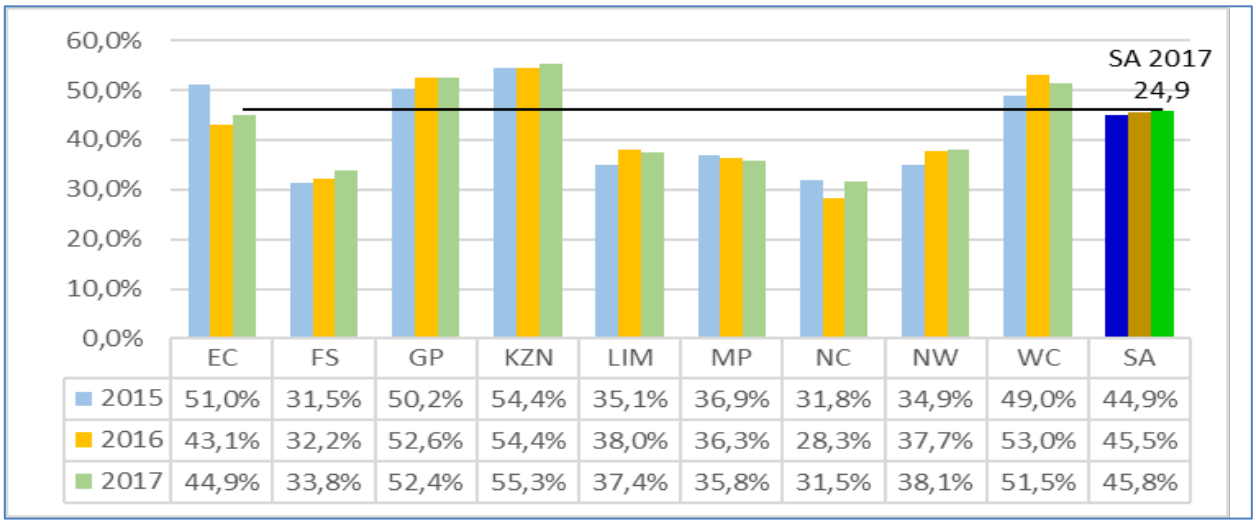


Figure 8: Road Fatalities per Road User Type (RTMC, 2015-2017)

Risky driving behaviour is mostly witnessed in the North West, Mpumalanga and the Free State (Figure 8) with driver fatality rates higher than 31%. All three provinces are rural with large proportional two-lane single carriageways that accommodate high speeds. The level of law enforcement and driver education in rural areas may influence high speed risky driver behaviour.

When isolating the number of fatal crashes over the study period, where one or more pedestrians were killed in a fatal crash, the magnitude of the problem is highlighted even more, in 2017, when 45.8% (almost half) of all fatal crashes in South Africa, one or more pedestrians were killed (See Figure 9).



	EC	FS	GP	KZN	LIM	MP	NC	NW	WC	SA
2015	51,0%	31,5%	50,2%	54,4%	35,1%	36,9%	31,8%	34,9%	49,0%	44,9%
2016	43,1%	32,2%	52,6%	54,4%	38,0%	36,3%	28,3%	37,7%	53,0%	45,5%
2017	44,9%	33,8%	52,4%	55,3%	37,4%	35,8%	31,5%	38,1%	51,5%	45,8%

Figure 9: Percentage Pedestrian Crashes per Province (RTMC, 2015-2017)

In 2017, in the Kwazulu-Natal and the Gauteng provinces, one or more pedestrians were killed in 55.3% and 52.4% of all fatal crashes, respectively, with the percentage of pedestrian fatal crashes increasing from 2015 to 2017 in both provinces. The Western Cape Province follows closely with one or more pedestrians killed in 51.5% of fatal crashes in the province. The Free State and Northern Cape provinces recorded the lowest number of fatal crashes where one or more pedestrians were killed with 33.8% and 31.5%, respectively. However, this percentage increased for the Free State province from 2015 to 2017 and for the Northern Cape Province from 2016 to 2017. Thus, in South Africa, one or more pedestrians were killed in almost half of all 33 726 recorded fatal crashes from 2015 to 2017.

3.4 Road fatalities per mode of transport

The RTMC data from 2015 to 2017, unfortunately, does not indicate fatalities per mode of transport in each fatal crash, thus, for the purposes of this study, the percentage where one or more of each mode of transport were involved in a fatal crash was analysed and summarised in Figure 10.

3.4.1 Public transport

Nationally, one or more public transport vehicles is involved in 10.3% of all fatal crashes in South Africa. In most rural provinces, such as the North West, the Northern Cape, Mpumalanga and the Free State, the percentage where public transport vehicles are involved in fatal crashes is less, with the Northern Cape and the North West provinces the lowest with 7.5%. However, this is most likely due to a lower level of public transport

availability in these provinces. KwaZulu-Natal has the highest percentage of crashes (13.0%) where one or more public transport vehicle was involved in fatal crashes.

3.4.2 Heavy vehicles

Over the study period 8.5% of all fatal crashes involved one or more heavy vehicles. Again, quite a bit of variation is witnessed between provinces. The Free State has the highest percentage (13.7%), while one or more heavy vehicles were involved in a fatal crash in only 5.8% of fatal crashes in the Gauteng province and 6.7% in the North West province. Traditional 'Heavy vehicle' routes fall within the provinces with the highest percentages, such as the N3, N1 and N5 routes, through the Free State province.

3.4.3 Private vehicles, LDVs and panel vans

Private Vehicle Types (Sedans, Station Wagons and SUVs) were involved in most fatal crashes (almost 50% overall) whereas Gauteng province (53.1%) and Mpumalanga (52.4%) had more than half of all fatal crashes involving one or more private type vehicle. It should be taken into account that from the Light Delivery Vehicle Type Vehicle (LDV and Panel Van), a large proportion of the LDV population needs to be taken as 'Private Vehicle' mode (Double Cabs and Single Cab 'Bakkies'), which are very popular amongst private vehicle owners. This could, however, not be determined from the available data and needs further research. One or more LDVs were involved in more than a quarter of fatal crashes in the Northern Cape (27.8%) and in the North West (26.7%) provinces, with the Gauteng province having the lowest (12.4%) LDVs involved in fatal crashes. The national percentage, where one or more Light Delivery Type Vehicles were involved in a fatal crash, is 19.2% (see Figure 10).

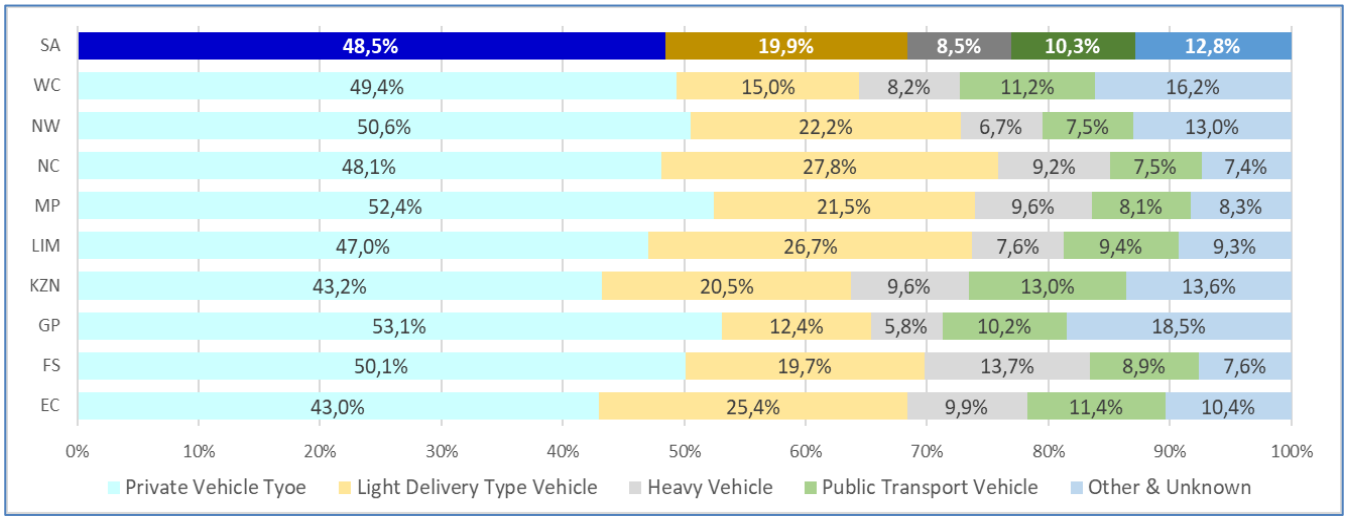


Figure 10: Fatal Road Crashes per Mode of Transport (RTMC, 2015-2017)

The Vehicle Type Distribution for Self-Propelled vehicles within the study period (NaTIS, December 2017) indicates that some transport modes are over- and under-represented in fatal crashes (See Figure 11).

For the country, the private vehicle type population is 66.1% with 48.5% of this transport mode involved in fatal crashes; an under-representation of 17.6%. Private vehicle types are under-represented in all provinces with the North West province having the largest under-representation (20.6%) and Mpumalanga having the lowest under-represented percentage (2.6%). In all provinces Light Delivery Type vehicles were also under-represented in fatal crashes, except the Western Cape Province, where an over-representation of 3.7% was recorded. Heavy vehicles and public transport vehicles were

over-represented in fatal crashes in all provinces, with heavy vehicles showing lower representation in the Gauteng (2.6%) and Limpopo (1.2%) provinces.

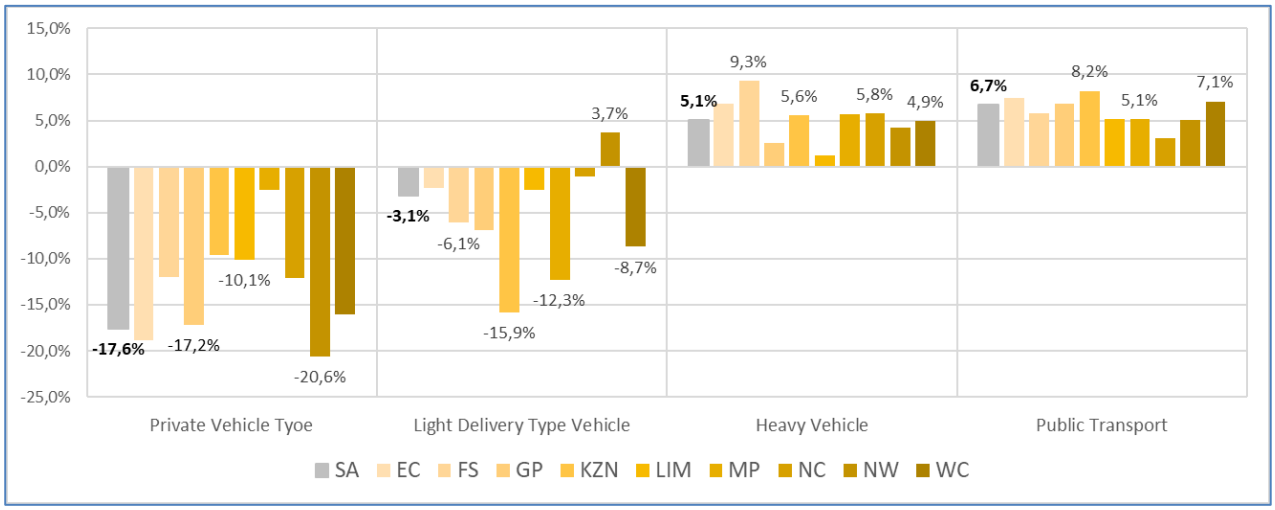
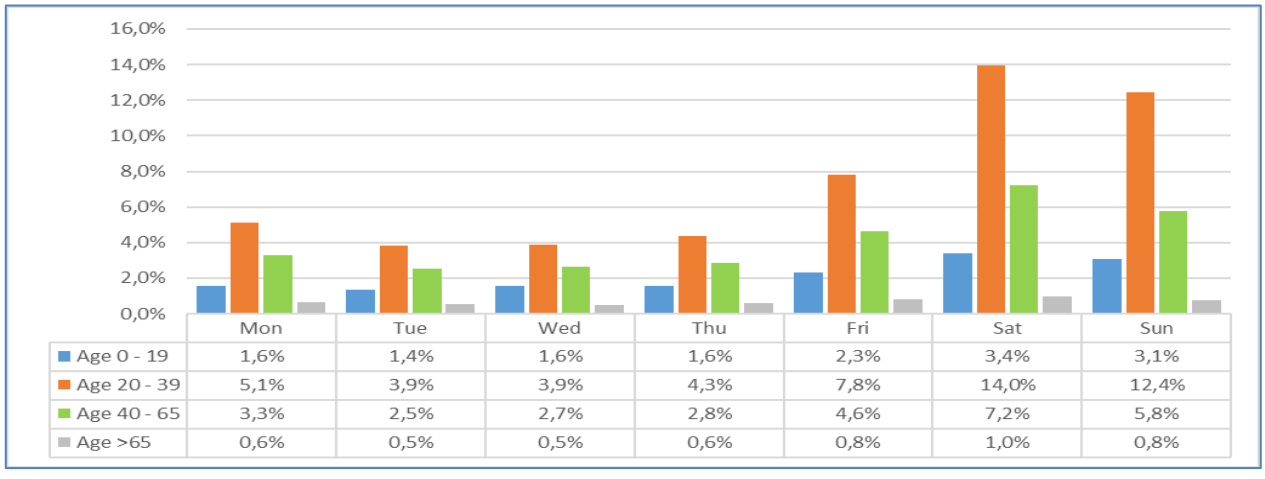


Figure 11: Percentage Over- and Under-Represented per Mode of Transport

The over-representation of heavy vehicles, public transport vehicles and the LDV type vehicles in the Western Cape Province is, most probably, due to much more vehicle kilometres travelled by these transport modes. Further research is needed in this regard. Thus, theoretically, it could be argued that it is safer to drive with a private type vehicle in the North West province and most dangerous to drive with a private type vehicle in the Mpumalanga province; safer to drive in the KwaZulu-Natal province with a light delivery type vehicle and most unsafe to drive a light delivery type vehicle in the Western Cape province.

3.5 Road fatalities and day of the Week

Figure 12 illustrates the outcome of the analysis of fatalities versus day of the week.



	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Age 0 - 19	1,6%	1,4%	1,6%	1,6%	2,3%	3,4%	3,1%
Age 20 - 39	5,1%	3,9%	3,9%	4,3%	7,8%	14,0%	12,4%
Age 40 - 65	3,3%	2,5%	2,7%	2,8%	4,6%	7,2%	5,8%
Age >65	0,6%	0,5%	0,5%	0,6%	0,8%	1,0%	0,8%

Figure 12: Road Fatalities per Age Group per Day of the Week (RTMC, 2015-2017)

Almost half (47.6%) of all fatalities occur on Saturdays and Sundays, with Saturdays having the largest proportion of victims in all age groups of 25.6% (See Figure 11). These two days have the highest death rates for all age groups with a recorded 26.4% for victims between 20 and 39 years of age and 13% for victims aged between 40 and 65. The least

fatalities were recorded on a Tuesday, for all age groups, with an average of 9.2% from Monday to Thursday and 25.5% of all fatalities recorded on a Friday.

3.6 Road fatalities and month of year

Fatalities for ages between 0 and 65 peak in the school holiday periods viz: April (8.8%), July (10.2%), September (9.5%) and December (10.7%), with the Easter period adding to the high April fatality rate (see Figure 13). The most fatalities occurred in December and July (i.e. the holidays) with the lowest number of fatalities recorded in February (5.6%). The highest number of fatalities (5.6%) was recorded for the age group 20 to 39 in the month of December, with the fatalities (5.4%) in the age group 35 to 39 peaking in the month of July. Fatalities for the age groups 40 to 65 and 0–19 years show the same trend with slightly lower percentage fatalities in the respective months for the two age groups. The percentage fatalities per month for the age group older than 65 years does not change significantly over the study period.

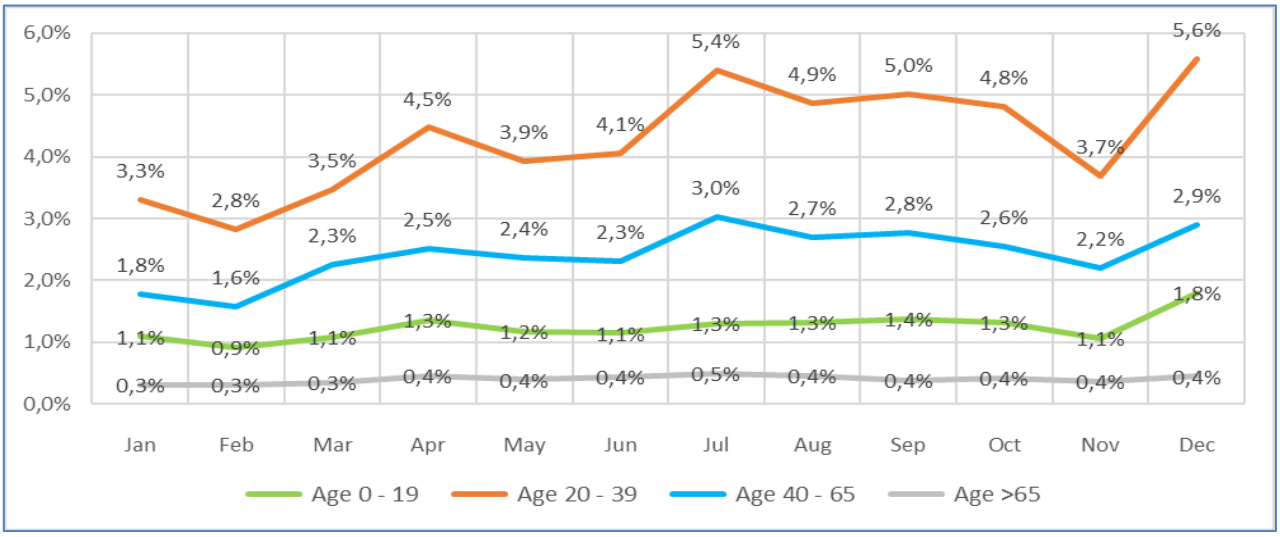


Figure 13: Percentage Road Fatalities per Age Group per Month of Year (RTMC, 2015-2017)

3.7 Road fatalities and time of day

The age group 20 to 39 has the highest percentage (14.6%) of all fatalities over the study period between 17:00 to 21:00 (4-hour period) and the lowest percentage (11.8%) between 08:00 to 17:00 (8-hour period) with a similar trend for the age group 40 to 65 years (see Figure 14). The peak fatality periods for these age groups correlate with travel times to and from work from 06:00 to 08:00 and a sharp increase during leisure hours (from 17:00). The high number of fatalities from 18:00 to 23:00 for the combined age group 40 to 65 is, most probably, due to after-hour activities, which may include alcohol consumption by both drivers and pedestrians, especially over weekends, as established in paragraph 3.5. Due to reduced traffic congestion after-hours, speeds and the fatality risk increases. Furthermore, the level of enforcement may reduce.

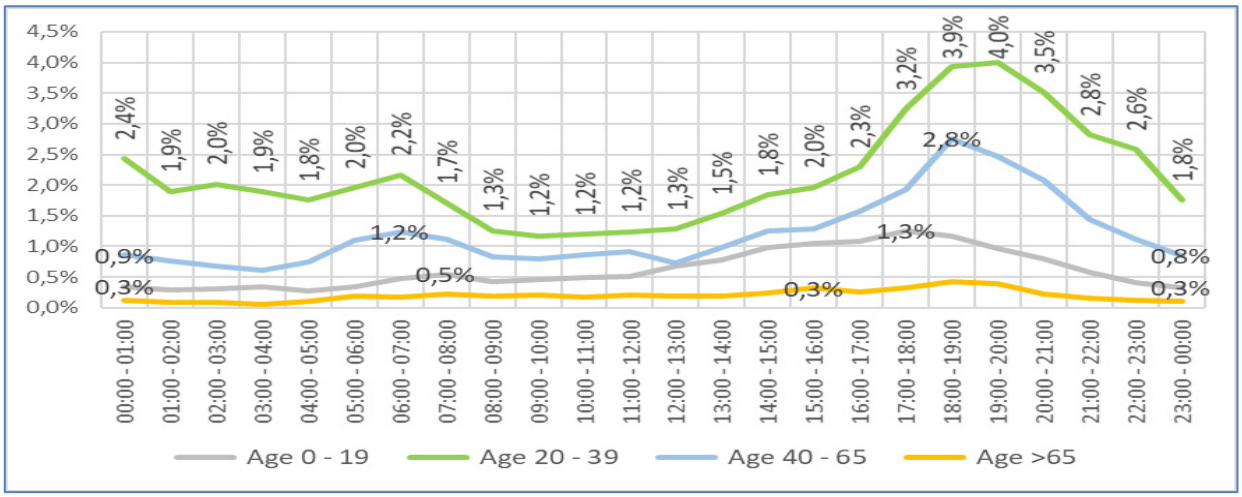


Figure 14: Percentage Road Fatalities per Age Group per Time of Day (RTMC, 2015-2017)

4. CONCLUSIONS

Road safety relates fatalities as a global pandemic, not achieving the goals set out by the UN in the Global Decade of Action for Road Safety (UN, 2010). Although South Africa has good road safety data and the country has been able to reduce absolute, as well as relative fatality rates, further action is required. Of 98 middle income countries, South Africa is ranked 83rd on fatalities per 100 000 population. On average, 25.9 fatalities per 100 000 population occur every year.

Fatalities per 100 000 population vary substantially amongst provinces. Gauteng and the Western Cape have fatality rates around 18 fatalities per 100 000 population, while the Northern Cape, Mpumalanga and the Free State have rates close to 35 fatalities per 100 000 population.

Fatalities per age group do not significantly differ per province. Citizens between 20-39 years have the highest percentage fatalities (38.7%), followed by the age group between 40-65 years (21.8%).

Large differences between gender-related fatalities were identified. Males account for 76.2% of all fatalities. Fatality rates per 100 000 population are particularly high for males in Mpumalanga (45.1), the Northern Cape (44.6) and the Free State (42.7). The Northern Cape (13.8) and the Free State (13.4) have fatality rates for females that are higher than the South African average.

Pedestrians and Cyclists are the most vulnerable road users globally (WHO, 2018), and even more so on the African continent. In Africa, pedestrians account for 40% of all fatalities. In South Africa, pedestrian fatalities are almost as high as the African average, i.e. 38%. KwaZulu-Natal, Gauteng and the Western Cape have the highest pedestrian fatalities in the country, with more than 50% of road crashes having one or more pedestrian deaths.

Although most fatalities are caused by private vehicles, relative to the number of vehicles registered, this category shows less fatalities caused (up to 20% less, depending on the province). Heavy vehicles, public transport vehicles and, in some cases, LDVs cause relatively more fatalities than the registered vehicle percentage.

Focussed strategic road safety programmes need to be implemented in all provinces to reduce road related injuries and fatalities. For provinces to create a road safety strategy that has a significantly higher success rate, data mining, as demonstrated in this paper, is required. Based on the limited analysis presented, it is already possible to identify specific focus areas per province (see Table 1). Gauteng and KwaZulu-Natal can warrant relatively high levels of investment in road safety; the Northern Cape, Mpumalanga, the Free State, Limpopo, the North West and KwaZulu-Natal need to reduce fatality rates. Education is a possible solution here. Furthermore, some provinces can be strategic regarding the gender, road users, modes of transport and behaviour they focus on. Furthermore, the North West and Gauteng should address their data completeness, i.e. reduce missing data for age, for example.

Table 1: Focus Areas for Tailor-Made interventions per Province

Province	Cost of Fatalities	Fatalities/ 100 000 Pop	Gender	Road User	Mode of Transport	Behaviour	Incomplete Data
NC		High	Males (Females)		LDV Type Vehicles		
MP		High	Males		Private Type Vehicles	Risky Drivers	
FS		High	Males (Females)		Heavy Vehicles	Risky Drivers	
LI		High					
NW		High			LDV Type Vehicles	Risky Drivers	High Unknown Ages
EC		High					
KZN	High	High		Pedestrians	Public Transport		
GP	High			Pedestrians			High Unknown Ages
WC				Pedestrians	LDV Type Vehicles Heavy Vehicles		

6. ACKNOWLEDGEMENTS

The authors thank the Road Traffic Management Corporation (RTMC) for availing their data and permitting us to undertake these analyses orientated towards reducing the burden of road fatalities in the country. The hard work of all staff collecting and processing the data is acknowledged.

7. REFERENCES

Jobanputra, R, 2013. An investigation into the reduction of road safety risk in Cape Town through the use of microscopic simulation modelling. Thesis submitted for the Degree of Doctor of Philosophy in Civil Engineering, University of Cape Town.

Kopits E and Cropper, M, 2005. Traffic fatalities and economic growth. *Accident Analysis and Prevention*, 37(1): 169-178. Doi:10.1016/j.aap.2004.04.006.

Labuschagne, F, Beer, E, Roux, D and Venter, K, 2017. The cost of crashes in South Africa 2016. 2004 (July):474-485.
https://researchspace.csir.co.za/dspace/handle/10204/10135.

Ogendi J, Odero, W, Mitullah, W and Khayesi, M, 2013. Pattern of pedestrian injuries in the city of Nairobi: implications for urban safety planning. *Journal of Urban Health*: *Bulletin of the New York Academy of Medicine*. Doi: 10.1007/s11524-013-9789-8.

Peden, M, Kobusingye, O, Monono, ME, 2013. Africa's roads – the deadliest in the world. Editorial, South African Medical Journal, 103(4): 228-229. Doi:10.7196/SAMJ.6866.

Road Traffic Management Corporation (RTMC), 2015. Road Traffic Report Calendar: 1 January - 31 December 2015.
http://www.rtmc.co.za/images/docs/Jan%20-%20Dec%202015%20G.pdf.

31 December Road Traffic Management Corporation (RTMC), 2016. Road Traffic Report Calendar: 1 January - 2016.
http://www.rtmc.co.za/images/docs/Calender/Calendar2016/Calender%202016%20 report.pdf.

Road Traffic Management Corporation (RTMC), 2017. Road Traffic Report Calendar: 1 January - 31 December 2017.
http://www.rtmc.co.za/images/docs/Calendar_Jan_%20Dec%202017.pdf.

Statistics South Africa (STATSSA), 2016. Statistical release P0302, Mid-year population estimates 2016. pp. 15-16. https://www.statssa.gov.za/publications/P0302/P03022016.pdf.

United Nations (UN), 2010. UN General Assembly Resolution A/RES/64/255. Improving global road safety. Available at:
www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/64/255.

Vanderschuren, M and Zuidgeest, M, 2017. Road safety and non-motorised transport in African cities. In book: Non-Motorised Transport Integration into Urban Transport Planning in Africa, Edition: 1, Chapter: 4, Publisher: Routledge, Editors: Winnie Mitullah, Marianne.

Vanderschuren, Meleckidzedeck Khayesi, pp.57-72. DOI: 10.4324/9781315598451-4.

World Health Organisation. 2018. Global status report on road safety 2018.
https://apps.who.int/iris/ bitstream/handle/10665/276462/9789241565684-eng.pdf?ua=1.