

# Development of the Investment Case to Reduce Road Traffic Injuries among Adolescents

## Colombia Road Safety Case Study

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## Introduction

This case study on the road safety situation in Colombia has been undertaken to illustrate how more detailed information on a country can be used to better inform an investment case on the introduction of a set of interventions to reduce road traffic deaths and serious injuries among adolescents. The study contains a review of the road safety situation in Colombia, a description of Government regulations and performance reviews, as well as a description of road infrastructure and the motor vehicle fleet, the causes of road accidents and fatalities, and other information relevant to modelling an investment case.

The information gathered together is used to refine the assumptions and data for the Road Safety Intervention Model (RSIM) to estimate the impact of a range of interventions on road traffic fatalities and injuries in Colombia. The RSIM is described in detail in the main body of the report to FIA Foundation. The set of interventions used in the modelling is shown in Table 1 **Error! Reference source not found.**

Table 1: Interventions and effectiveness

	Intervention	Baseline 2019	Effective reduction
Motor cycles	Helmet usage	70%	36%
	Alcohol limit enforcement	5%	25%
	Infrastructure	See Table 8 and Table 9	20%
	Speed compliance	0%	14%
	Public awareness and education	0%	4.5%
	Graduated licensing scheme 15–19	0%	20%
	Graduated licensing scheme 20–24	0%	4%
Motor vehicles	Seat belts	10%	20%
	Alcohol limit enforcement	5%	25%
	Infrastructure	See Table 8 and Table 9	13%
	Speed compliance	0%	14%
	Graduated Licensing Scheme 15–19	0%	20%
	Graduated Licensing Scheme 20–24	0%	4%
	NCAP	0%	1%
	Public awareness and education	0%	4.5%
Cyclists	Alcohol limit enforcement	5%	4%
	Infrastructure	See Table 8 and Table 9	25%
	Speed compliance	0%	14%
	Public awareness and education	0%	4.5%
Pedestrians	Alcohol limit enforcement	5%	4%
	Infrastructure	See Table 8 and Table 9	31%
	Speed compliance	0%	14%
	Public awareness and education	0%	4.5%
All	Capacity building	N/A	N/A

The bulk of this report is a series of graphs comparing deaths and serious injuries under the baseline with those under the intervention scenario. Separately for males and females in three age groups – 10 to 14, 15 to 19 and 20 to 24 – graphs are given for deaths and injuries for pedestrians, cyclists, motorcyclists, motor vehicle occupants and in total in both urban and rural settings.

The baseline trend for combined male and female road fatalities for the 10 to 24 in Colombia is expected to be one of gradual decline out to 2050 from 1,600 per annum to just over 1,000. However, when all the interventions are modelled, this reduces this figure to 570 by 2030 and 430 by 2050 (Figure 8).



The forecast for male and female 10 to 24 year-old road fatalities differs in the absolute number, while both are forecast to decline by approximately one third. This is consistent with all countries where there are a much greater number of road fatalities for males than females.

Serious injuries for 10 to 24 year olds in Colombia are forecast to decline rapidly in the next few decades, albeit from a high figure than fatalities. The peak of occurred in 2007 with 11,500 serious injuries that has declined to 6,200 by 2020. The trend indicates serious injuries will reduce to 3,400 by 2030 and 1,200 by 2050. Due to the projected decline in serious injuries, the effect of interventions are not nearly as significant with interventions serious injuries expected to be 2,000 by 2030 (down from 3,400) and 700 in 2050 (down from 1,200).

Individual cohorts differ somewhat in that the 10 to 14 cohort has a much greater number of pedestrian fatalities than the older cohorts, while all other modes are equally represented in fatalities for this cohort.

Serious injuries for 10 to 14 year olds show the same declining trend as fatalities, but with much greater numbers with the peak figure being nearly eight times higher. However, the ratio between male and female serious injuries is much more even than for fatalities, being nearly 1:1 in 2020, as well as the majority of serious injuries occurring to cyclists rather than pedestrians. This is more so the case with males, whereas with females, pedestrians and cyclists are more evenly represented.

Road fatalities for the 15 to 19 age cohort in Colombia differ significantly from the 10 to 14 year olds with the primary mode for fatalities being motor cyclists which have increased substantially from 1990 to 2015. The same trend is found for both males and females, though the increase in motorcycle fatalities and decrease in pedestrian fatalities occurred at a slower rate for females. The number of male deaths is also substantially larger comparatively than the 10 to 14 year olds, whereas for 10 to 14 year olds male fatalities are approximately double female, for 15 to 19 year olds this figure is over three times. The full set of interventions have a substantial effect on fatalities with these figures projected to decline to 118 in 2030 and 90 in 2050 for males, while for females these reduce to 37 in 2030 and 30 in 2050.

As with baseline serious injuries for 10 to 14 year olds, serious injuries for both 15 to 19 males and females are expected to decline substantially out to 2050. For males, the baseline is forecast to reduce from 1,500 in 2020 to 825 (2030) to 315 (2050). For females these figures are 600 (2020) to 240 (2030) to 60 (2050). As with the 10 to 14 cohort, males again have much higher numbers than females, with the main modes responsible for these serious injuries differing between males and females and from the 10 to 14 cohort. For males in the 15 to 19 cohort, the primary modes for serious injuries are cyclists, while for females it is motor vehicle occupants who bear the majority of serious injuries.

Fatalities in the 20 to 24 age cohort are also forecast to decline for both males and females. As with the 15 to 19 cohort, there is a large discrepancy between male and female fatalities, where there are over six times as many male fatalities per annum compared to females. While motorcyclists represent the majority of fatalities for both males and females, they make up a larger percentage for males than females. Consistent with younger cohort, serious injuries in Colombia are forecast to decline substantially from 2020 through to 2050.

The effect of implementing all interventions leads to a 52.9% reduction in fatalities annually by 2030, when they are fully implemented, and 42.2% reduction in serious injuries (Table 2). The annual reduction in number of fatalities is shown in Table 3. The percentage reduction in cumulative

fatalities and serious injuries over the period 2022 to 2030 is shown in Table 4, while the cumulative reduction in fatalities and serious injuries is shown in Table 5.

Table 2: Percentage reduction in fatalities and serious injuries due to interventions, annual by 2030

	10 to 14	15 to 19	20 to 24	Total
<b>Deaths averted</b>				
Male	45.0%	57.2%	51.8%	52.9%
Female	46.9%	56.9%	51.2%	52.7%
Persons	45.7%	57.2%	51.7%	52.9%
<b>Disability averted</b>				
Male	40.1%	44.3%	40.5%	41.7%
Female	43.6%	46.0%	39.7%	43.6%
Persons	41.9%	44.7%	40.4%	42.2%

Table 3: Annual reduction in fatalities and serious injuries due to interventions, annual by 2030

	10 to 14	15 to 19	20 to 24	Total
<b>Deaths averted</b>				
Male	27	174	366	566
Female	18	52	58	128
Persons	45	226	424	694
<b>Disability averted</b>				
Male	201	365	465	1,032
Female	250	109	59	418
Persons	451	475	524	1,450

Table 4: Percentage reduction in fatalities and serious injuries due to interventions aggregated, 2022–2030

	10 to 14	15 to 19	20 to 24	Total
<b>Deaths averted</b>				
Male	32.7%	43.0%	38.5%	39.4%
Female	34.6%	42.8%	38.0%	39.2%
Persons	33.4%	42.9%	38.4%	39.3%
<b>Disability averted</b>				
Male	28.0%	32.0%	29.7%	30.1%
Female	31.1%	32.9%	27.9%	31.0%
Persons	29.6%	32.2%	29.4%	30.3%

Table 5: Aggregated reduction in fatalities and serious injuries due to interventions, 2022–2030

	10 to 14	15 to 19	20 to 24	Total
<b>Deaths averted</b>				
Male	198	1,240	2,676	4,114
Female	127	365	423	915
Persons	325	1605	3099	5,029
<b>Disability averted</b>				
Male	1,687	2,925	3,753	8,365
Female	2,002	948	559	3,509
Persons	3,689	3,873	4,312	11,874

The modelling predicts the number of deaths and serious injuries averted due to the interventions for males and females in the three age groups. This information along with the costs of the interventions modelled is incorporated within the economic model described in detail in the main body of the report. The economic benefits associated with the reduced deaths and disability are compared to the costs and expressed in terms of benefit-cost ratios. The results are shown in Table 6.

Table 6: Economic analysis of interventions

		2%	3%	5%	0%
Economic benefit, million USD (NPV)	Deaths	6,552	4,584	2,400	14,401
Economic benefit, million USD (NPV)	Disability	11,978	8,499	4,572	25,596
Economic benefit, million USD (NPV)	Deaths plus disability	18,530	13,083	6,973	39,998
Cost, million USD (NPV)		2,986	2,678	2,182	3,769
<b>Benefit-cost ratio</b>					
Economic benefit	Deaths	2.2	1.7	1.1	3.8
Economic benefit	Deaths plus disability	6.2	4.9	3.2	10.6

An optimisation model was constructed to determine best value for money investments with constraints either on percentage reduction in fatalities or serious injuries at least cost, or a given percentage of GDP with greatest reduction in fatalities or serious injuries. Of the four optimisation models, the model with a constraint of 0.15% of GDP with a goal to minimise serious injuries had the best return on investment measured by the benefit-cost ratio (Table 7).

Table 7: Economic analysis of optimisation model 0.15% GDP minimise serious injuries

		2%	3%	5%	0%
Economic benefit, million USD (NPV)	Deaths	5,969	4,174	2,184	13,129
Economic benefit, million USD (NPV)	Disability	10,765	7,638	4,109	23,001
Economic benefit, million USD (NPV)	Deaths plus disability	16,733	11,812	6,293	36,131
Cost, million USD (NPV)		1,059	963	806	1,298
<b>Benefit-cost ratio</b>					
Economic benefit	Deaths	5.6	4.3	2.7	10.1
Economic benefit	Deaths plus disability	15.8	12.3	7.8	27.8

## Current Road Safety Situation

In response to the 2030 Agenda for Sustainable Development's goal to reduce deaths and injuries from traffic accidents in a 50% by 2030, the Colombian Government has focused on road accidents in their policy priorities. One feature of this is the *National Yearbook of Road Accidents, Colombia 2019* that has been produced to document road safety management and statistical information in Colombia. This is the primary publicly available document detailing road safety initiatives and results. According to the National Yearbook of Road Accidents there were:

- In 2019, 175,604 road accidents were recorded, with 743,977 injured and 40,563 seriously injured (people who required hospitalisation of more than a day), which generated 45,525 hospitalisations.
- Of the 6,495 who died following an accident within 30 days after an accident, 54% were motorcyclists and 25% were pedestrians with evenings being the main time of accidents.
- The main causes of death in Colombia in the last 13 years have been chronic non-communicable diseases and injuries with the road accident rate among the top 10 causes (number 8 in 2018).
- Road accidents have an urban profile. 70% of accidents occur in cities capitals and 43% of deaths occurred in 11 cities with more than 500 thousand inhabitants.
- Since 2008, the motorcycle became the predominant mode of transport, making up 57% of the vehicles registered in 2019, while light vehicles accounting for 36%.

## Road Accident Rate

In Colombia, the number road accidents from 2007 to 2018 (Figure 1) has shown a gradually increasing trend, with an average annual record of 220,000 claims, of which around 50% were classified as serious by Colombian authorities, that is, they involve at least one injured or deceased person (Figure 1).

### Total accidents and % of serious accidents (fatalities and injuries)

In Colombia, the total number of deaths from road accidents has gradually increased since 2005, reaching a maximum of 7,294 cases in 2016. The fatality rate per 100,000 inhabitants has fluctuated, but risen slightly from 13.8 in 2005 to 14.7 in 2018 (Figure 2). While the National Road Safety Plan 2011–2021 and Ten-Year Public Health Plan 2012–2021 set a goal of 25% reduction in road traffic fatalities by 2021, this was not achieved.

Figure 1: Total accidents, fatalities and injuries

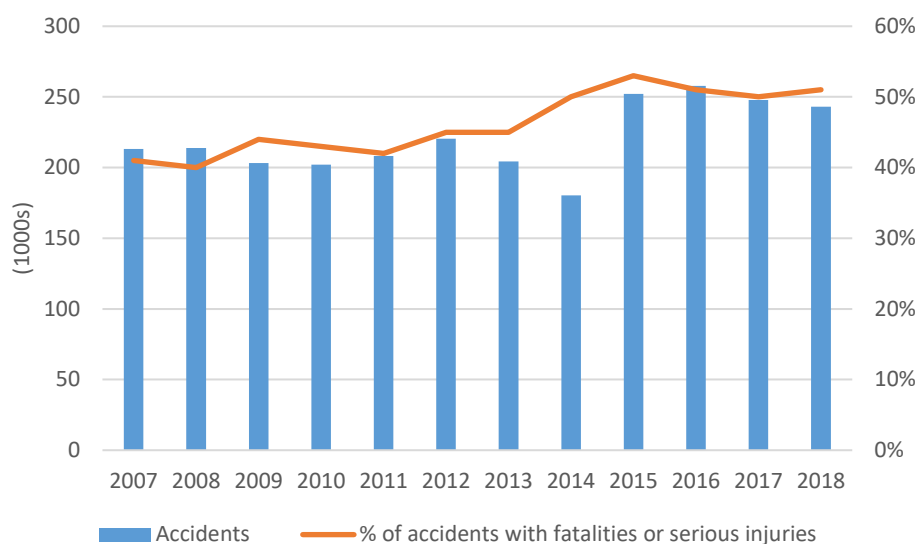
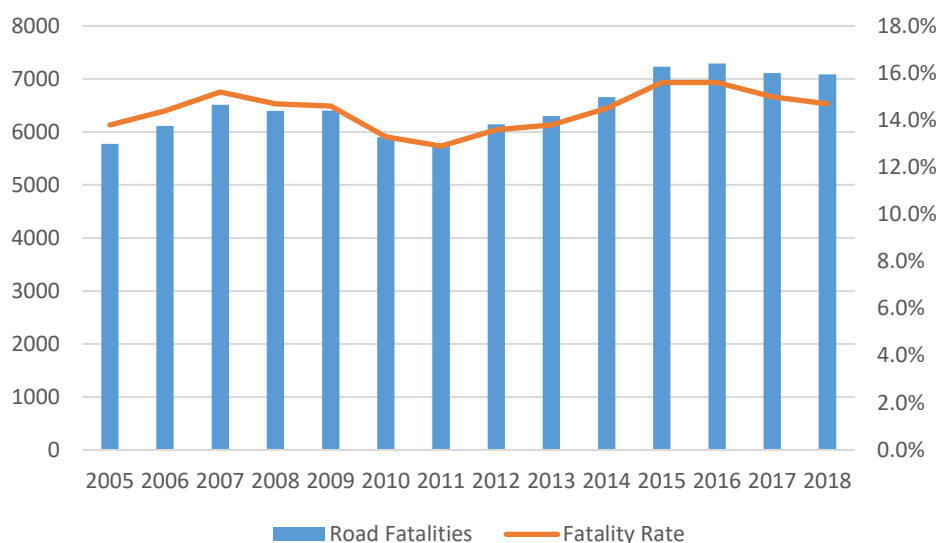


Figure 2: Road fatalities and rate trend



## Infrastructure

The National Yearbook of Road Accidents does not report information on road infrastructure. However, according to 2005 data reported by the Colombian government, the road network included 163,000 km, 68% of which were sealed and in good condition. This contrasts with estimates by the International Transport Forum who report Colombia has slightly over 200,000 km of roads.

The International Road Assessment Program (iRAP) assessed over 10,000 km of roads in Colombia to determine the relative amounts of 1- through 5-star roads. These star ratings are shown in Table 8 and Table 9.

Table 8: IRAP star rating of roads in Colombia, % of travel, all data

	1-star	2-star	3-star	4-star	5-star
Motor vehicle	6.8%	29.9%	53.3%	8.1%	1.9%
Motor cyclist	14.3%	37.3%	41.4%	6.2%	0.8%
Cyclist	22.1%	30.7%	36.0%	7.4%	3.8%
Pedestrian	24.4%	42.8%	25.6%	6.8%	0.5%

Table 9: IRAP star rating of roads in Colombia, % of road length, all data

	1-star	2-star	3-star	4-star	5-star
Motor vehicle	8.2%	30.9%	52.7%	7.1%	1.0%
Motor cyclist	16.3%	37.2%	41.9%	4.1%	0.5%
Cyclist	24.3%	36.4%	32.6%	4.5%	2.1%
Pedestrian	32.9%	45.0%	17.2%	4.2%	0.8%

## Vehicle Fleet

As of December 2020, more than 16 million motor vehicles were registered in Colombia. In line with recent trends towards motorcycle usage, motorcycles accounted for 59% of the motorised vehicle fleet, with approximately 9.4 million motorcycles, while there were approximately 6.4 million cars.

Car safety features that are legislated in Colombia include mandatory front and rear seat belts in all new cars, but not in imported vehicles. Colombia does not have a new car safety assessment program.

Colombia recorded 4.7 road fatalities per 10,000 registered vehicles in 2017. This represents a decrease of nearly 30% compared to 2010. This significant decrease occurred during the same period that the number of road deaths increased and is explained by a very strong rise of motorisation, in particular a strong increase in the number of motorcycles in the fleet.

## Helmets

Motorcycle helmet laws are in place in Colombia and apply to both drivers and passengers with a high compliance rate for drivers (~99%), but much lower for passengers (40%) (Table 10), with 90% being used in the model. In addition, a national standard for motorcycle helmets was introduced to improve the quality of the helmet.

Table 10: Motor cycle helmet wearing (WHO 2018)

	2013, %	2016, %
Driver	92	96
Passenger	79	80

## Speed

Excess speed was reported as a contributing factor in 8.3% in Colombia of all road fatalities in 2018. However, for 78% of road fatalities, the cause of the crash was not identified.

The speed limits in Colombia are 60 km/h on urban roads, 80 km/h on rural roads and 120 km/h on motorways. The government of Colombia is considering reducing the speed limit in urban areas from 60 km/h to 50 km/h. Some cities are considering reducing the speed limit even before a decision is taken at national level. As of 2019, Bogotá D.C. was the only city that had reduced speed limit to 50 km/h.

## Alcohol

Driving under the influence of alcohol is a significant cause of road crashes in Colombia with police reports suggesting 2% of all road deaths in 2018 were alcohol-related. However, this figure is considered to be a significant underestimation. In contrast, a recent report by the International Traffic Safety Data and Analysis Group (IRTAD), found IRTAD countries have on average 21.6% of road deaths being alcohol related (Vissers 2017).

The maximum legal blood alcohol content (BAC) in Colombia is 0.2 g/l for all drivers. A 2013 regulation increased the fine for drinking and driving. Prior to 2013, the maximum amount of the fine was approximately US\$740, subsequently the fine can be as high as US\$11,800.

## Seat belts

Wearing a seat-belt has been compulsory in Colombia since 2002 in both front and rear seats. With respect to rear seats, the law stipulates that the use of seat belt is only mandatory for vehicles manufactured after 2004. Consequently, the wearing rate in rear seats is very low, estimated at 2% in 2016. Children under 10 years of age must be seated in the back and properly restrained, taking into account their weight and height. A figure of 60% is used in the model for Colombia (Table 11).

Table 11: Seat belt wearing rates

	2012 (%)	2016 (%)
Front seats		
Driver	60	75
Passenger	41	64
Rear seats		
General	N/A	2

## Road safety management and strategies

Establishing a New Road Safety Lead Agency in Colombia, the Global Road Safety Facility (GRSF) (World Bank 2021) provided a grant to the Colombian government to review the road safety management capacity of the country and support the creation of a road safety lead agency, the National Road Safety Agency.

There are several factors influencing Colombia's road safety performance including the rapid increase in the number of motorised vehicles, specifically motor cycles. Between 2010 and 2017, the number of motorcycles has more than doubled and the number of cars has increased by nearly 60%. The rise in motorcycles is attributed to a lack of adequate and accessible public transport, which tend to encourage the use of private motorcycles, which are considered cheaper and faster than private cars. There are consequences of this for traffic management, infrastructure maintenance and road safety.

In responses to these developments, the Colombian Government developed the first road safety national plan that was adopted in 2012 and covered the period 2011–16. A second version of the plan was adopted in 2013 and covers the period 2011–21. Key road safety measures included in the plan are as follows.

- 1993: creation of the “Fondo de Prevención Vial” or Road Prevention Fund, the first governmental body dedicated to road safety.
- 1993: creation of the Seguro Obligatorio de Accidentes de Transito (SOAT) or Mandatory Traffic Accident Insurance, the main source of funding for road safety.
- 2002: adoption of the National Transit Code (769 Law of 2002).
- 2012: adoption of the first national road safety plan, 2011–16 (PNSV).
- 2013: adoption of the second version of the national road safety plan 2011–21.
- 2013: creation of the Agencia Nacional de Seguridad Vial (National Road Safety Agency (ANSV)), which replaced the Road Prevention Fund.
- 2013: adoption of the *Drink Driving Law 1696*.

The National Road Safety Agency (ANSV) is responsible for the organisation and management of road safety in Colombia. The agency was created in 2013, but it became operational in December 2016 due to issues in providing the administrative, legal and financial mechanisms required for the full operation of the Agency. The Agency is attached to the Ministry of Transport, but is financially autonomous. Its main mission is to prevent and reduce traffic crashes (*1702 Law of 2013, Article 2*). The Agency coordinates public and private organisations committed to road safety and implements the road safety action plan of the government.

## Programs

The ANSV has implemented several programs to improve road safety in the areas of management or capacity building, speed enforcement, alcohol use and helmet wearing.

### Capacity building

Local committees and councils for road safety have been established through the National Road Safety Agency, to facilitate implementing the concept of shared responsibility and involve the local authorities.

#### *Speed management and infrastructure*

Since 2018, the National Road Safety Agency has been working on Pequeñas Grandes Obras (PGO) (*Small Great Works*), a program to make improvements to local infrastructure. This program aims to implement small, efficient interventions at significant points to reduce the number of crashes and introduce traffic calming.

#### *Public awareness*

A wide range of communications campaigns has been conducted with a particular focus on drinking and driving, speeding and the use of helmets.

## Urbanisation

Movement from rural to urban areas was very large in the middle of the twentieth century, however, this has tapered off in recent decades. The urban population increased from 31% of the total population in 1938, to 57% in 1951 and about 70% by 1990 and 81% in 2019. The list of the

most populated cities in the country only contains the population living in the urban area of the municipalities, according to the results of the 2018 population census (Figure 3).

Figure 3: Colombia urbanisation rates

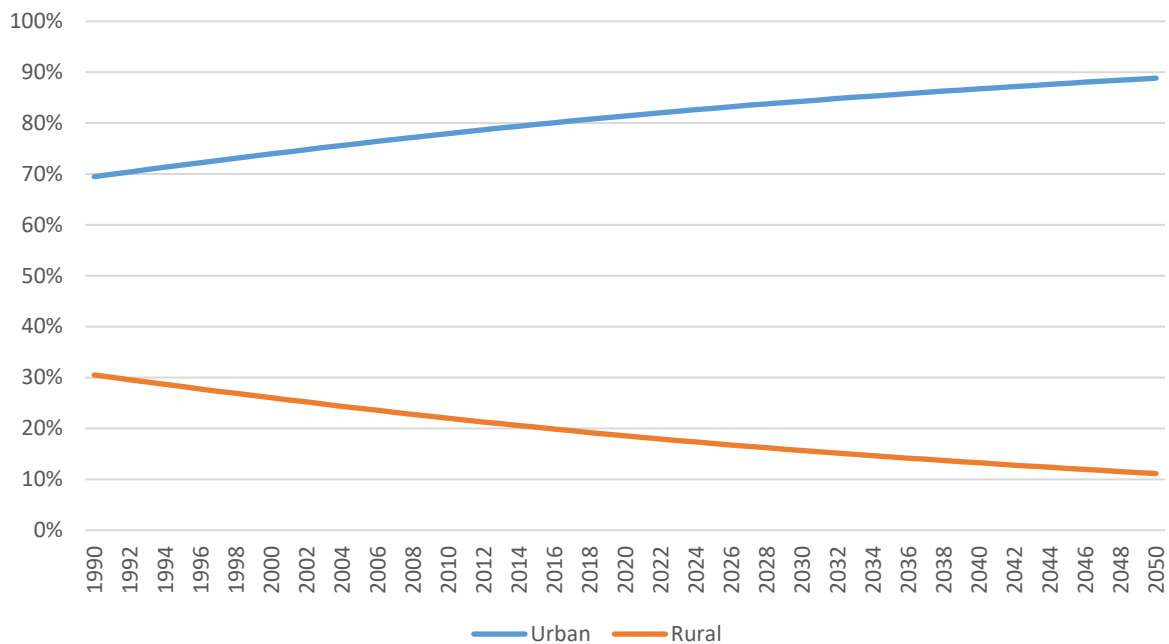
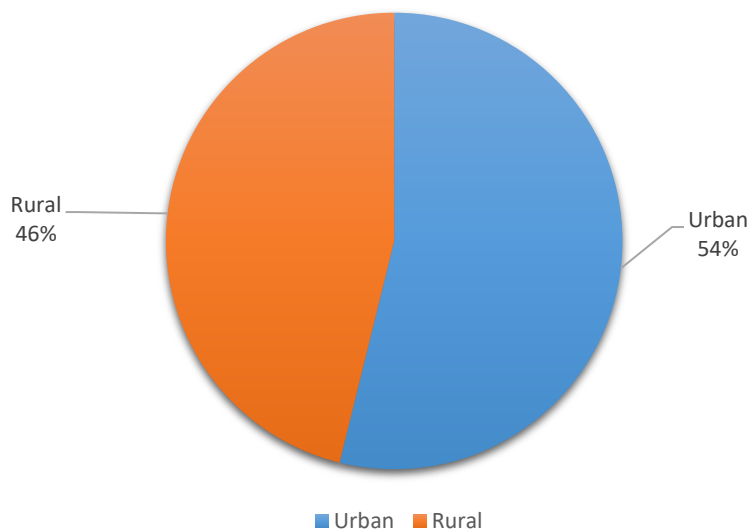


Figure 4 shows the relative occurrence of fatalities in urban and rural areas in Colombia for 2019, with urban areas accounting for 52.6% and rural areas 44.9% with 2.5% uncertain. Assuming the 2.5% is evenly split between the urban and rural areas and given 81% of Colombia’s population was urban in 2019, this means the rate for rural fatalities is 3.67 times that of urban areas. This is nearly twice as high as the assumed ratio according to the literature. Unfortunately, the National Yearbook of Road Accidents does not report the ratio of serious injuries in urban and rural areas.

Figure 4: Colombia urban rural fatalities





## Population

As of 2019, the total population of Colombia was approximately 50.3 million people with the 10–24 age cohort being circa 12.7 million (25.2%). The population has grown significantly since 1960 when the population was 16.1 million (Figure 5 and Figure 6).

Figure 5: Colombia female population 10 to 24 cohort

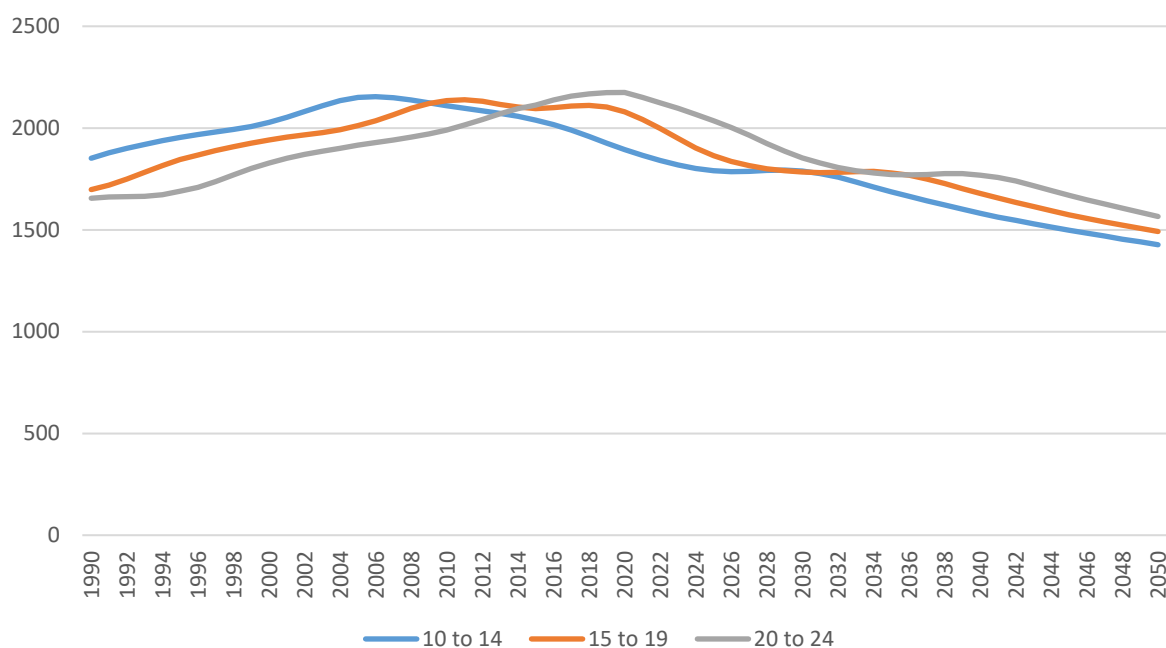
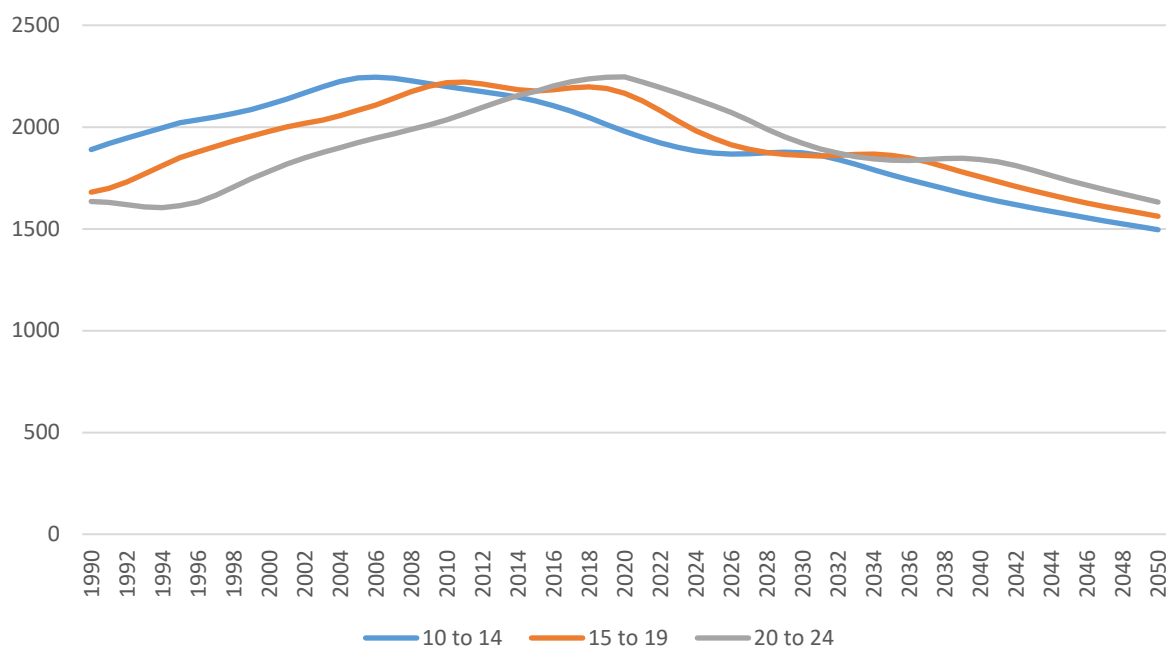


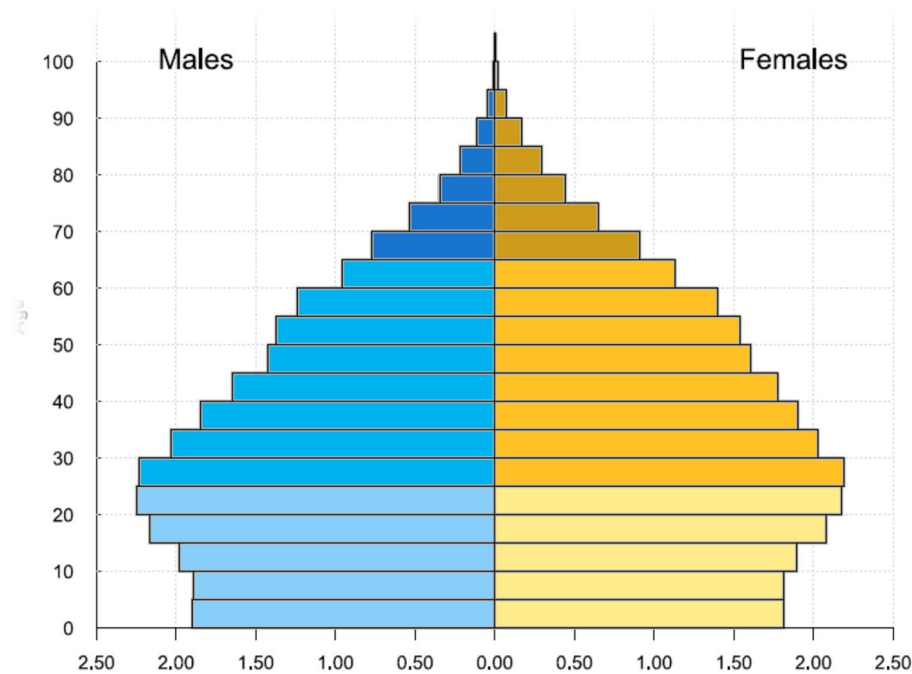
Figure 6: Colombia male population 10 to 24 cohort



A population pyramid that is narrowed at the base (Figure 7) such as Colombia's, is generally older on average, as the country has long life expectancy (77 years in Colombia), a low death rate, but also

a low birth rate. This is a typical pattern for a very developed country, however, the low level of narrowing indicates these factors are not pronounced. The stable to slightly decreasing 10–24 population supports this conclusion.

Figure 7: Colombia population pyramid, 2020 (UNDESA 2019)



## Modelling Interventions Using the Road Safety Intervention Model

We used the Road Safety Intervention Model (RSIM) to estimate the impact of a range of interventions on road traffic fatalities and injuries in Colombia. We assume that interventions are introduced in 2022 and increase over time reaching a maximum in 2030 where they maintain that effect until 2050.

The interventions and the way they are incorporated into the RSIM model are described in the main Report. While no new interventions specific to Colombia have been introduced, changes have been made to the effectiveness of different interventions as well as baselines. Specific changes are shown with the specific effectiveness for Colombia for each intervention in Table 12.

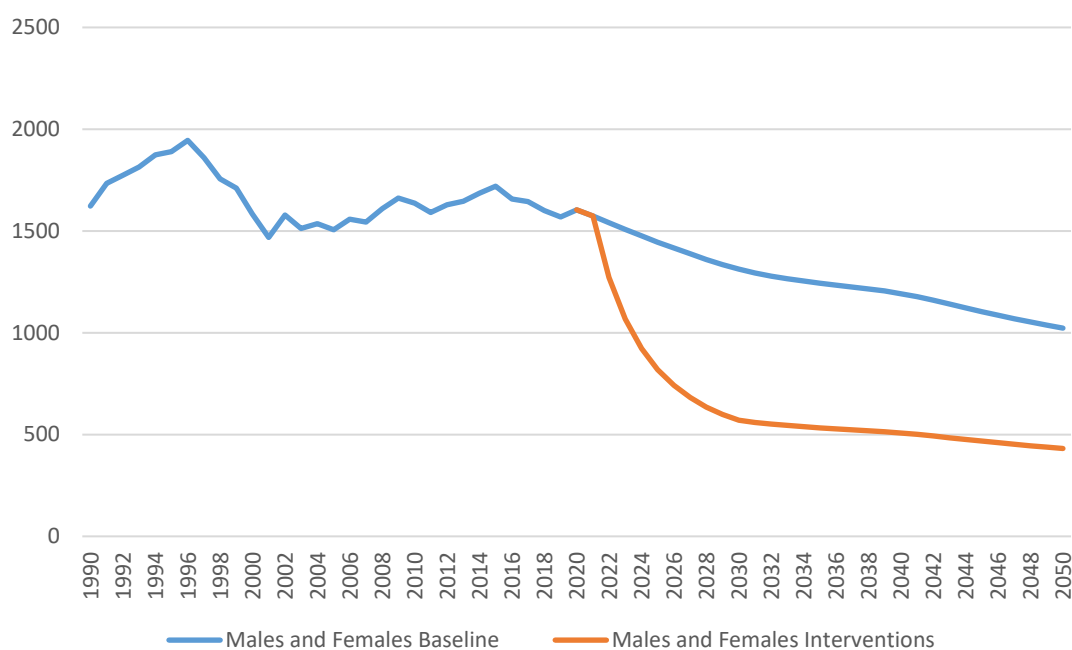
Table 12: Interventions and effectiveness

	Intervention	Effective reduction
Motor cycles	Helmet usage	36%
	Alcohol limit enforcement	25%
	Infrastructure	20%
	Speed compliance	14%
	Public awareness and education	4.5%
	Graduated licensing scheme 15–19	20%
	Graduated licensing scheme 20–24	4%
Motor vehicles	Seat belts	20%
	Alcohol limit enforcement	25%
	Infrastructure	13%
	Speed compliance	14%
	Graduated licensing scheme 15–19	20%
	Graduated licensing scheme 20–24	4%
	NCAP	1%
	Public awareness and education	4.5%
Cyclists	Alcohol limit enforcement	4%
	Infrastructure	25%
	Speed compliance	14%
	Public awareness and education	4.5%
Pedestrians	Alcohol limit enforcement	4%
	Infrastructure	31%
	Speed compliance	14%
	Public awareness and education	4.5%
All	Capacity building	N/A

## Fatalities

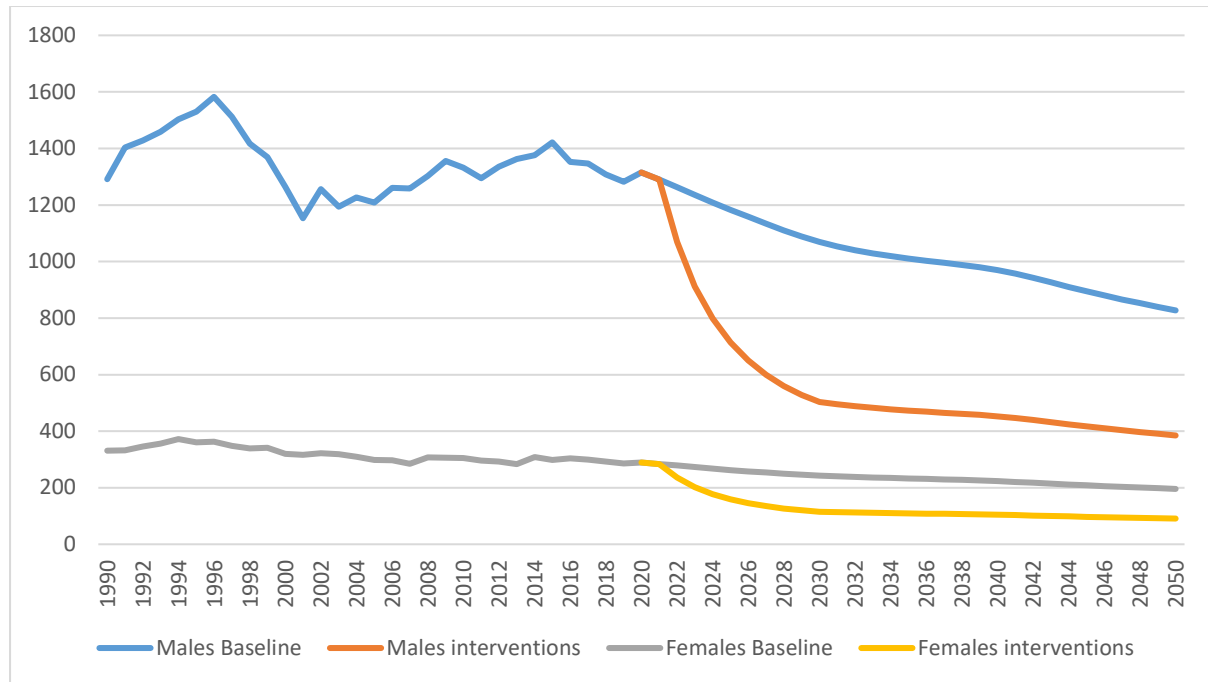
The baseline trend for combined male and female road fatalities for the 10 to 24 cohort in Colombia is expected to be one of gradual decline out to 2050 from 1,600 per annum to just over 1,000. When all the interventions are modelled this reduces this figure to 570 by 2030 and 430 by 2050 (Figure 8).

Figure 8: Total baseline and intervention fatalities for 10–24 cohort



The forecast for male and female 10 to 24 cohort road fatalities differs in the absolute number, while both are forecast to decline by approximately one third (Figure 9). Female fatalities are expected to reduce from 300 in 2020 to 200 by 2050, while males decline from 1,300 in 2020 to 1,070 in 2030 down to 830 in 2050. This is consistent with all countries where there are a much greater number of road fatalities for males than females.

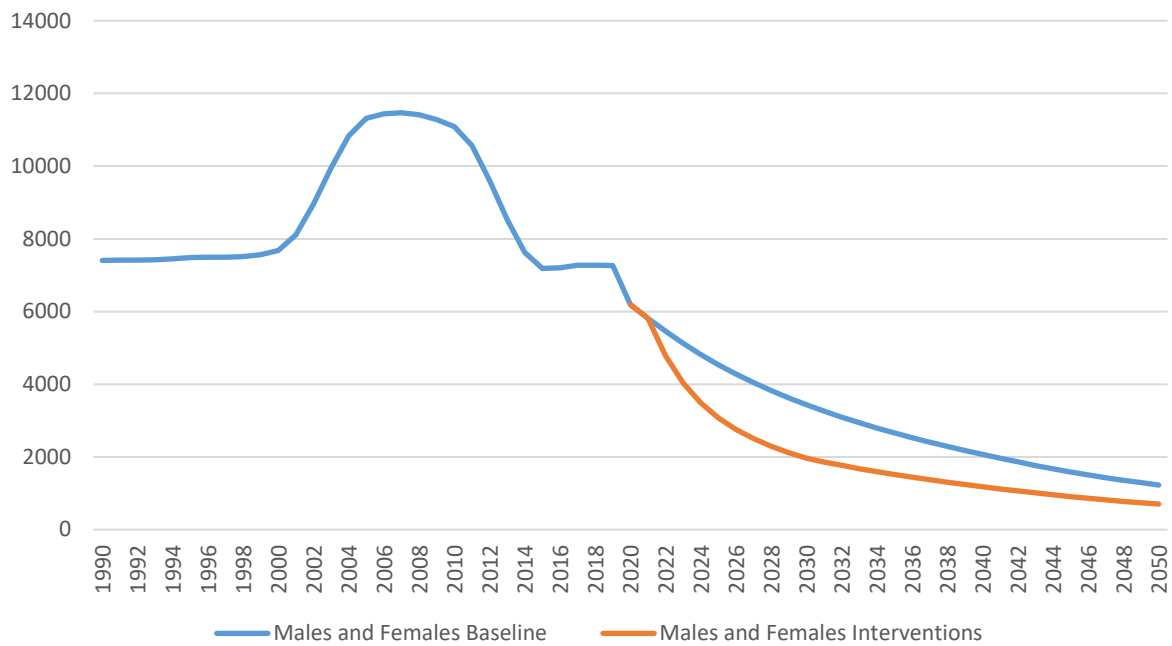
Figure 9: Male and female baseline and intervention fatalities



### Serious injuries

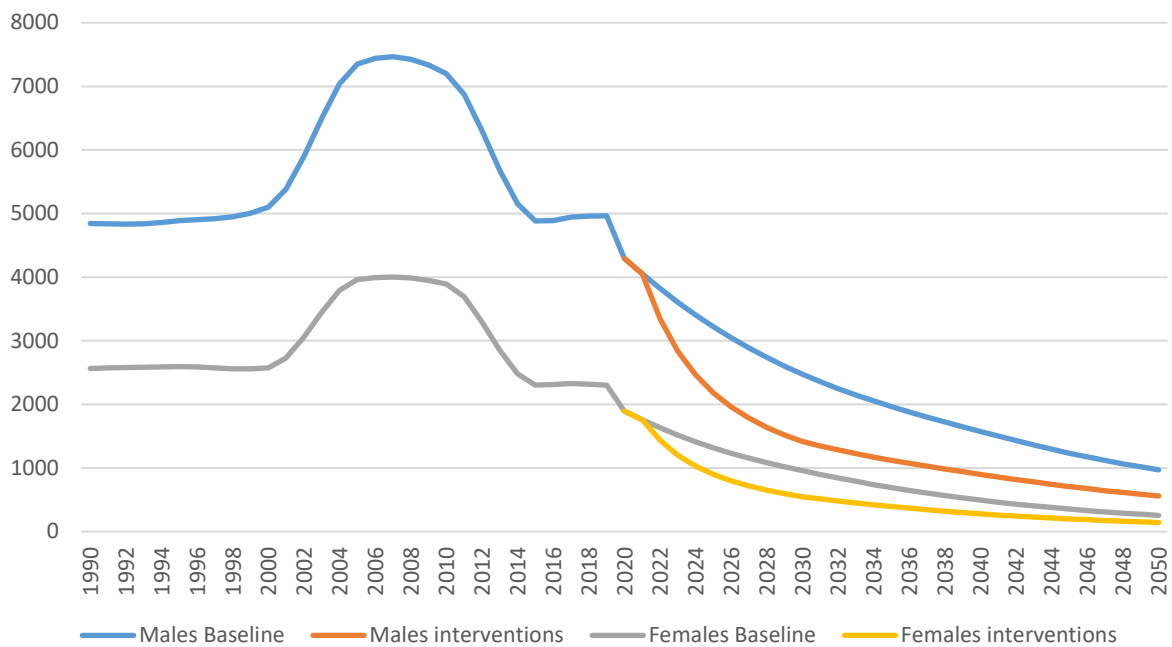
Serious injuries for 10 to 24 year olds in Colombia are forecast to decline rapidly in the next few decades, albeit from a high figure. The peak occurred in 2007 with 11,500 serious injuries that declined to 6,200 by 2020 (Figure 10). The trend suggests serious injuries will decline to 3,400 by 2030 and 1,200 by 2050. There is not a clear-cut explanation for the differing trends between fatalities and serious injuries, though government measures around motorcycle helmets and seat belts are likely to be part of the cause. Due to the forecast declining number of serious injuries, the effect of interventions are not nearly so significant with interventions serious injuries expected to be 2,000 by 2030 (down from 3,400) and 700 in 2050 (down from 1,200).

Figure 10: Total baseline and intervention serious injuries



As with fatalities, the trend of serious injuries with males and female are similar with the males starting at a higher base value. As a consequence, the impact of interventions is even smaller for females, down from 960 to 550 by 2030 and 2,500 to 1,400 by 2030 and 970 to 560 by 2050 (Figure 11).

Figure 11: Male and female baseline and intervention serious injuries



## 10 to 14 cohort

### Fatalities

The 10 to 14 cohort is most heavily reliant on walking as a form of transport and unsurprisingly it is pedestrians who endure the greatest burden of fatalities representing 40% of all fatalities. For both males and females the baseline trend is a steep decline from a peak in 1994, however, the gradient is greater for males (Figure 12) than females (Figure 13). All other modes are equally represented in fatalities.

Figure 12: Total male fatalities 10–14 cohort

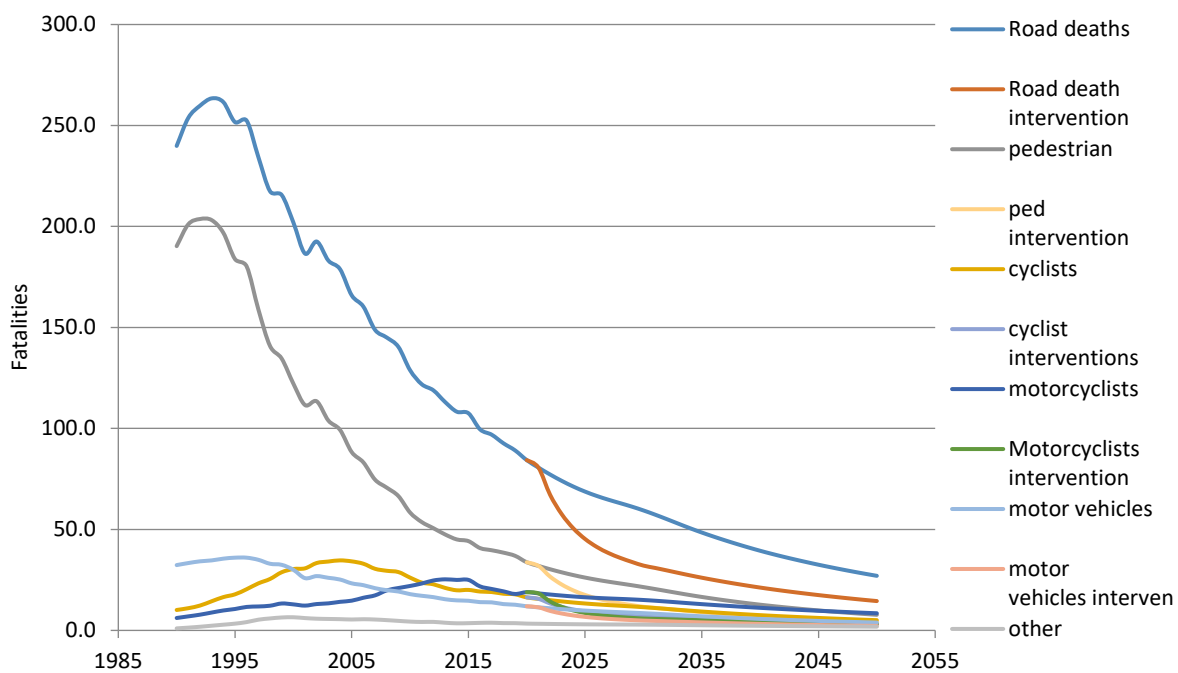
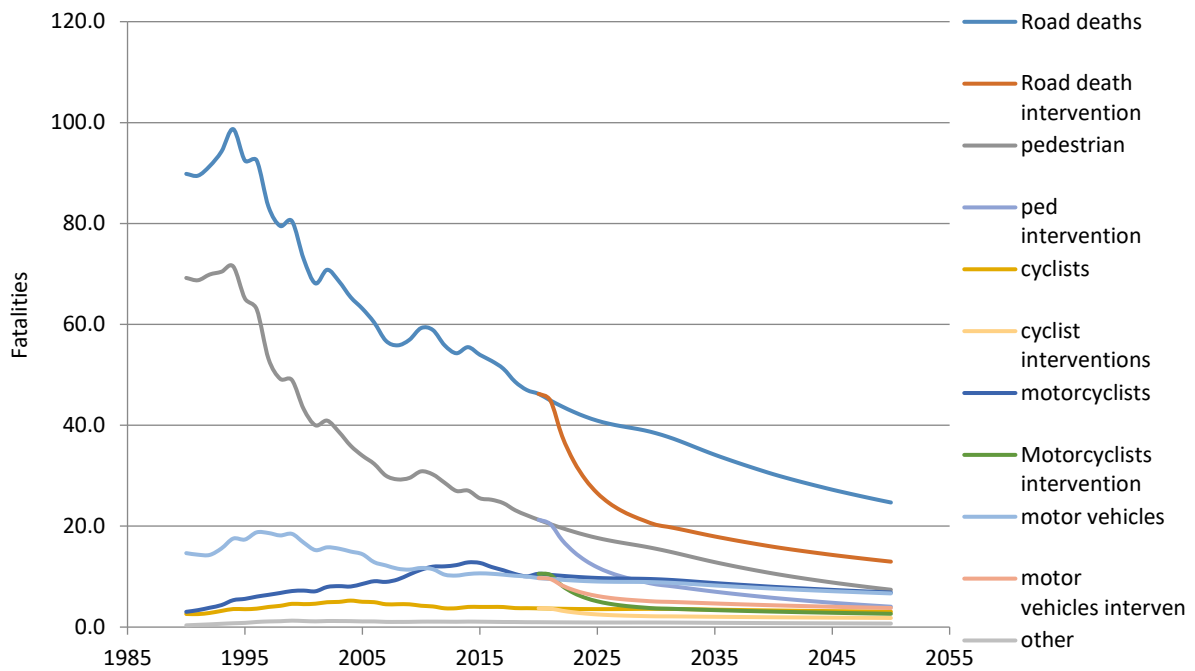


Figure 13: Total female fatalities 10–14 cohort



Urban and rural

The same trend is found for both male and female in urban and rural settings with pedestrians making up the largest number of fatalities and a step decline for males and slightly less steep decline for females (Figure 14 and Figure 15). Despite only 20% of the population being rural in Colombia, it is the rural setting which has the greater number of fatalities.

Figure 14: Urban male fatalities 10–14 cohorts

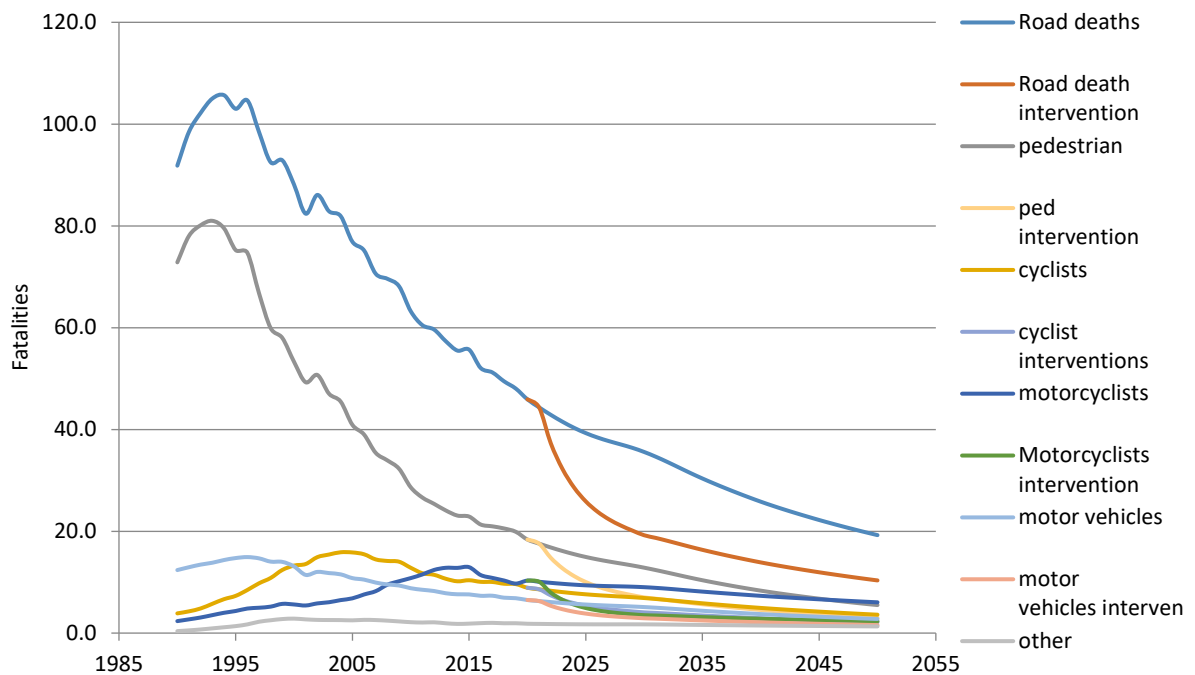


Figure 15: Urban female fatalities 10–14 cohorts

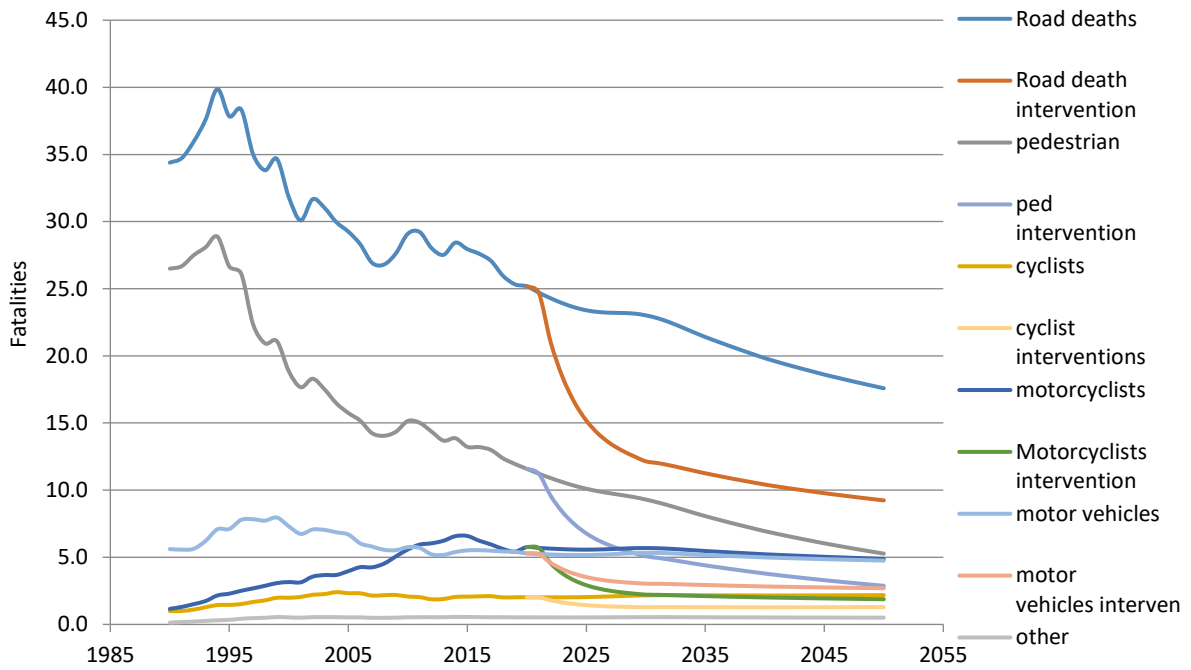


Figure 16: Rural male fatalities 10–14 cohorts

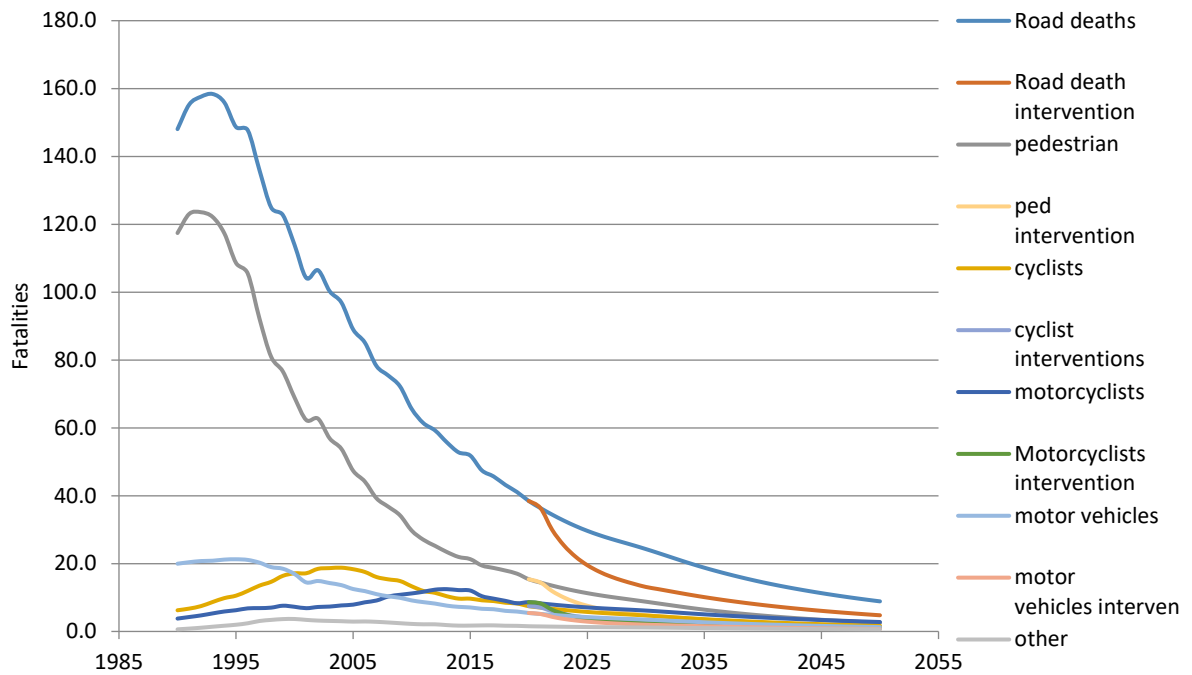
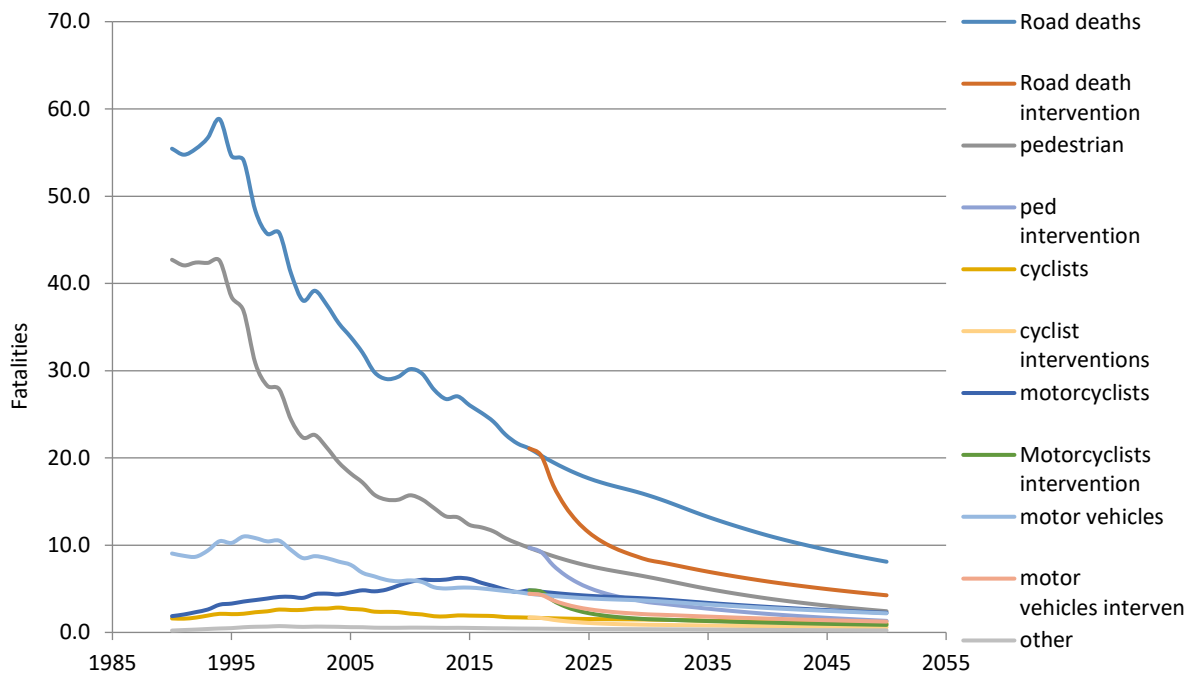




Figure 17: Rural female fatalities 10–14 cohorts



### Serious injuries

Serious injuries for 10 to 14 year olds show the same trends as fatalities for this cohort, but at much greater numbers with the peak figure being nearly eight times higher. However, the ratio between male and female serious injuries is much more even than for fatalities being nearly 1:1 in 2020. Apart from the quantity of serious injuries, the major difference with fatalities is the mode that makes up with the majority of serious injuries, in this case cycling. This is more so the case with males, whereas with females pedestrians and cyclists are more evenly represented (Figure 18 and Figure 19).

Figure 18: Serious and permanent injury total male 10 to 14 cohorts

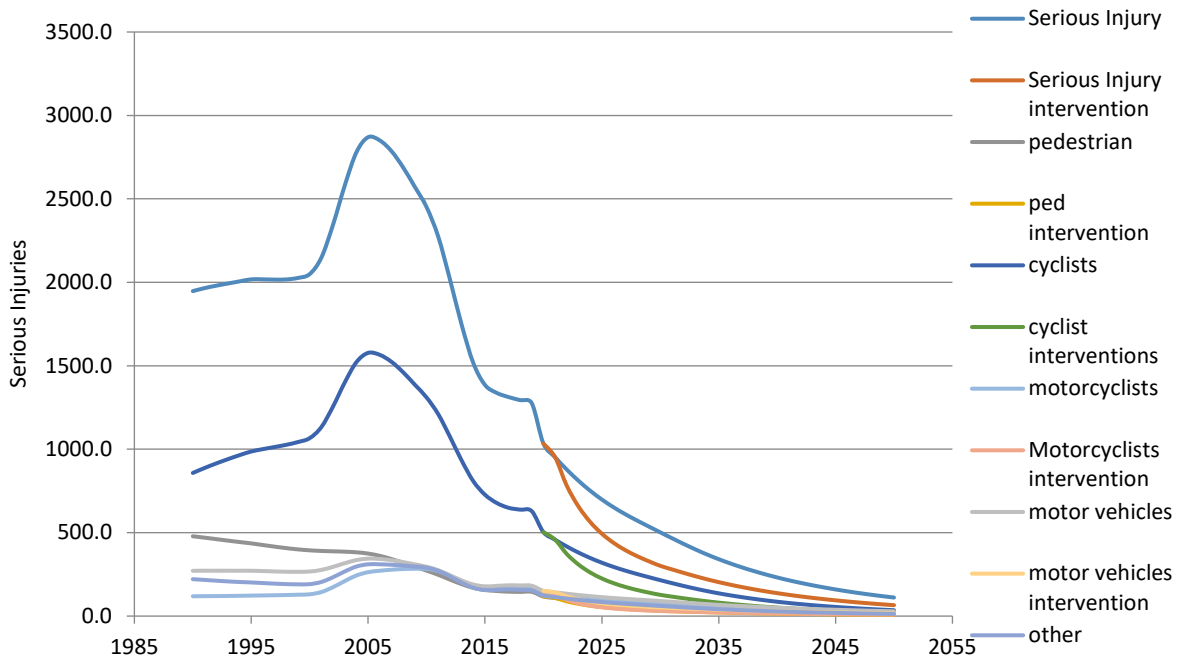
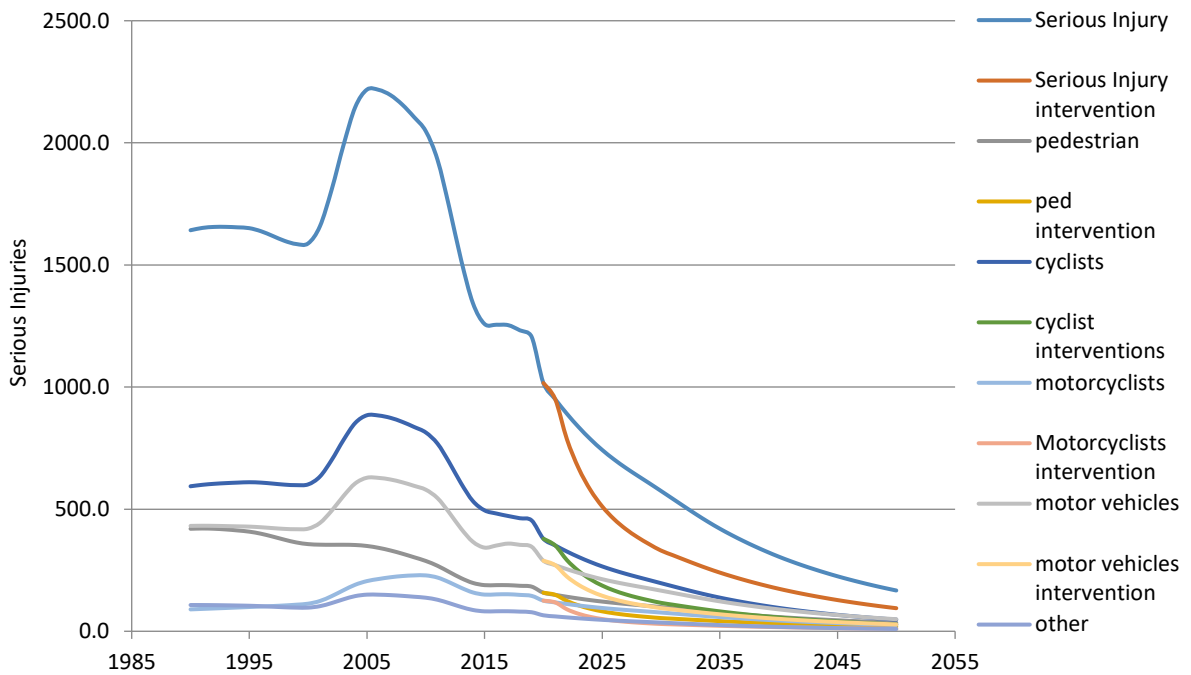


Figure 19: Serious and permanent injury total female 10 to 14 cohorts



*Urban and rural*

There are significantly more serious injuries in urban settings than rural settings that reflects the much larger urban population in Colombia and the same steep decline in total numbers.

Figure 20: Serious and permanent injury urban male 10 to 14 cohorts

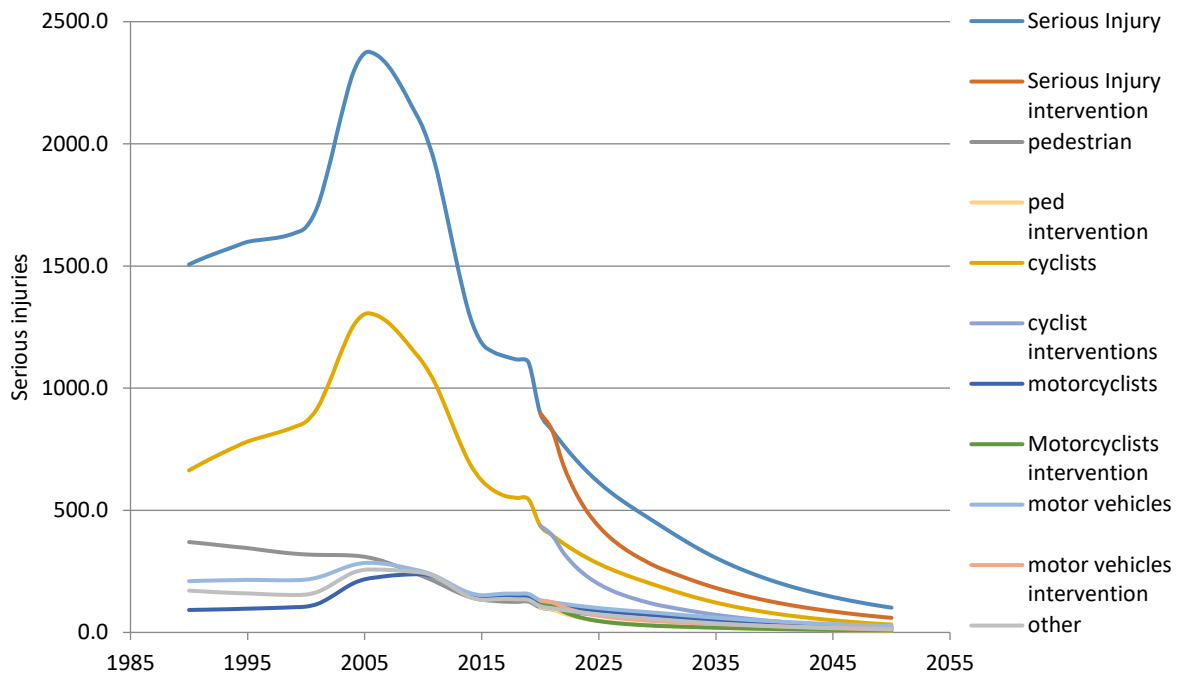


Figure 21: Serious and permanent injury urban female 10 to 14 cohorts

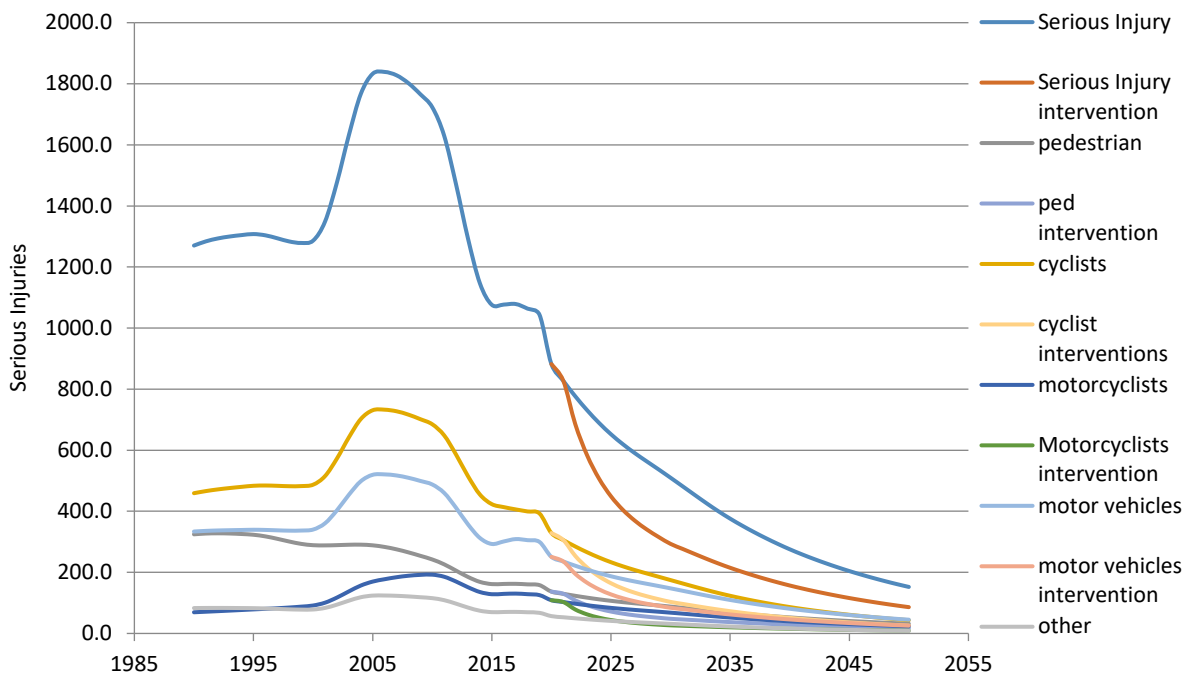


Figure 22: Serious and permanent injury rural male 10 to 14 cohorts

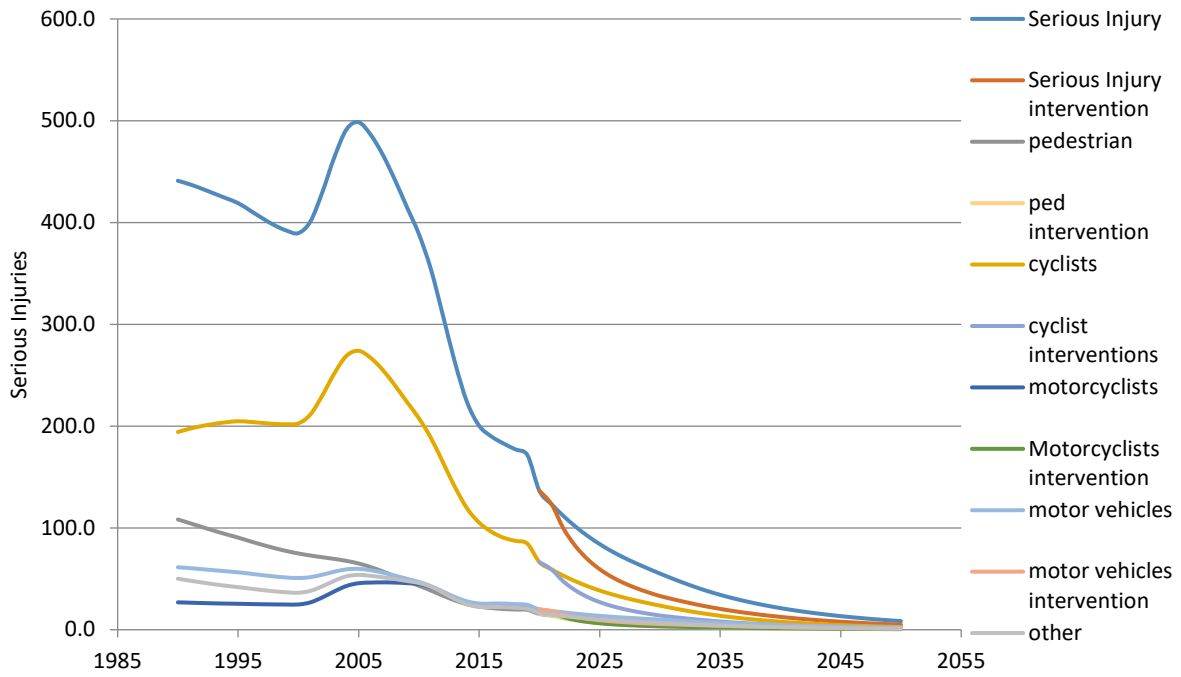
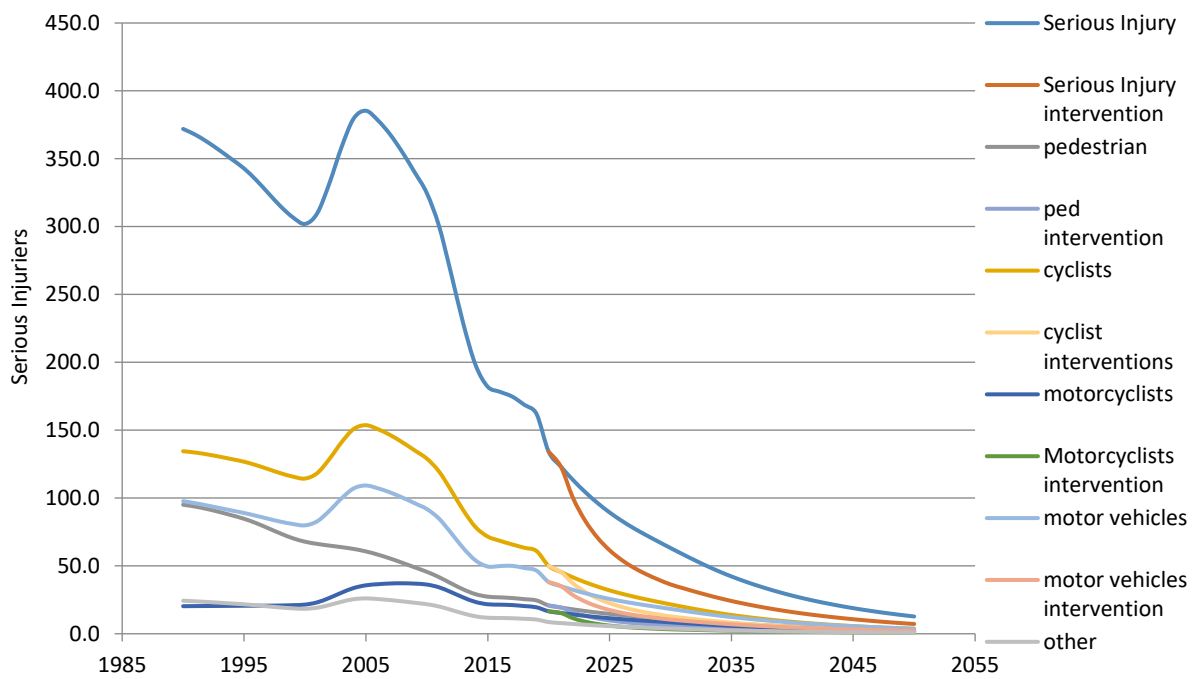


Figure 23: Serious and permanent injury rural female 10 to 14 cohorts



## 15 to 19 cohort

### Fatalities

Road fatalities for the 15 to 19 age cohort in Colombia vary substantially from the 10 to 14 year olds. A significant and far reaching difference is the primary mode for fatalities being motor cycles which have increased substantially from 1990 to 2015. During the same period, the number of pedestrian fatalities reduced showing an inverse relationship. The same trend is found for both males and females, though the increase in motorcycle fatalities and decrease in pedestrian fatalities occurred at a slower rate for females. While motorcyclists are by far the largest category for fatalities, motor vehicle occupants and pedestrians are approximately equal. The number of male deaths is also substantially larger comparatively than the 10 to 14 year olds, whereas for 10 to 14 year olds male fatalities are approximately double female, for 15 to 19 year olds this figure is over three times. The baseline trend for 15 to 19 year olds shows less of a decline than the 10 to 14 year olds with male fatalities forecast to decline from 360 in 2020, 303 in 2030 to 240 in 2050, while females are expected to decline from 105 in 2020, 90 in 2030 to 80 in 2050. The full set of interventions have a substantial effect on fatalities with these figures projected to decline to 118 in 2030 and 90 in 2050 for males, while for females these reduce to 37 in 2030 and 30 in 2050.

Figure 24: Fatalities total male 15 to 19 cohorts

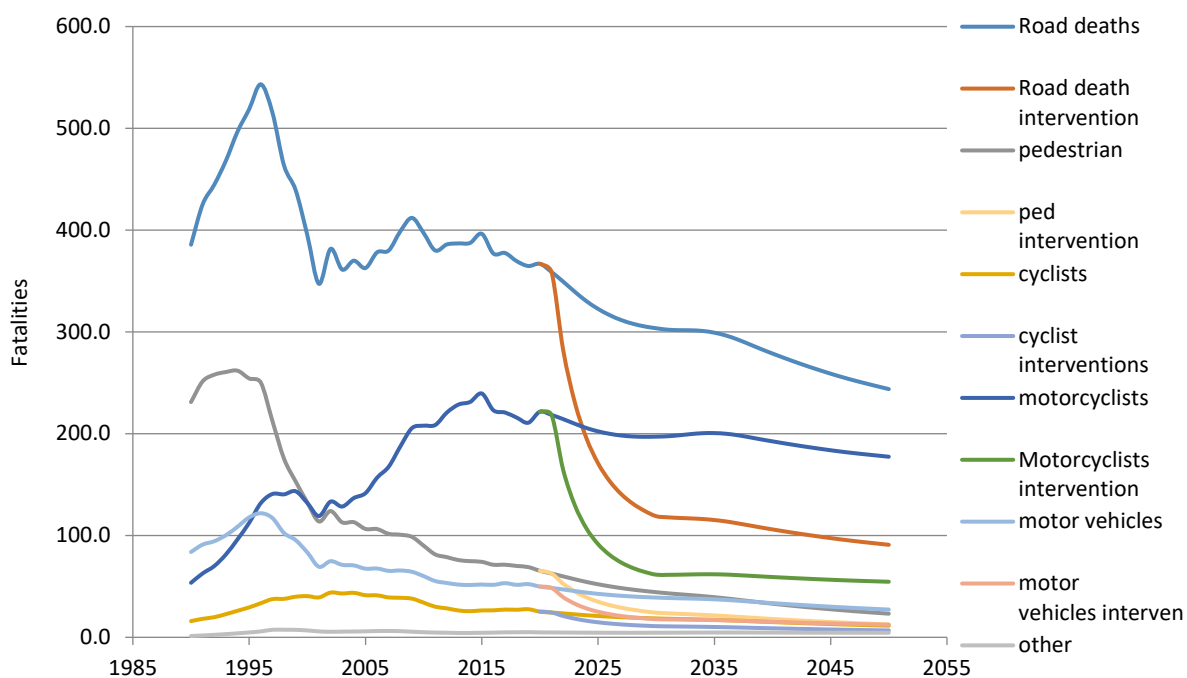
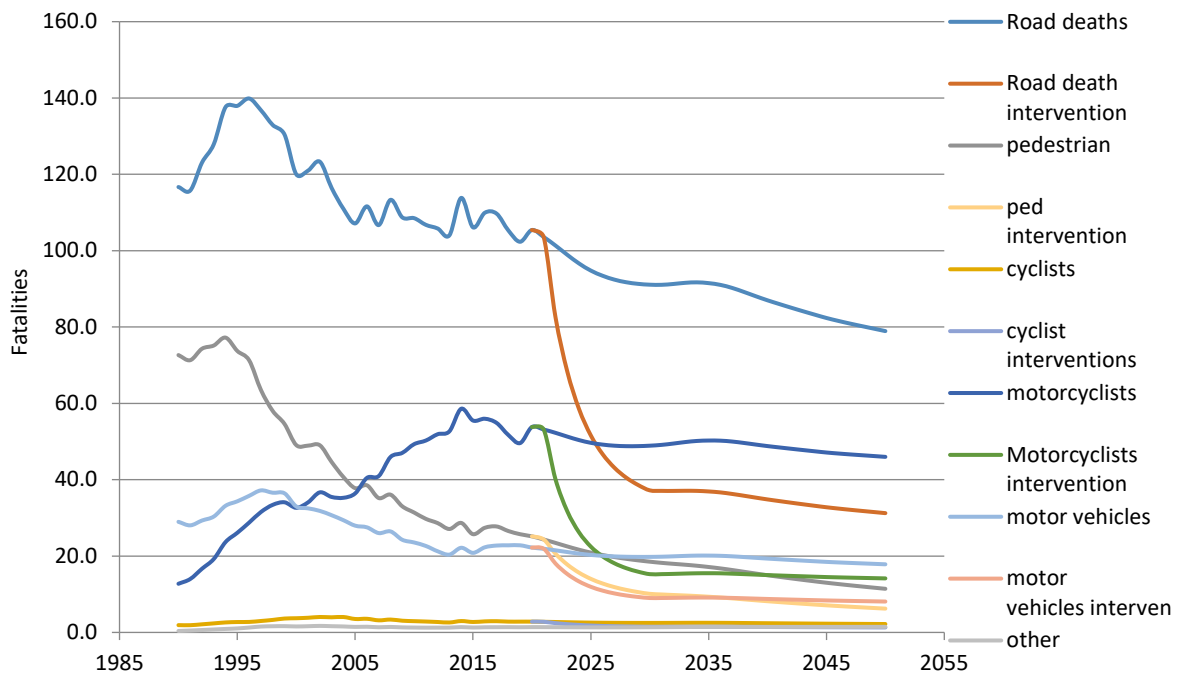


Figure 25: Fatalities total female 15 to 19 cohorts



### Urban and Rural

Baseline urban fatalities for both males and females are expected to remain stable out to 2050, while rural fatalities are expected to decline. This represents a combination of gradually increasing urbanisation and gradually reducing rates of fatalities for all modes except motor cycles, which are expected to gradually increase. These factors combine (decreasing rural population and decreasing rates of fatality) to lead to a significant decrease in rural fatalities despite the historic trend of much larger rates of rural fatalities in Colombia.

Figure 26: Fatalities urban male 15 to 19 cohorts

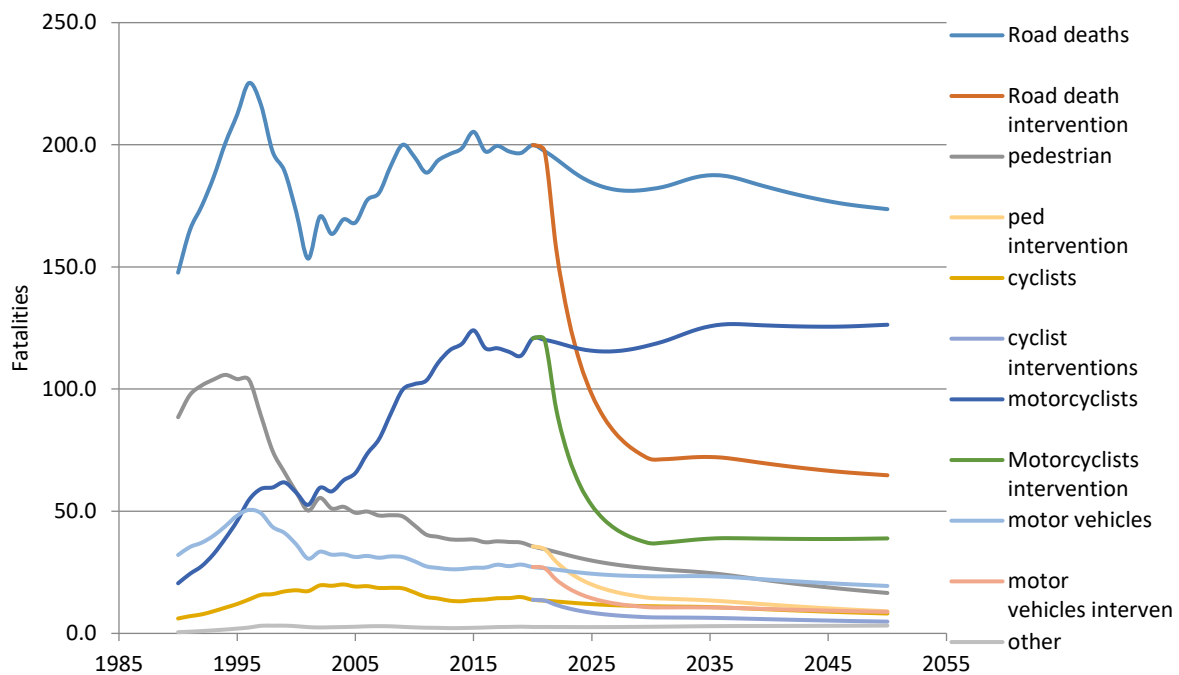


Figure 27: Fatalities urban female 15 to 19 cohorts

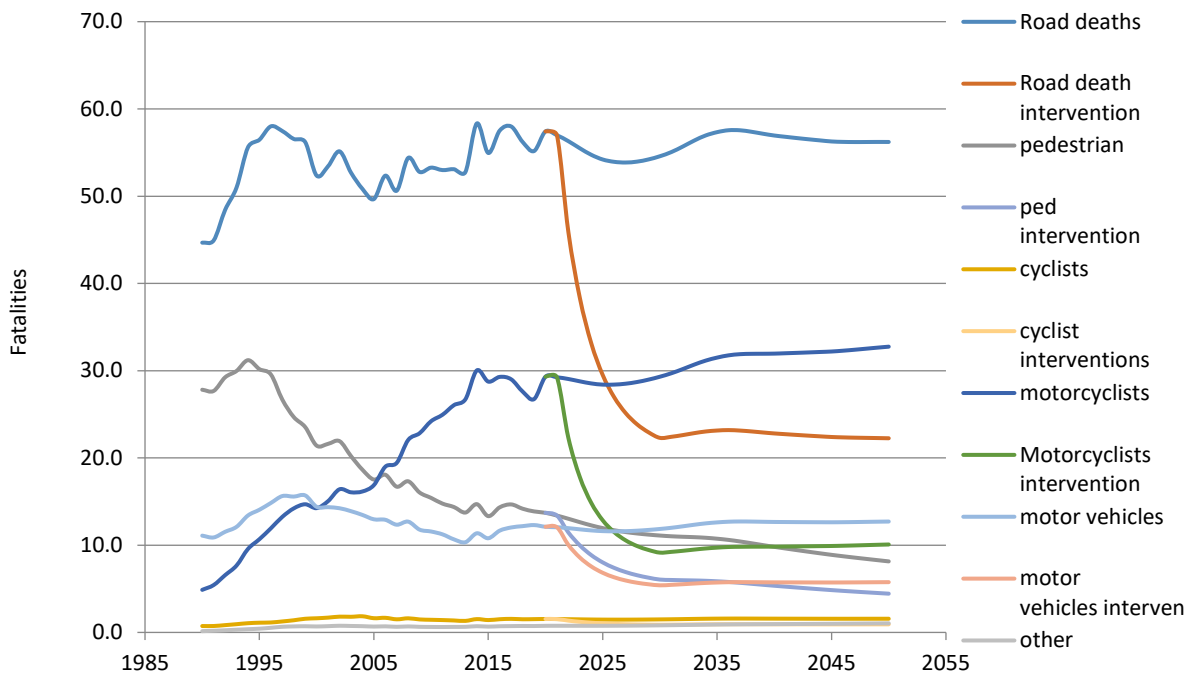


Figure 28: Fatalities rural male 15 to 19 cohorts

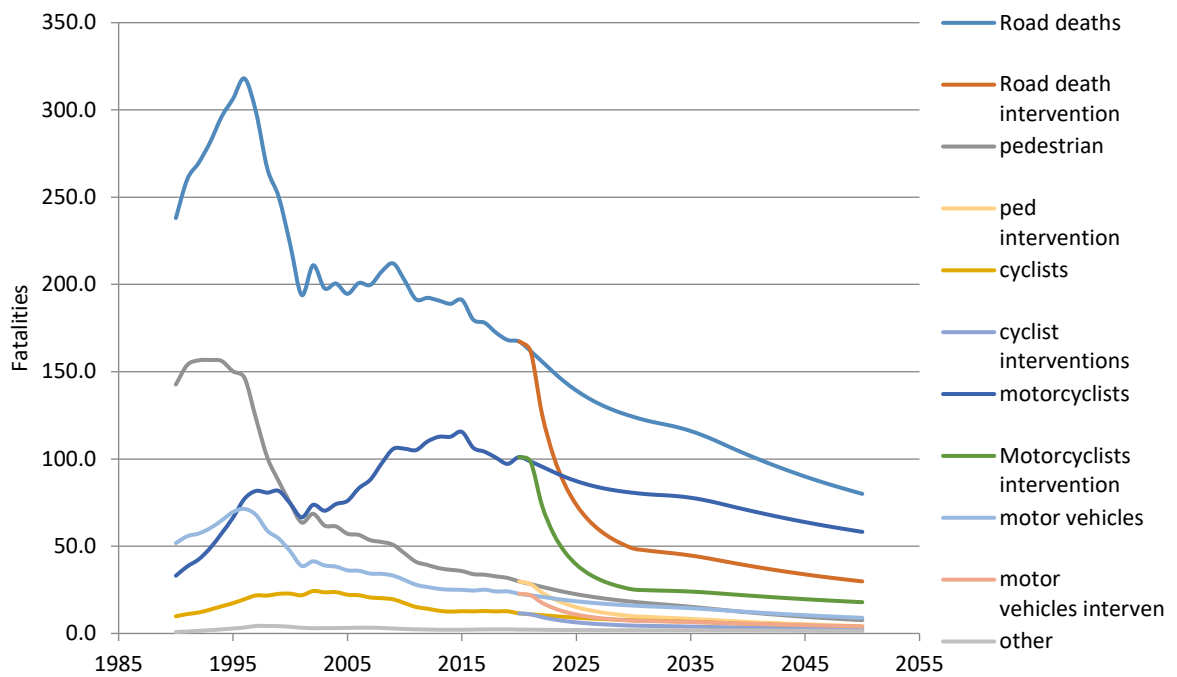
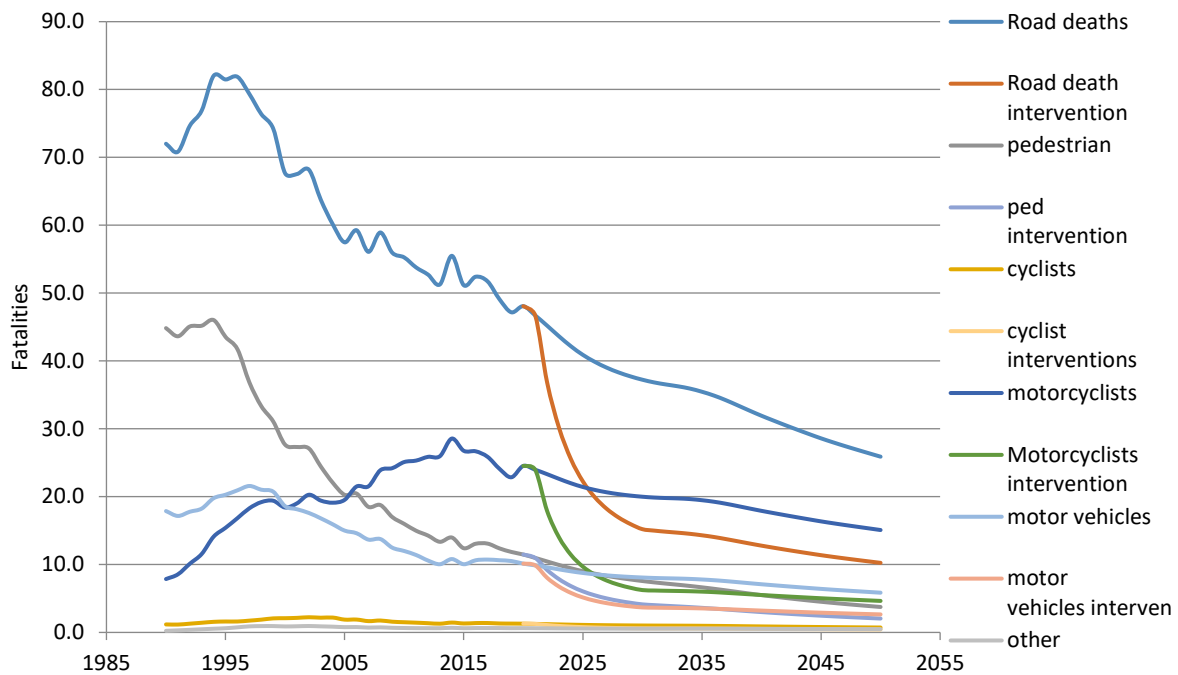


Figure 29: Fatalities rural female 15 to 19 cohorts



### Serious injuries

As with baseline serious injuries for 10 to 14 year olds, serious injuries for both 15 to 19 males and females are expected to decline substantially out to 2050. For males, the baseline is forecast to reduce from 1,500 in 2020 to 825 (2030) to 315 (2050). For females these figures are 600 (2020) to 240 (2030) to 60 (2050). As with the 10 to 14 cohort, males again have much higher numbers than females. The main modes responsible for these serious injuries differ between males and females and from the 10 to 14 cohort. For males in the 15 to 19 cohort, the primary modes for serious injuries are cyclists with approximately one third and motor cyclists with approximately one quarter. For females, it is motor vehicle occupants (30%) and cyclists (25%) who bear the majority of serious injuries.

Due to the steeply declining number of serious injuries, the interventions have a smaller effect on the amount of serious injuries when compared to fatalities.



Figure 30: Serious and permanent injury total male 15 to 19 cohorts

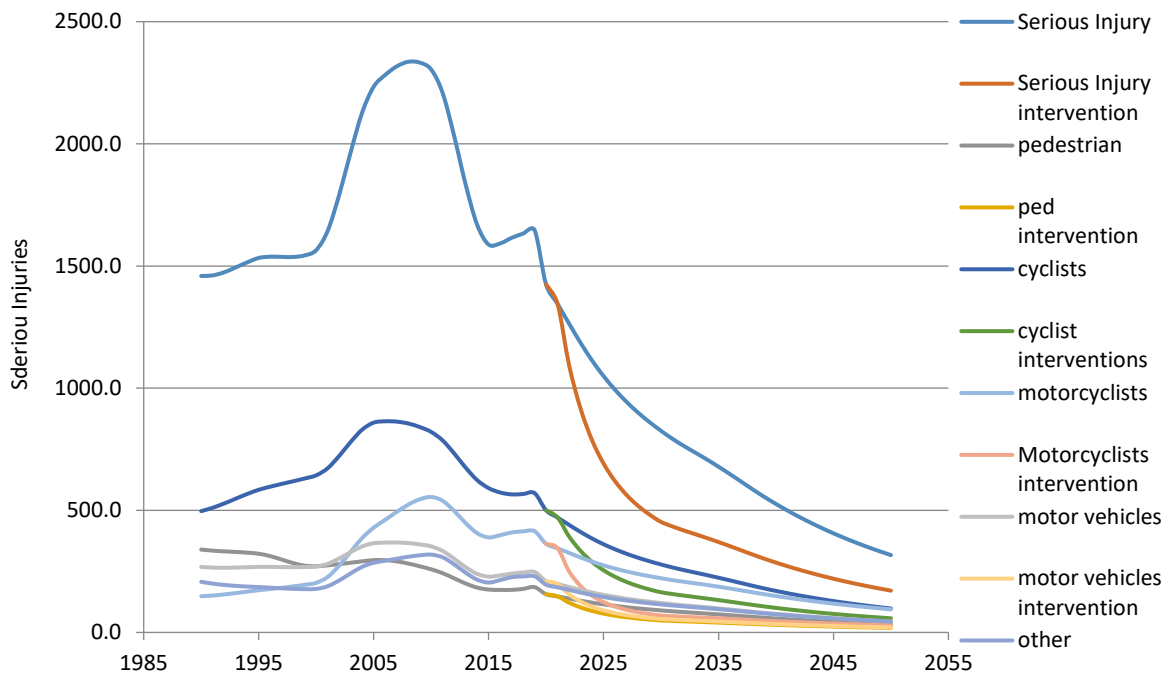
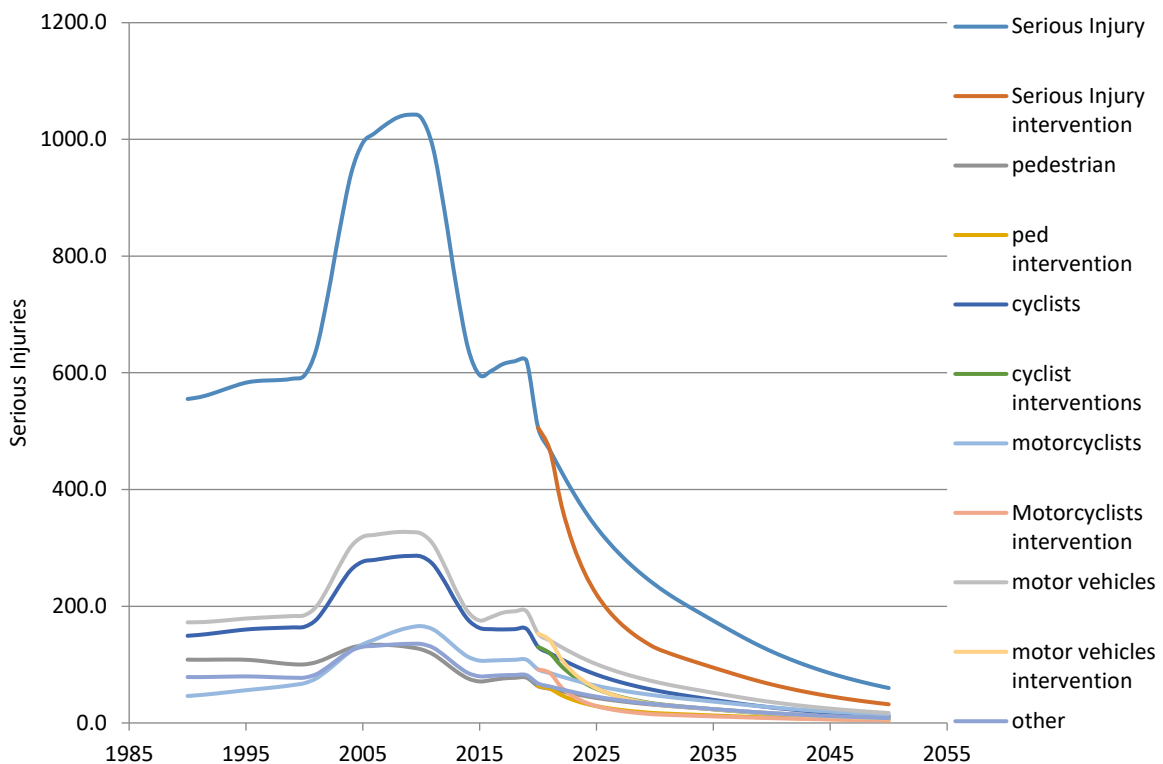


Figure 31: Serious and permanent injury total female 15 to 19 cohorts



Urban and rural serious injuries

As over 80% of the population is urban and this rate is increasing, the number of serious injuries in urban areas is substantially larger than in rural areas with the rate being roughly proportional to the

percentage of the population. The number of serious injuries is expected to decline rapidly in both urban and rural areas with male urban serious injuries forecast to drop from 1,230 in 2020 to 300 by 2050. The same trend is shown for females with expected numbers to drop from 450 (2020) to 55 (2050).

Figure 32: Serious and permanent injury urban male 15 to 19 cohorts

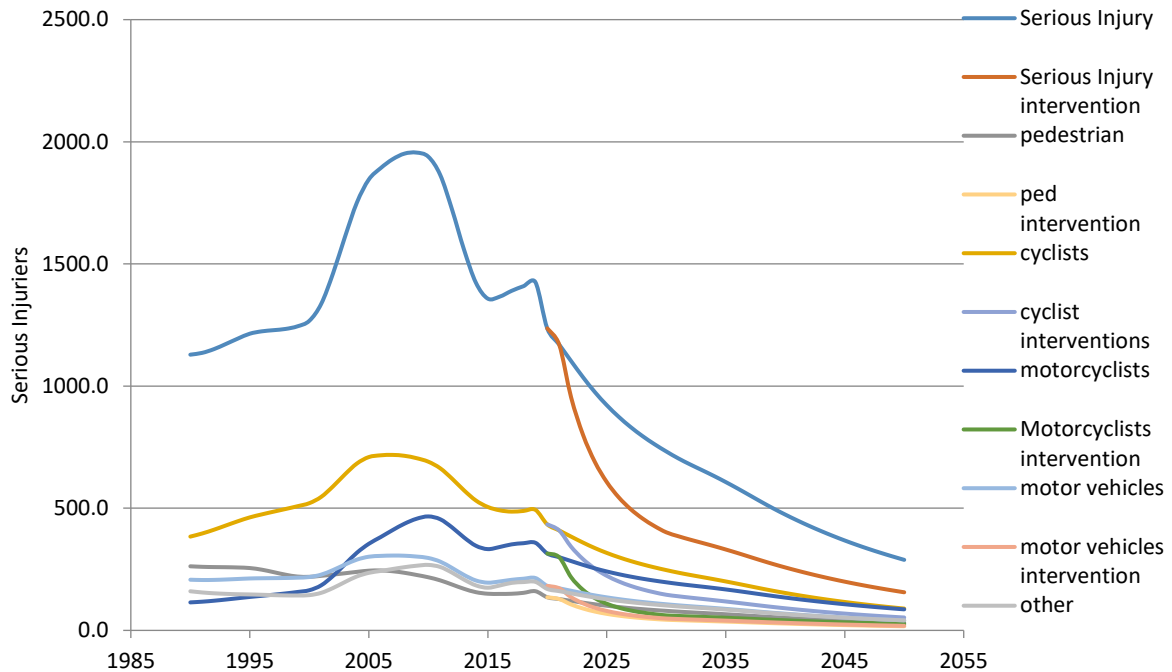


Figure 33: Serious and permanent injury urban female 15 to 19 cohorts

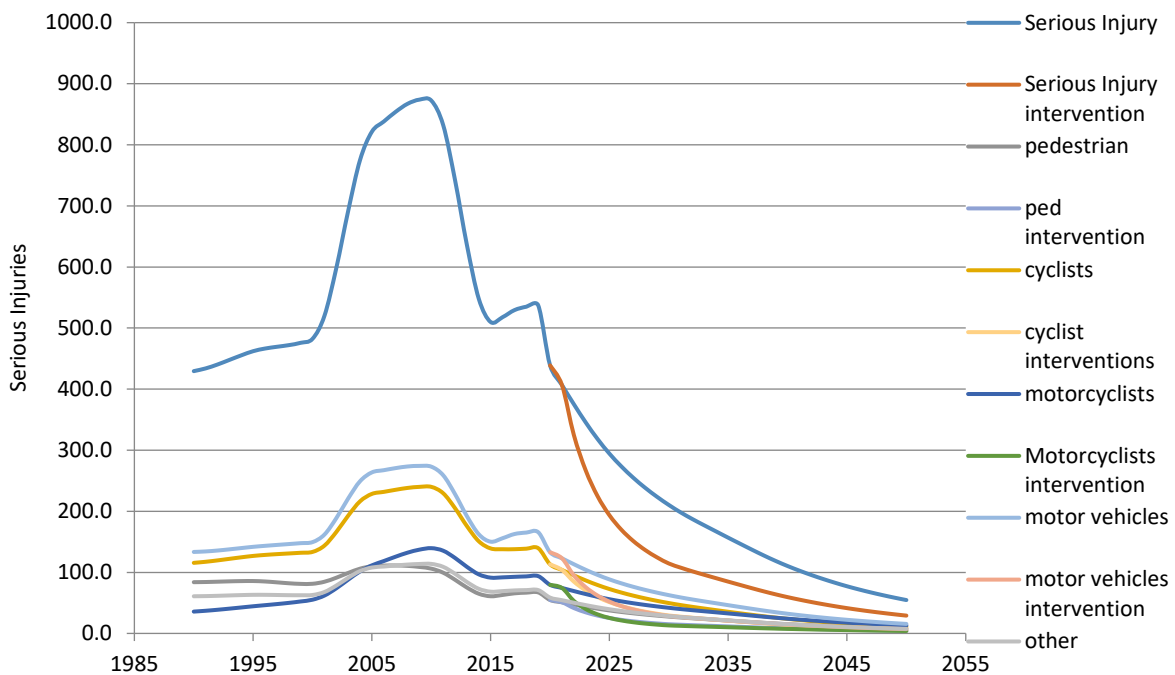


Figure 34: Serious and permanent injury rural male 15 to 19 cohorts

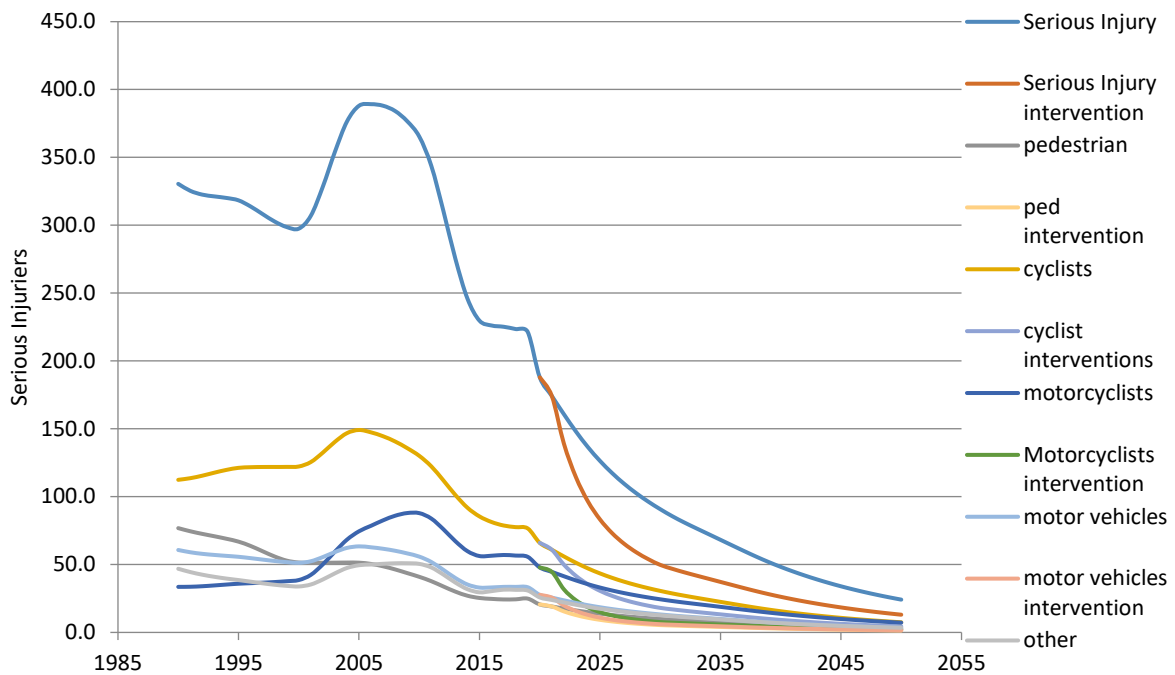
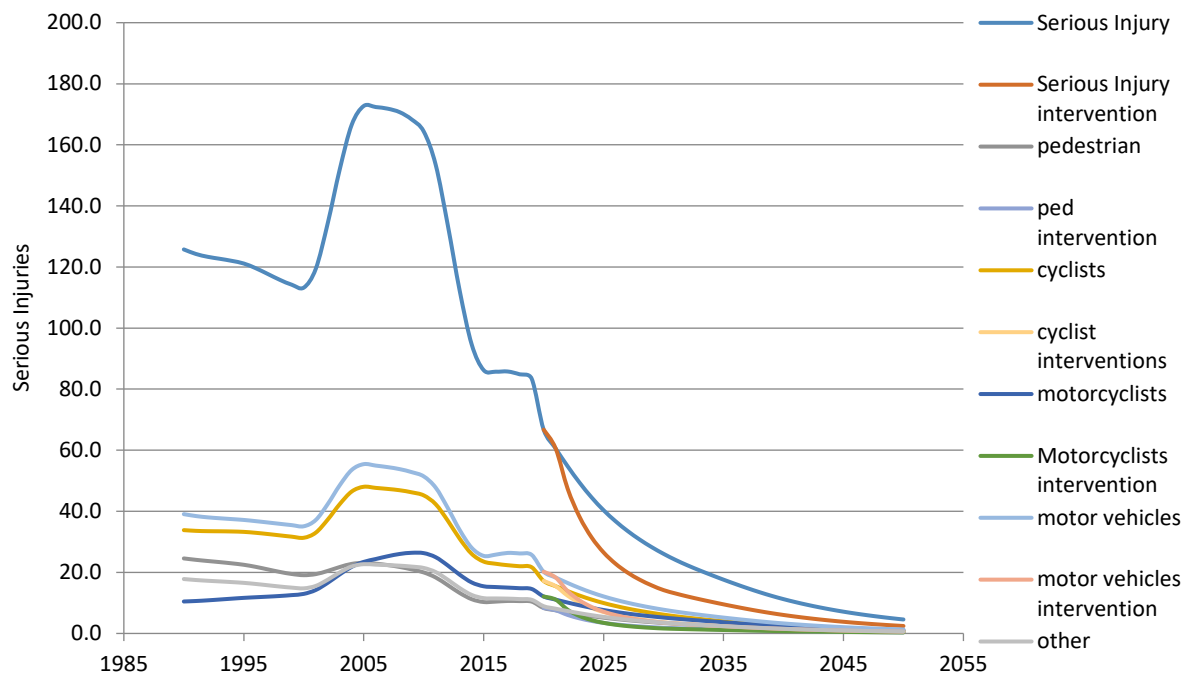


Figure 35: Serious and permanent injury rural female 15 to 19 cohorts



### 20 to 24 cohort

Fatalities in the 20 to 24 age cohort are forecast to decline for both males and females. The baseline for males is forecast to fall from 860 (2020) to 705 in 2030 to 550 in 2050. Females are forecast to decline from 138 in 2020, to 115 in 2030 and 90 in 2050. This demonstrates the large discrepancy between male and female fatalities, where there are over six times as many male fatalities per

annum compared to females. While motorcyclists represent the majority of fatalities for both males and females, they make up a larger percentage for males (65%) than females (~50%). Pedestrians are the next largest group of fatalities for both genders, but represent a larger percentage for females (~25%) than males (16%) with motor vehicle occupants the next most common (males 14% and females 21%). Motorcyclist fatalities are expected to gradually decline for both males and females as are pedestrian fatalities, whereas motor vehicle occupants are forecast to remain stable out to 2050 and become the second most common type of fatality by the late 2030.

As motorcycle fatalities are by far the largest group, interventions have the greatest impact on this mode, with numerically small gains for pedestrians and motor vehicle occupants.

Figure 36: Fatalities total male 20 to 24 cohorts

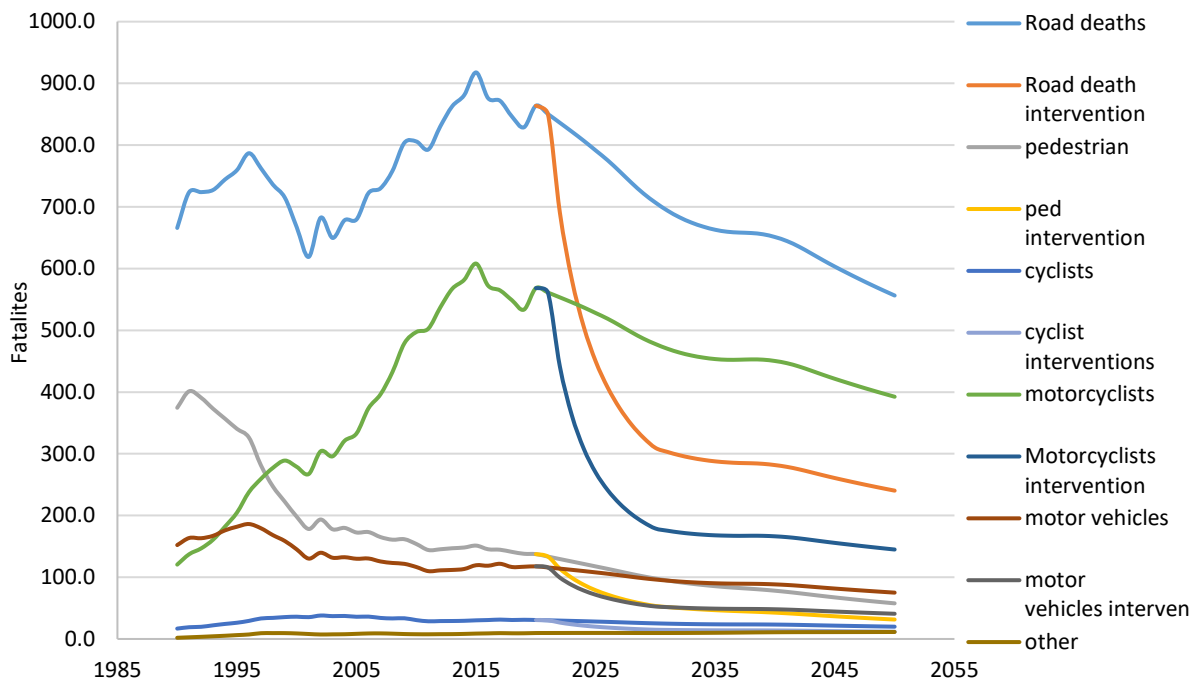
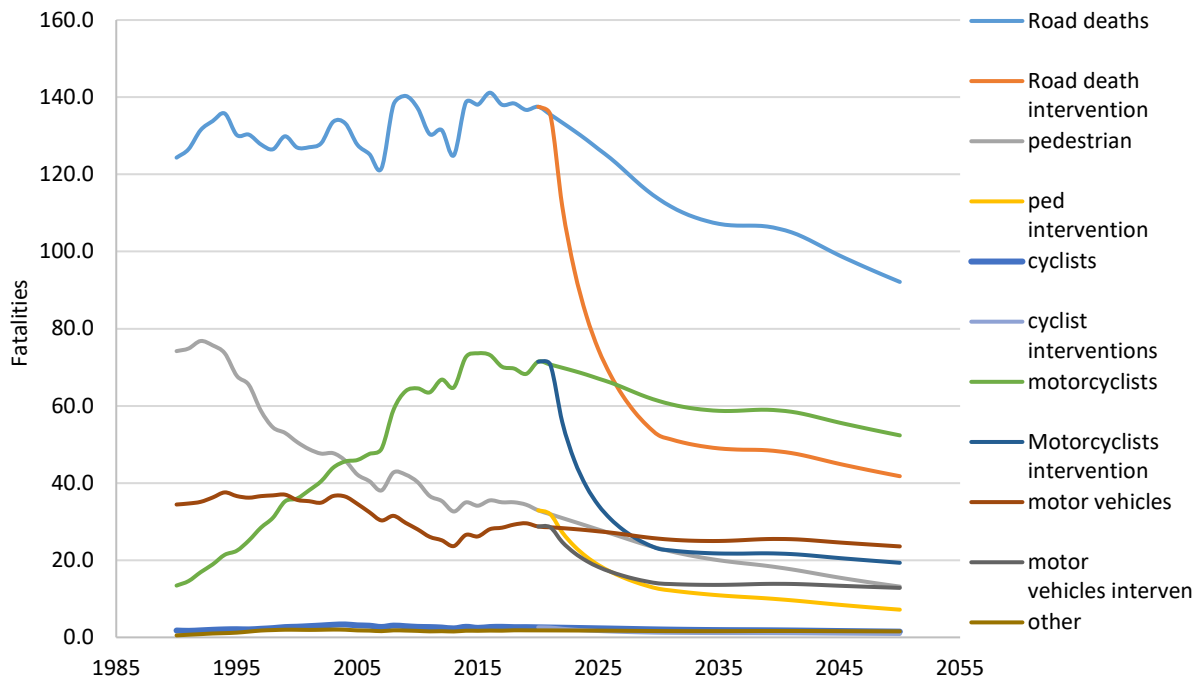


Figure 37: Fatalities total female 20 to 24 cohorts



*Urban and rural fatalities*

The most significant trend with respect to urban and rural fatalities is the large decline in rural fatalities, while urban fatalities remain relatively stable for both males and females. The relatively equal proportions of fatalities in urban and rural settings in 2020 becomes markedly different by 2050, with twice as many fatalities expected to occur in urban settings by then. In urban settings, pedestrian fatalities are expected to continue to fall for both males and females with other modes remaining relatively constant. This contrasts with rural settings where fatalities from all modes are expected to fall for both males and females, and interventions having less of an impact on an already declining baseline.

Figure 38: Fatalities urban male 20 to 24 cohorts

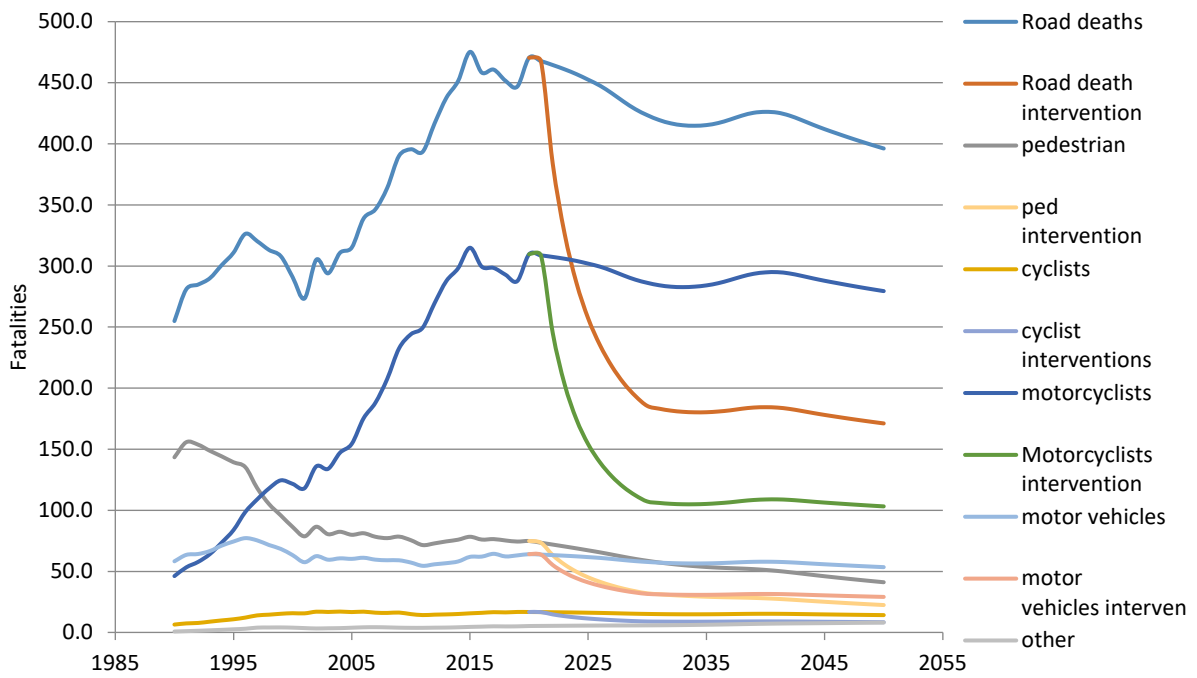


Figure 39: Fatalities urban female 20 to 24 cohorts

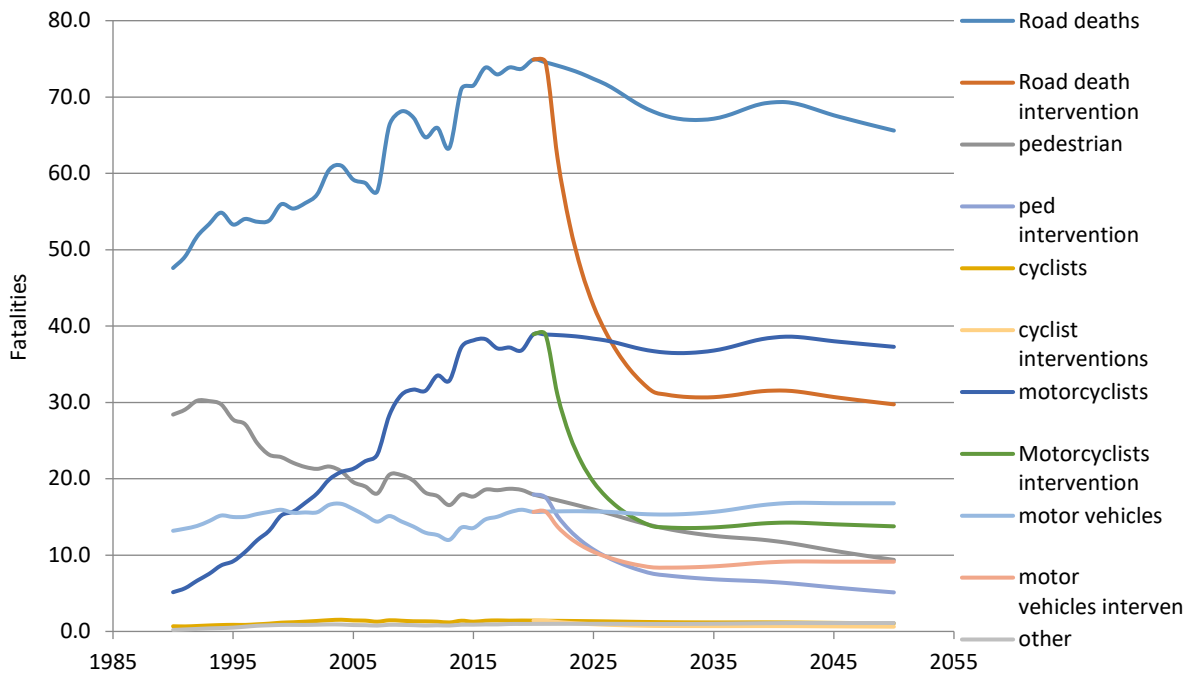


Figure 40: Fatalities rural male 20 to 24 cohorts

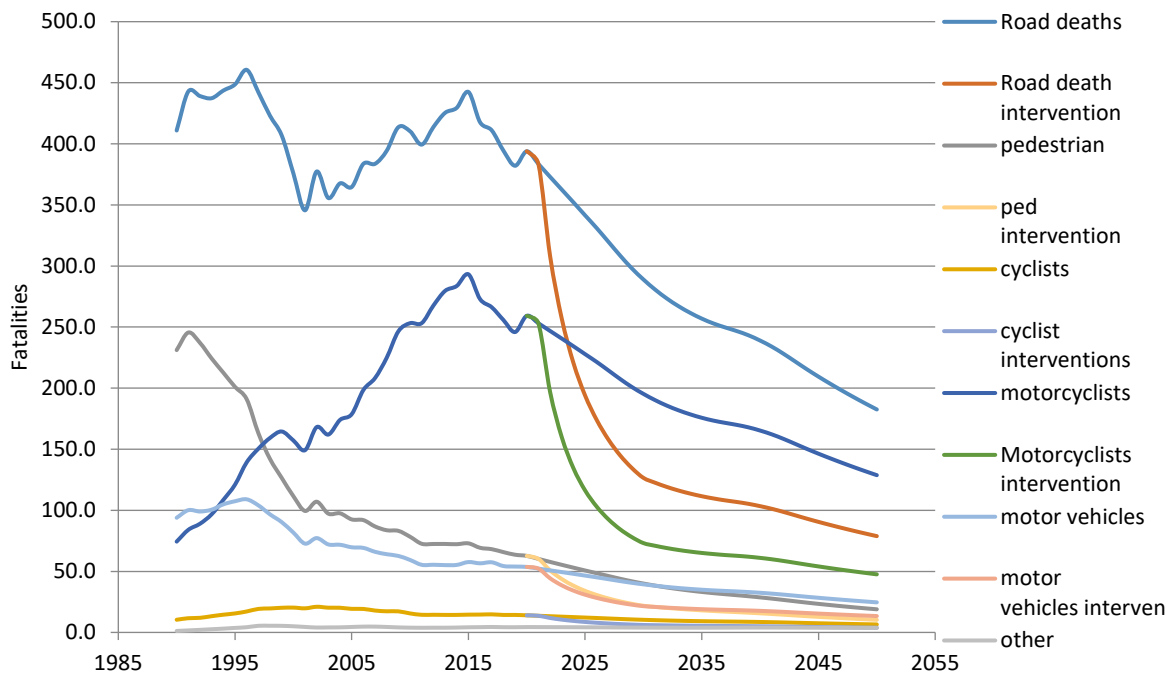
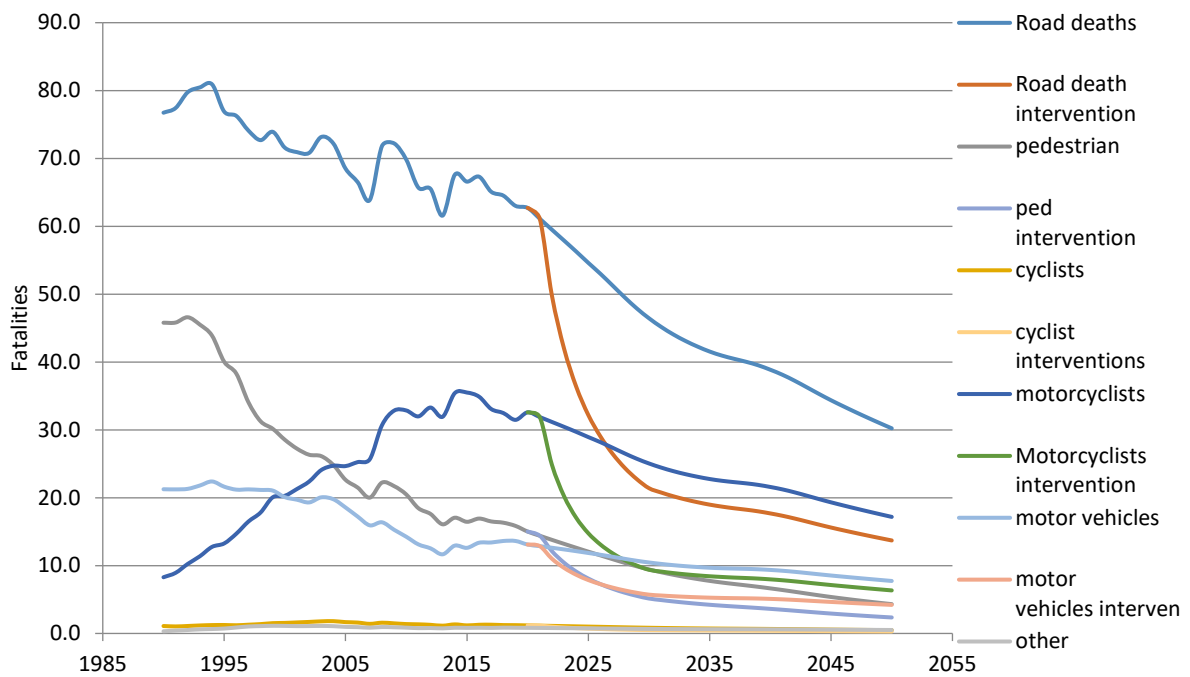


Figure 41: Fatalities rural female 20 to 24 cohorts



### Serious injuries

Consistent with younger cohort, serious injuries in Colombia are forecast to decline substantially from 2020 through to 2050, from 1,830 to 540 for males and from 370 to 20 for females.

Figure 42: Serious and permanent injury total male 20 to 24 cohorts

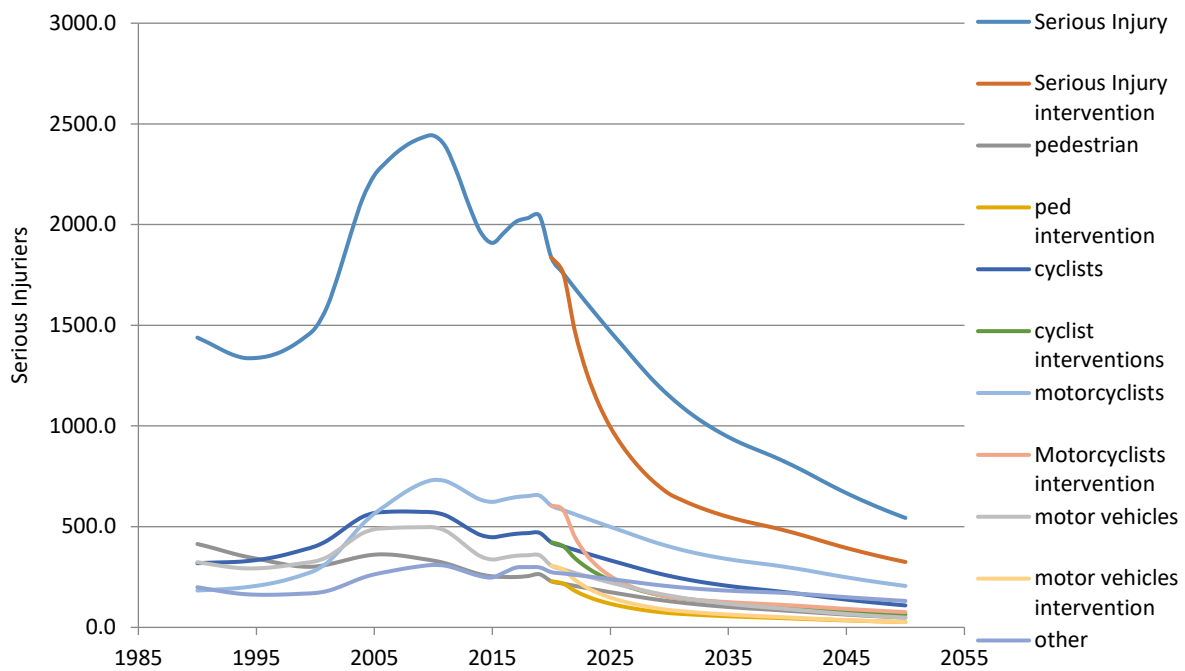
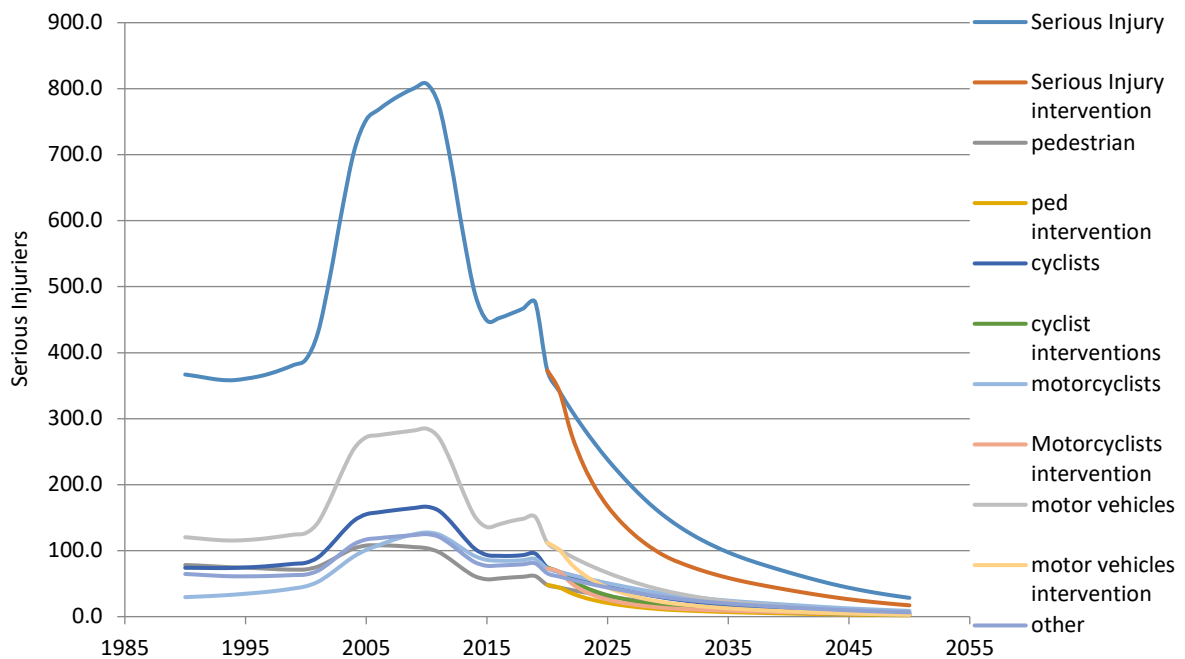


Figure 43: Serious and permanent injury total female 20 to 24 cohorts



### Urban and rural serious injuries

Serious injuries are expected to increase at a substantial rate in urban settings for males, with the same distribution of cyclists, pedestrians and motor vehicle occupants being the main source of serious injuries. Serious injuries in urban settings for females are also expected to increase, but less dramatically out to 2040 then level off. Serious injuries in rural settings are expected to gradually rise for males and gradually decline for females.



Figure 44: Serious and permanent injury urban male 20 to 24 cohorts

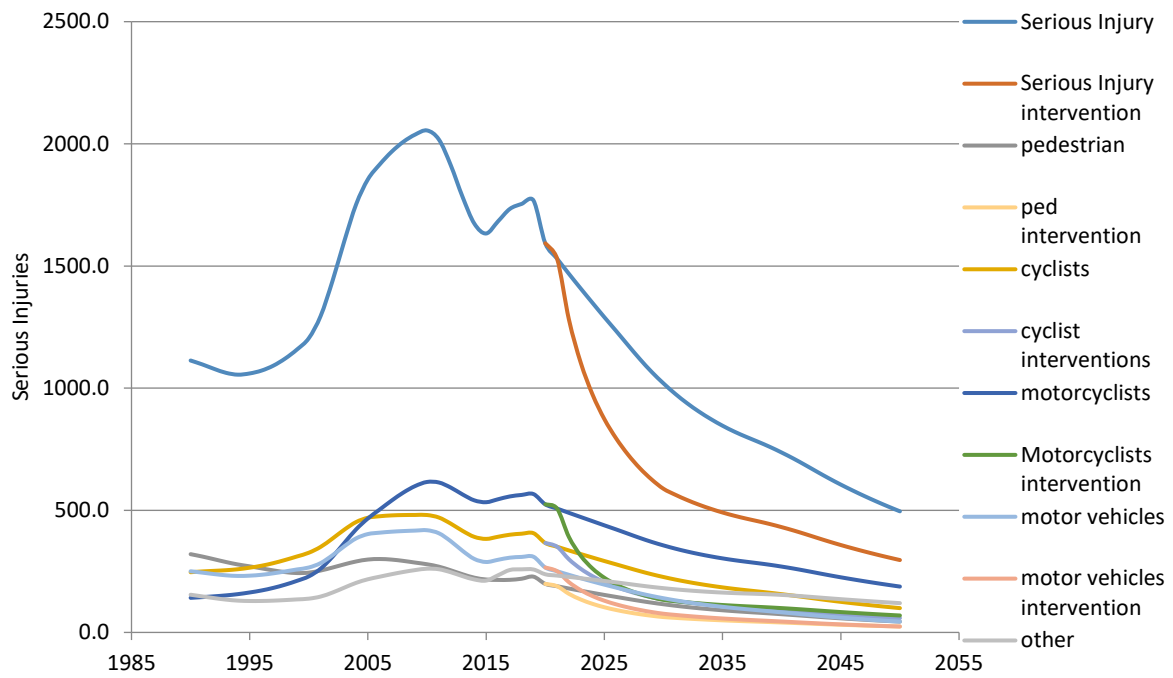


Figure 45: Serious and permanent injury urban female 20 to 24 cohorts

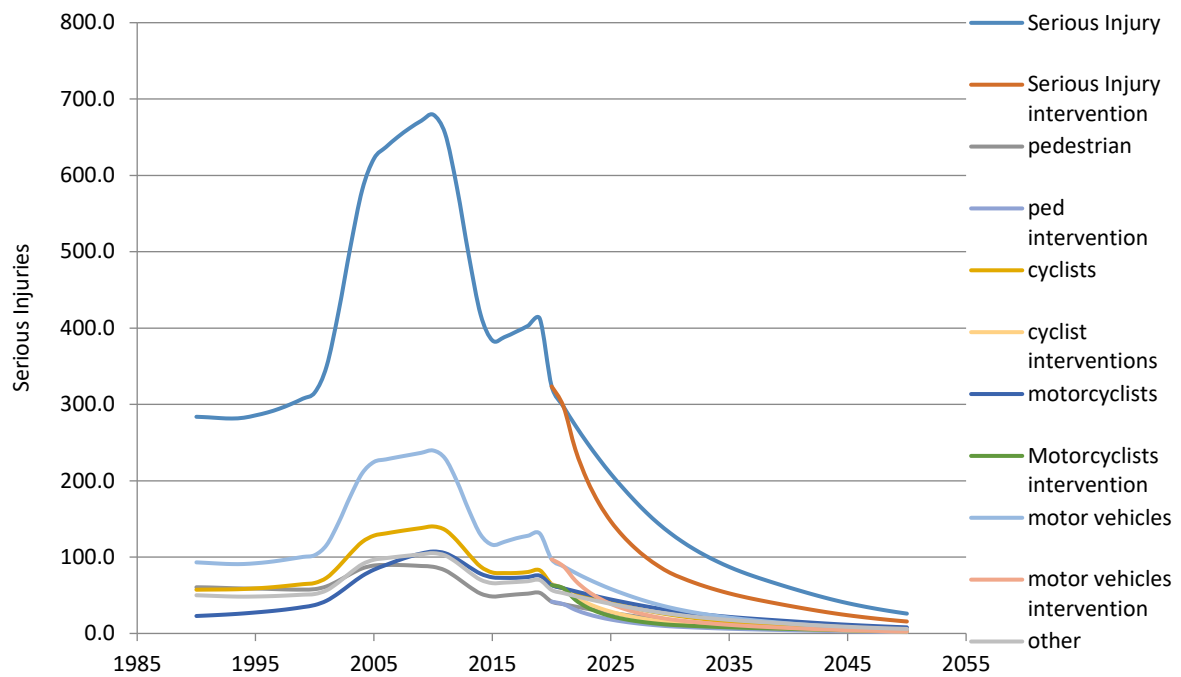


Figure 46: Serious and permanent injury rural male 20 to 24 cohorts

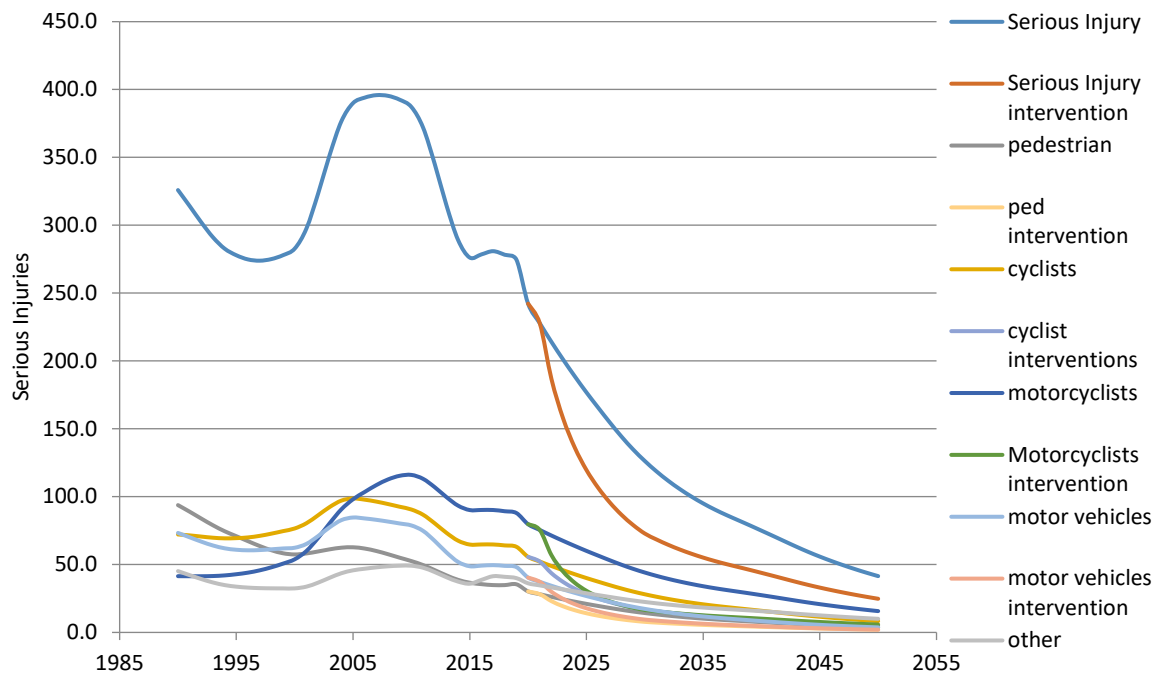
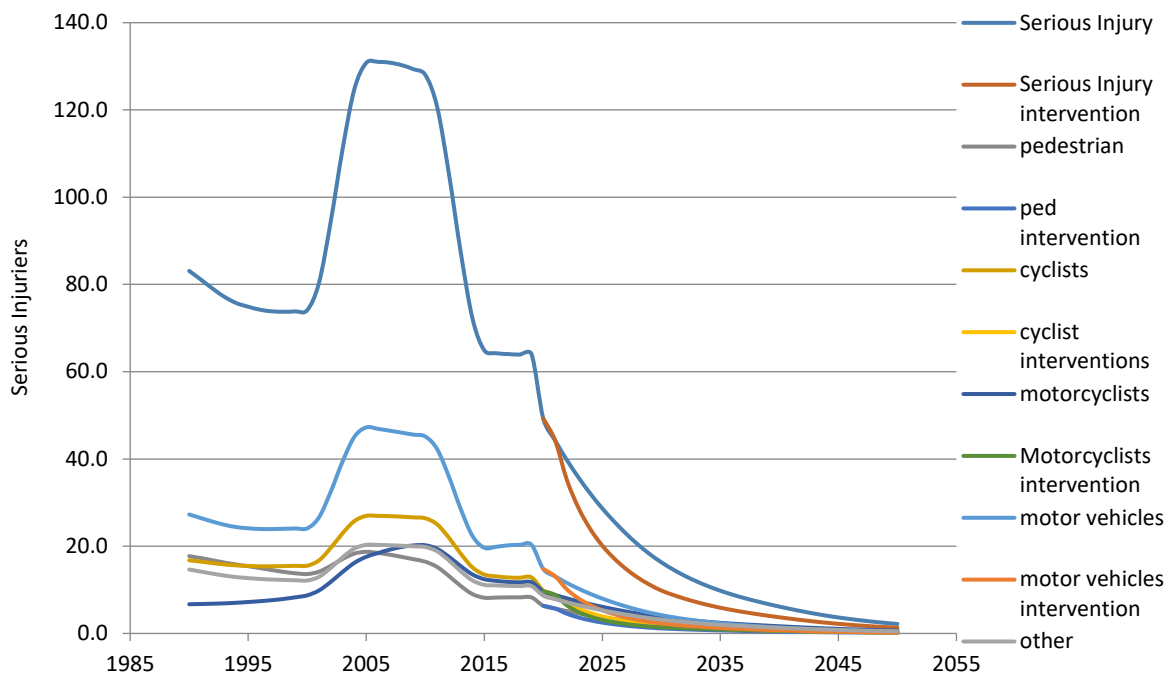


Figure 47: Serious and permanent injury rural female 20 to 24 cohorts



## Economic Analysis and Optimisation Model

The cost of the all interventions was calculated out to 2030, with economic benefits estimated from reduced fatalities and averted serious injuries averted. Net present values were calculated using a 3% discount rate. These calculations are used to estimate benefit-cost ratios (BCRs) for reduced deaths, averted serious injuries, and both deaths and serious injuries for all of Colombia, as well as disaggregated urban and rural results. These results show a BCR for all interventions for the whole country of 1.7. This means that for every \$1 dollar invested, it will return a benefit of \$1.70. When the benefits from serious injuries averted are included, this figure rises to 4.9, i.e., every \$1 dollar invested, gives an economic benefit of \$4.90 (Table ). Given the baseline trend for fatalities to slightly decrease while the baseline serious injuries are expected to increase, this result is expected.

Table 13: Economic benefits all interventions

Benefits		
Economic benefit, million USD (NPV)	Deaths	\$4,584
Economic benefit, million USD (NPV)	Disability	\$8,499
Economic benefit, million USD (NPV)	Deaths plus disability	\$13,083
Cost, million USD (NPV)		\$2,678
Benefit-cost ratio		
Economic benefit	Deaths	1.7
Economic benefit	Deaths plus disability	4.9

When the results are separated into urban and rural areas, this shows a decreased BCR for urban area fatalities (1.3) and marginally decreased BCR when serious injuries are included (4.6) (Table 14). The reverse is true for rural areas with substantially increased BCRs (4.4 and 6.6) (Table 15).

Table 14: Economic benefits urban areas

Benefits		
Economic benefit, million USD (NPV)	Deaths	\$2,875
Economic benefit, million USD (NPV)	Disability	\$7,568
Economic benefit, million USD (NPV)	Deaths plus disability	\$10,444
Cost, million USD (NPV)		\$2,269
Benefit-cost ratio		
Economic benefit	Deaths	1.3
Economic benefit	Deaths plus disability	4.6

Table 15: Economic benefits rural areas

Benefits		
Economic benefit, million USD (NPV)	Deaths	\$1,781
Economic benefit, million USD (NPV)	Disability	\$898
Economic benefit, million USD (NPV)	Deaths plus disability	\$2,679
Cost, million USD (NPV)		\$408
Benefit-cost ratio		
Economic benefit	Deaths	4.4
Economic benefit	Deaths plus disability	6.6

## Optimisation model

As with the other case studies in Tanzania and Vietnam, the optimisation model has been constructed in two ways with different objective functions for each. Firstly, to achieve a certain percentage reduction in fatalities or serious injuries at minimum cost, secondly, for a given financial constraint, and minimise fatalities or serious injuries. For Colombia, a 50% reduction was specified for fatalities and a 40% serious injuries, and 0.15% of GDP for the second objective function. A lower target was specified for serious injuries for Colombia (40%) than the other case studies, as the trend for serious injuries is already steeply declining and the interventions are not able to achieve a 50% reduction by 2030.

### *Minimise cost for percentage reduction model*

With a 50% reduction in fatalities goal achieved with least cost, the optimisation model selected the following interventions to achieve that figure:

- motorcycle helmet enforcement;
- alcohol enforcement;
- motorcycle infrastructure;
- cycling infrastructure;
- speed enforcement;
- public awareness campaigns; and
- graduated licensing scheme.

The multiplicative nature of the interventions means that each added intervention has a diminishing return, and consequently only two interventions can achieve most of the reduction shown. All the other interventions only achieve an additional 10% reduction in fatalities.

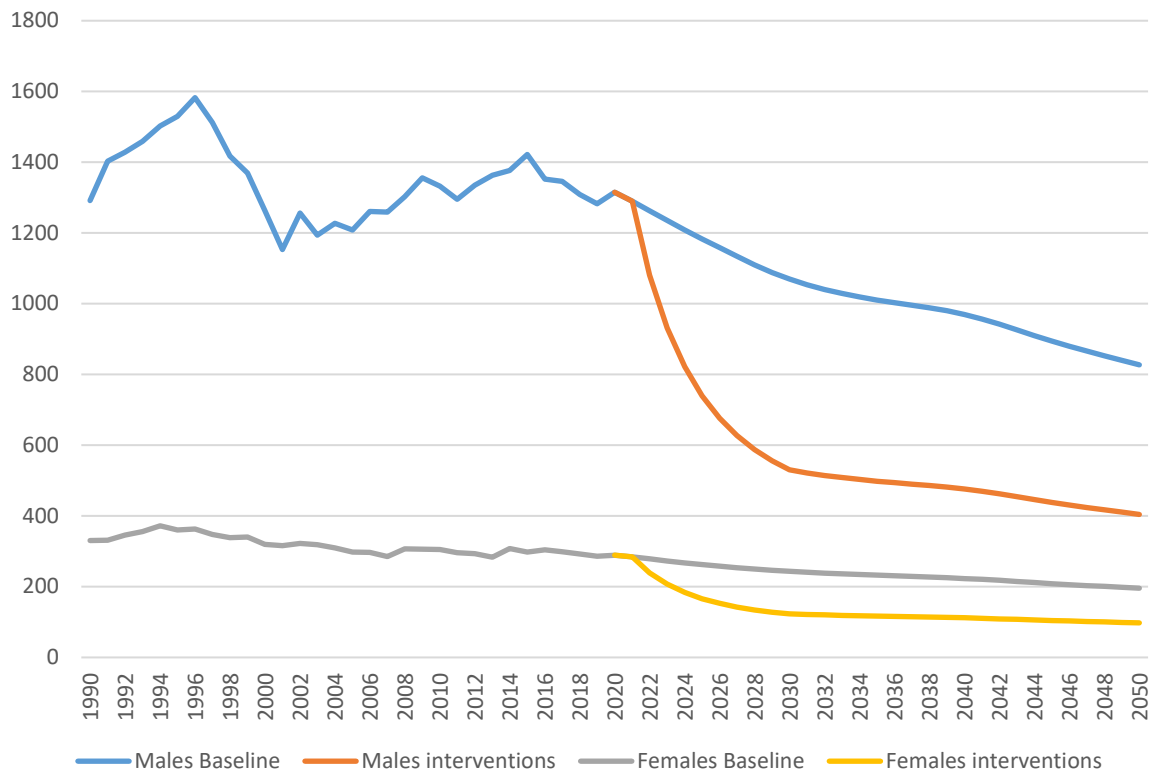
This optimisation solution achieves a 50.2% reduction in fatalities in 2030 from 1,312 to 653, with a BCR of 3.8 for fatalities and 9.8 when serious injuries are included (Table 16 and Figure 48).

It should be noted that while the goal of this configuration of the model has reduced fatalities as a goal, the interventions also reduce serious injuries, in this case a 34.2% reduction.

*Table 16: Minimise cost with 50% reduction in fatalities*

Benefits		
Economic benefit, million USD (NPV)	Deaths	\$4,350
Economic benefit, million USD (NPV)	Disability	\$6,854
Economic benefit, million USD (NPV)	Deaths plus disability	\$11,204
Cost, million USD (NPV)		\$1,149
Benefit-cost ratio		
Economic benefit	Deaths	3.8
Economic benefit	Deaths plus disability	9.8

Figure 48: Minimise cost with 50% reduction in fatalities graph



With a 40% reduction in serious injuries goal achieved with least cost, the optimisation model selected the following interventions to achieve that figure:

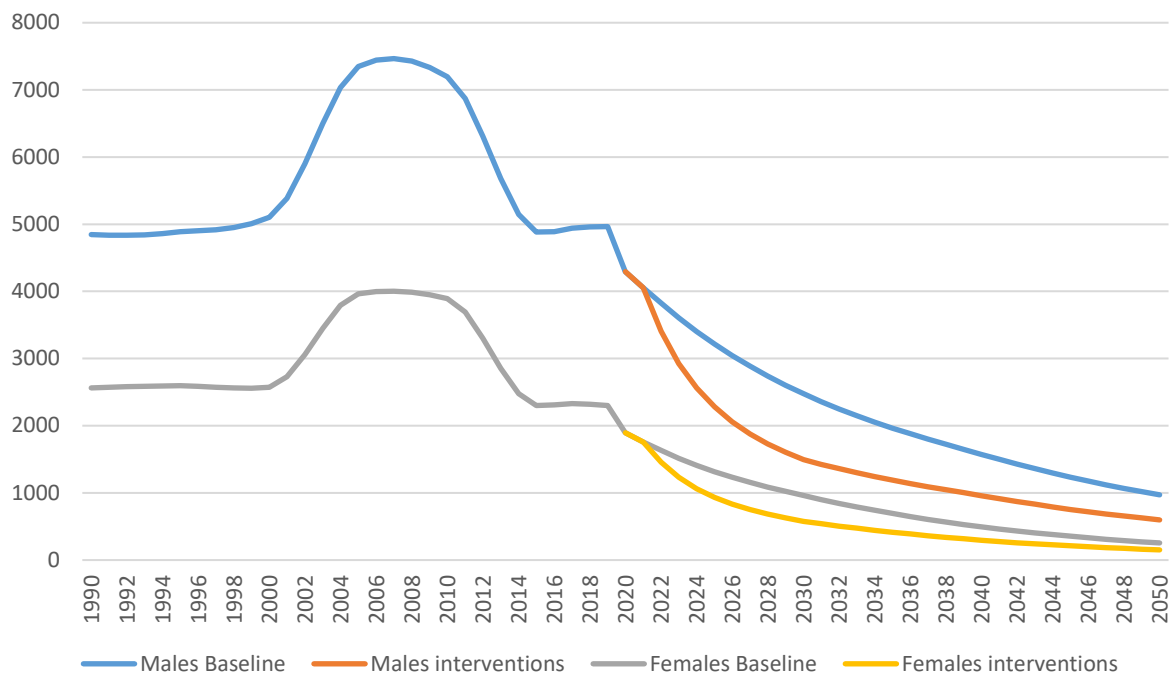
- alcohol enforcement;
- motor cycle infrastructure;
- cyclist infrastructure;
- pedestrian infrastructure;
- speed enforcement;
- public awareness campaigns; and
- graduated licensing scheme.

This optimisation solution achieves a 40.0% reduction in serious injuries by 2030 from a projected 3,436 to 2,072 serious injuries with BCRs of 3.6 and 10.2. These interventions also reduced the forecast number of fatalities by 39.2% from a projected 1,312 to 653 (Table 17 and Figure 49).

Table 17: Minimise cost with 40% reduction in serious injuries

Benefits		
Economic benefit, million USD (NPV)	Deaths	\$4,341
Economic benefit, million USD (NPV)	Disability	\$7,955
Economic benefit, million USD (NPV)	Deaths plus disability	\$12,296
Cost, million USD (NPV)		\$1,200
Benefit-cost ratio		
Economic benefit	Deaths	3.6
Economic benefit	Deaths plus disability	10.2

Figure 49: Minimise cost with 40% reduction in serious injuries graph



Minimum fatalities/injuries for percentage GDP model

With a constraint of 0.15% of GDP to minimise fatalities goal, the optimisation model selected the following interventions:

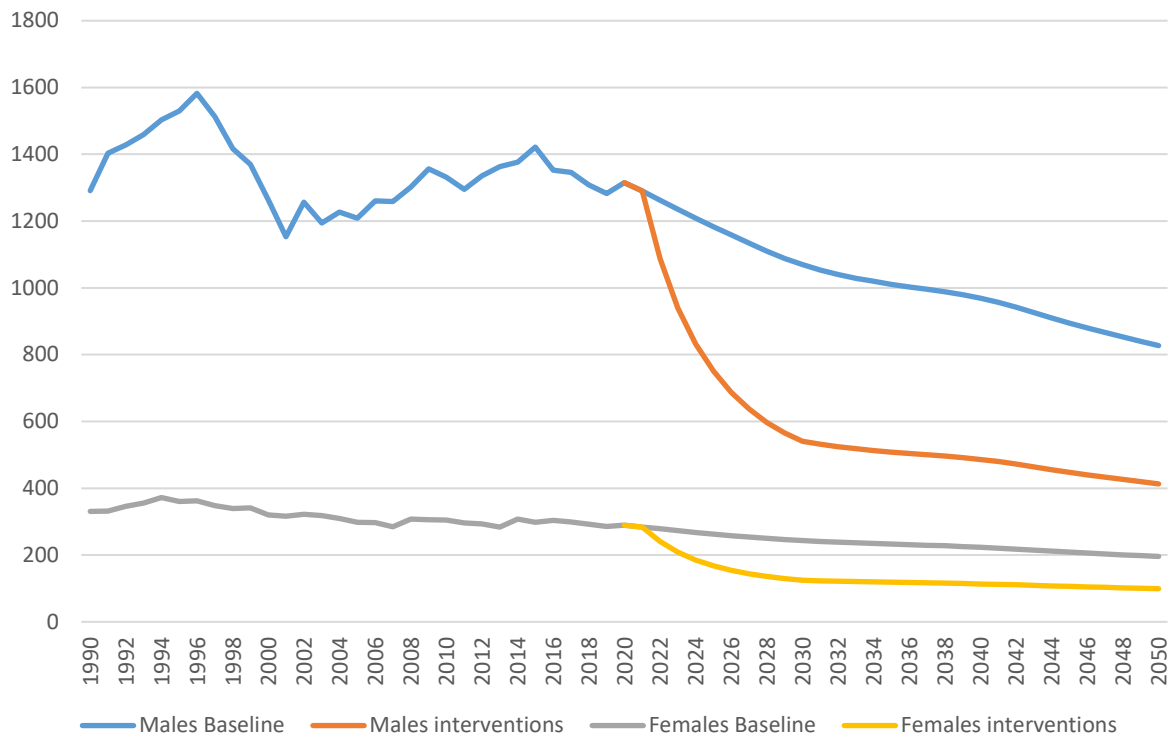
- alcohol enforcement;
- motor cycle infrastructure;
- pedestrian infrastructure;
- speed enforcement;
- public awareness campaigns;
- graduated licensing scheme; and
- car safety standards.

This optimisation solution achieves a 49.4% reduction in fatalities in 2030 from 1,312 to 664 with a BCR of 3.8 for fatalities and 9.8 when serious injuries are included. This solution also reduced serious injuries from 3,436 to 2,271 a 33.9% reduction (Table 18 and Figure 50).

Table 18: Minimise fatalities with 0.15% GDP constraint

Benefits		
Economic benefit, million USD (NPV)	Deaths	\$4,266
Economic benefit, million USD (NPV)	Disability	\$6,787
Economic benefit, million USD (NPV)	Deaths plus disability	\$11,053
Cost, million USD (NPV)		\$1,127
Benefit-cost ratio		
Economic benefit	Deaths	3.8
Economic benefit	Deaths plus disability	9.8

Figure 50: Fatalities with 0.15% GDP constraint



With a constraint of 0.15% of GDP to minimise serious injuries goal, the optimisation model selected the following interventions:

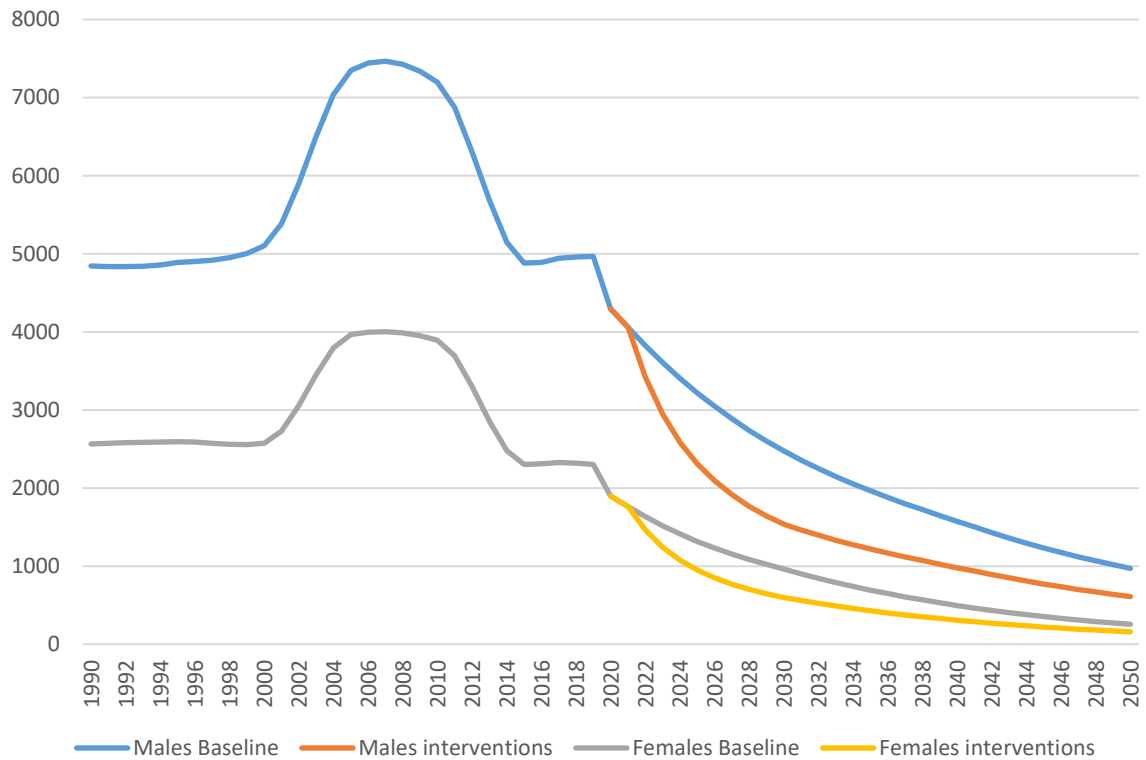
- motorcycle helmets;
- alcohol limit enforcement;
- motorcycle infrastructure;
- cyclist infrastructure;
- speed enforcement;
- public awareness campaigns;
- graduated licensing scheme;
- seat belt enforcement; and
- car safety standards.

This optimisation solution achieves a 38.0% reduction in serious injuries by 2030 from 3,436 to 2,129 with a BCR of 4.3 for fatalities and 12.3 when serious injuries are included. This solution also reduced serious injuries from 1,312 to 684, a 47.9% reduction (Table 19 and Figure 51).

Table 19: Minimise serious injuries with a 0.15% GDP constraint

Benefits		
Economic benefit, million USD (NPV)	Deaths	\$4,174
Economic benefit, million USD (NPV)	Disability	\$7,638
Economic benefit, million USD (NPV)	Deaths plus disability	\$11,812
Cost, million USD (NPV)		\$963
Benefit-cost ratio		
Economic benefit	Deaths	4.3
Economic benefit	Deaths plus disability	12.3

Figure 51: Serious injuries with a 0.15% GDP constraint





## Summary and Conclusion

This case study has drawn upon available evidence from both published research, survey work and intervention programs undertaken in Colombia by the WHO and the National Road Safety Agency (ANSV).

The baseline trend for combined male and female road fatalities for the 10 to 24 cohort in Colombia is expected to be one of gradual decline out to 2050 from 1,600 per annum to just over 1,000. However, when all the interventions are modelled, this reduces this figure to 570 by 2030 and 430 by 2050 (Figure 8).

The forecast for males and females aged 10 to 24 road fatalities differs in the absolute number, while both are forecast to decline by approximately one third. This is consistent with all countries where there are a much greater number of road fatalities for males than females.

Serious injuries for 10 to 24 year olds in Colombia are forecast to decline rapidly in the next few decades, albeit from a high figure than fatalities. The peak occurred in 2007 with 11,500 serious injuries that has declined to 6,200 by 2020. The trend indicates serious injuries will reduce to 3,400 by 2030 and 1,200 by 2050. Due to the projected decline in serious injuries, the effect of interventions are not nearly as significant with interventions serious injuries expected to be 2000 by 2030 (down from 3,400) and 700 in 2050 (down from 1,200).

Individual cohorts differ somewhat in that the 10 to 14 cohort has a much greater number of pedestrian fatalities than the older cohorts, while all other modes are equally represented in fatalities for this cohort.

Serious injuries for 10 to 14 year olds show the same declining trend as fatalities, but with much greater numbers with the peak figure being nearly eight times higher. However, the ratio between male and female serious injuries is much more even than for fatalities, being nearly 1:1 in 2020, as well as the majority of serious injuries occurring to cyclists rather than pedestrians. This is more so the case with males, whereas with females pedestrians and cyclists are more evenly represented.

Road fatalities for the 15 to 19 age cohort in Colombia differ significantly from the 10 to 14 year olds, with the primary mode for fatalities being motor cyclists which have increased substantially from 1990 to 2015. The same trend is found for both males and females, though the increase in motorcycle fatalities and decrease in pedestrian fatalities occurred at a slower rate for females. The number of male deaths is also substantially larger comparatively than the 10 to 14 year olds, whereas for 10 to 14 year olds male fatalities are approximately double female; for 15 to 19 year olds this figure is over three times. The full set of interventions have a substantial effect on fatalities with these figures projected to decline to 118 in 2030 and 90 in 2050 for males, while for females these reduce to 37 in 2030 and 30 in 2050.

As with baseline serious injuries for 10 to 14 year olds, serious injuries for both 15 to 19 males and females are expected to decline substantially out to 2050. For males, the baseline is forecast to reduce from 1,500 in 2020 to 825 (2030) and then to 315 (2050). For females these figures are 600 (2020) to 240 (2030), and then to 60 (2050). As with the 10 to 14 cohort, males again have much higher numbers than females where the main modes responsible for these serious injuries differ between males and females and from the 10 to 14 cohort. For males in the 15 to 19 cohort, the primary modes for serious injuries are cyclists, while for females it is motor vehicle occupants and who bear the majority of serious injuries.

Fatalities in the 20 to 24 age cohort are also forecast to decline for both males and females. As with the 15 to 19 cohort, there is a large discrepancy between male and female fatalities, where there are over six times as many male fatalities per annum compared to females. While motorcyclists represent the majority of fatalities for both males and females, they make up a larger percentage for males than females. Consistent with younger cohort, serious injuries in Colombia are forecast to decline substantially from 2020 through to 2050.

The cost of all the interventions was calculated out to 2030 with economic benefits estimated from reduced fatalities and averted serious injuries. Net present values were calculated using a 3% discount rate. These results show a BCR for all interventions for the whole country of 1.7. This means that for every \$1 dollar invested, it will return an economic benefit of \$1.70. When the benefits from serious injuries averted are included, this figure rises to 4.9, i.e., for every \$1 dollar invested, it will return an economic benefit of \$4.90 (Table 13). Four versions of the optimisation model were allied for Colombia showing greater BCRs for fatalities (3.6–4.3) and combined fatalities and serious injuries (9.8–12.3).

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Vissers, L. H. (2017). Alcohol-related road casualties in official crash statistics. Paris, International Transport Forum ITF, International Traffic Safety Data and Analysis Group

WHO (2018). Global status report on road safety 2018. Geneva, World Health Organization; 2018. Licence: CC BYNC- SA 3.0 IGO.

World Bank 2021, Global Road Safety Facility, <https://www.roadsafetyfacility.org/>

## Appendix 1: Number of Fatalities

Table 20: Baseline and intervention fatalities

Year	Males and females	
	Baseline	Interventions
1990	1622	
1991	1735	
1992	1774	
1993	1815	
1994	1875	
1995	1891	
1996	1945	
1997	1860	
1998	1756	
1999	1711	
2000	1584	
2001	1469	
2002	1579	
2003	1513	
2004	1537	
2005	1506	
2006	1558	
2007	1544	
2008	1609	
2009	1662	
2010	1637	
2011	1591	
2012	1628	
2013	1646	
2014	1685	
2015	1720	
2016	1656	
2017	1645	
2018	1601	
2019	1569	
2020	1604	1604
2021	1574	1574
2022	1541	1272
2023	1508	1067
2024	1476	923
2025	1445	818
2026	1416	741
2027	1387	682
2028	1360	635
2029	1334	599
2030	1313	570
2031	1294	560
2032	1278	552
2033	1265	545
2034	1254	538
2035	1243	533
2036	1234	528
2037	1225	523
2038	1216	519
2039	1205	514

2040	1192	508
2041	1178	501
2042	1160	493
2043	1141	485
2044	1122	476
2045	1103	468
2046	1086	460
2047	1069	452
2048	1053	445
2049	1038	438
2050	1023	432

Table 21: Baseline and intervention fatalities male and female

Year	Males		Females	
	Baseline	Interventions	Baseline	Interventions
1990	1291		331	
1991	1403		332	
1992	1428		346	
1993	1459		356	
1994	1503		372	
1995	1530		361	
1996	1583		363	
1997	1512		348	
1998	1417		339	
1999	1370		341	
2000	1264		320	
2001	1153		316	
2002	1257		322	
2003	1194		319	
2004	1227		310	
2005	1208		298	
2006	1261		297	
2007	1259		285	
2008	1302		307	
2009	1356		306	
2010	1332		305	
2011	1295		296	
2012	1335		293	
2013	1363		283	
2014	1377		308	
2015	1422		298	
2016	1352		304	
2017	1346		299	
2018	1308		292	
2019	1283		286	
2020	1315	1315	289	289
2021	1290	1290	284	284
2022	1263	1040	278	232
2023	1235	871	273	196
2024	1208	752	267	171
2025	1183	666	262	153
2026	1158	602	258	139
2027	1134	553	254	129
2028	1110	514	250	121
2029	1088	484	246	115

2030	1070	461	243	110
2031	1053	452	240	108
2032	1040	445	238	107
2033	1029	439	236	106
2034	1019	434	235	105
2035	1011	429	233	104
2036	1003	425	231	103
2037	995	421	229	102
2038	988	418	228	101
2039	980	414	226	100
2040	969	409	223	99
2041	957	403	221	98
2042	942	397	218	96
2043	926	390	215	95
2044	910	382	212	93
2045	895	376	209	92
2046	880	369	206	91
2047	866	363	203	90
2048	853	357	201	88
2049	840	351	198	87
2050	827	346	196	86

## Appendix 2: Number of Serious Injuries

Table 22: Baseline and intervention serious injuries

Year	Males and females	
	Baseline	Interventions
1990	7410	
1991	7412	
1992	7415	
1993	7425	
1994	7448	
1995	7483	
1996	7490	
1997	7493	
1998	7511	
1999	7563	
2000	7675	
2001	8112	
2002	8954	
2003	9948	
2004	10829	
2005	11313	
2006	11437	
2007	11468	
2008	11414	
2009	11284	
2010	11090	
2011	10564	
2012	9610	
2013	8531	
2014	7625	
2015	7185	
2016	7202	
2017	7270	
2018	7278	
2019	7269	
2020	6189	6189
2021	5815	5815
2022	5458	4779
2023	5123	4037
2024	4813	3490
2025	4532	3077
2026	4278	2757
2027	4042	2501
2028	3825	2291
2029	3623	2115
2030	3435	1965
2031	3258	1862
2032	3093	1766
2033	2939	1677
2034	2794	1594
2035	2657	1515
2036	2528	1442
2037	2406	1372
2038	2289	1306
2039	2177	1243
2040	2069	1181
2041	1964	1122
2042	1863	1065
2043	1765	1010

2044	1673	957
2045	1586	908
2046	1505	862
2047	1429	819
2048	1357	779
2049	1290	741
2050	1226	705

Table 23: Baseline and intervention serious injuries male and female

Year	Males		Females	
	Baseline	Interventions	Baseline	Interventions
1990	4845		2564	
1991	4838		2574	
1992	4835		2580	
1993	4840		2585	
1994	4858		2590	
1995	4889		2594	
1996	4902		2588	
1997	4919		2574	
1998	4950		2561	
1999	5006		2557	
2000	5101		2574	
2001	5384		2728	
2002	5898		3056	
2003	6498		3450	
2004	7036		3793	
2005	7348		3965	
2006	7442		3995	
2007	7466		4002	
2008	7428		3987	
2009	7335		3949	
2010	7198		3892	
2011	6872		3692	
2012	6309		3301	
2013	5679		2852	
2014	5148		2477	
2015	4882		2303	
2016	4891		2311	
2017	4942		2328	
2018	4959		2319	
2019	4966		2303	
2020	4294	4294	1895	1895
2021	4055	4055	1760	1760
2022	3825	3344	1633	1435
2023	3606	2836	1517	1202
2024	3403	2461	1410	1029
2025	3217	2179	1315	898
2026	3046	1960	1231	798
2027	2887	1783	1155	718
2028	2739	1638	1086	652
2029	2602	1518	1022	597
2030	2476	1416	960	549
2031	2357	1347	901	514
2032	2249	1285	844	482
2033	2148	1227	791	450



2034	2054	1173	740	421
2035	1964	1122	692	394
2036	1880	1074	648	368
2037	1799	1028	606	344
2038	1723	985	567	321
2039	1648	943	530	300
2040	1574	901	495	280
2041	1501	860	463	262
2042	1430	820	433	245
2043	1361	781	405	229
2044	1294	744	379	214
2045	1232	708	354	200
2046	1174	675	331	187
2047	1119	644	310	175
2048	1067	615	291	164
2049	1018	587	272	153
2050	971	561	255	144

## Appendix 3: Transport Mode Trends for Fatalities and Serious Injuries

Trends in fatalities and serious injuries for all modes, both genders and age groups are found from Figure 52 to Figure 111.

Figure 52: 10 to 14 year-old male pedestrian fatality rate per 100,000

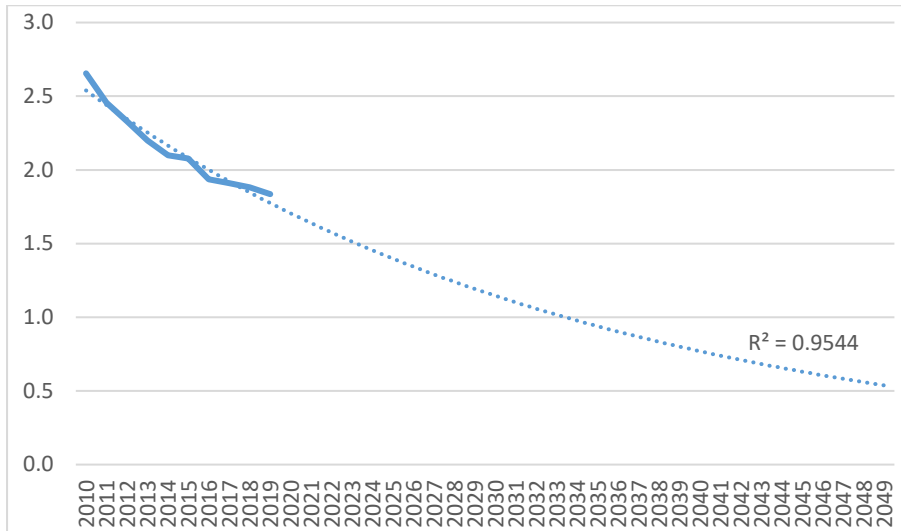


Figure 53: 10 to 14 year-old male cyclists fatality rate per 100,000

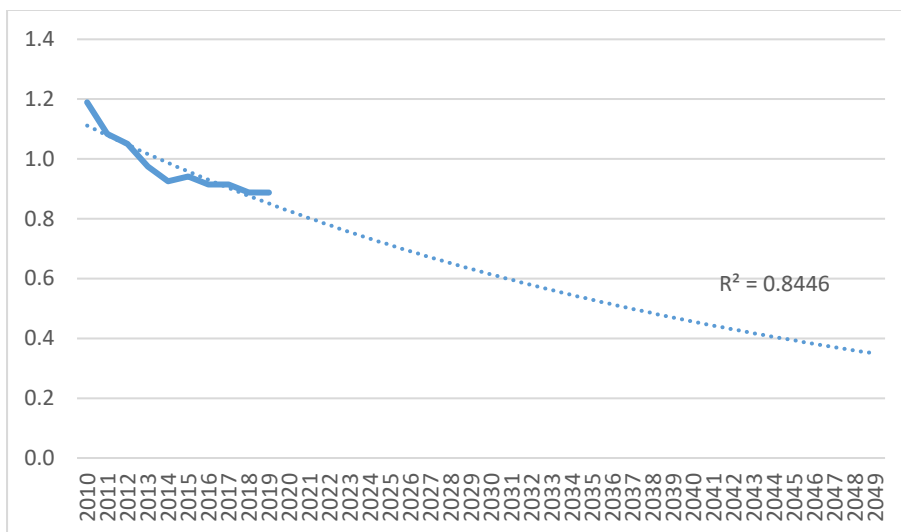


Figure 54: 10 to 14 year-old male motor cyclists fatality rate per 100,000

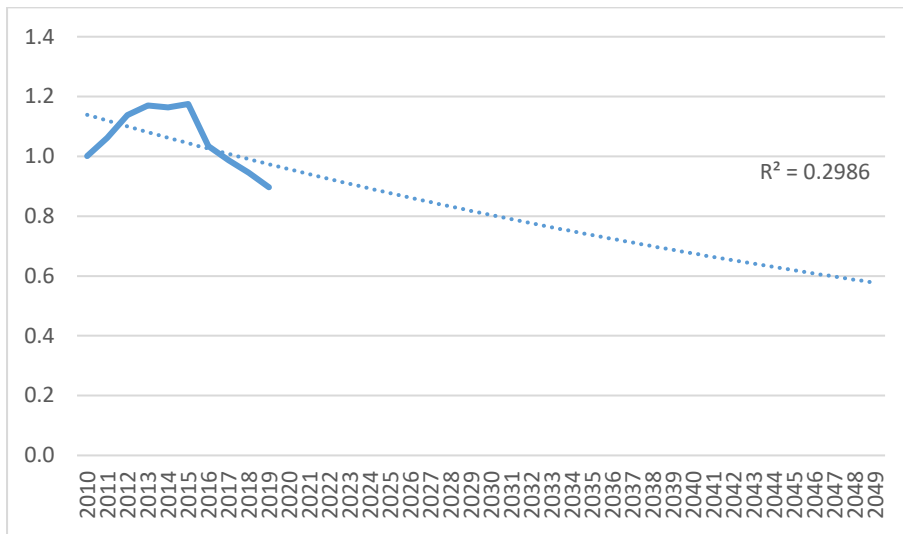


Figure 55: 10 to 14 year-old male motor vehicles fatality rate per 100,000

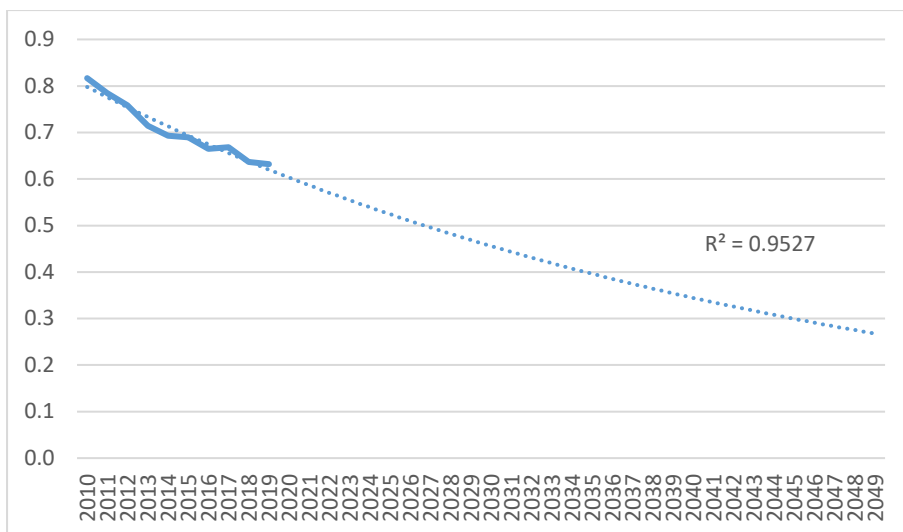


Figure 56: 10 to 14 year-old male other fatality rate per 100,000

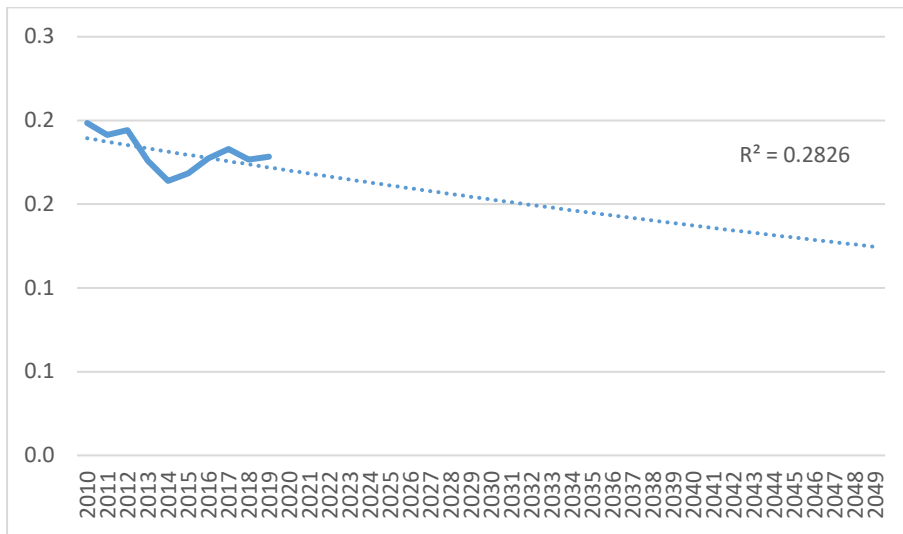


Figure 57: 10 to 14 year-old female pedestrian fatality rate per 100,000

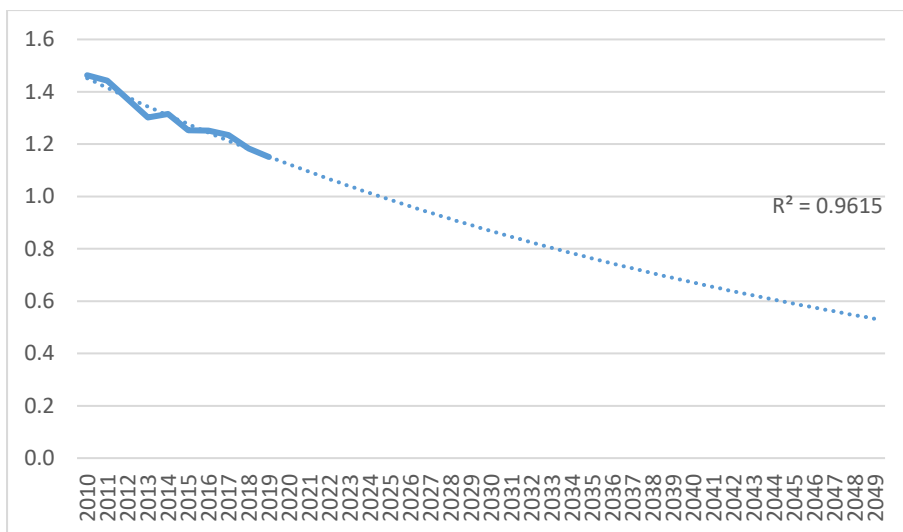


Figure 58: 10 to 14 year-old female cyclists fatality rate per 100,000

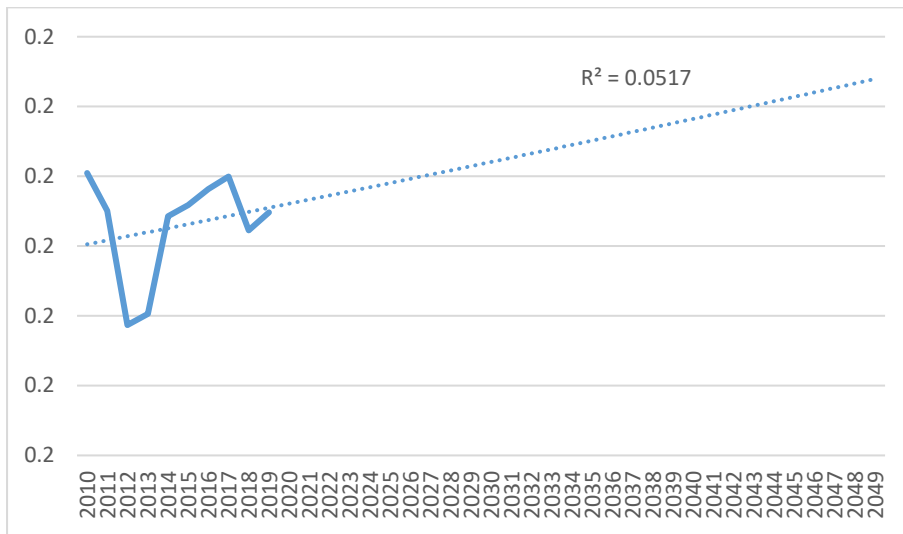


Figure 59: 10 to 14 year-old female motor cyclists fatality rate per 100,000

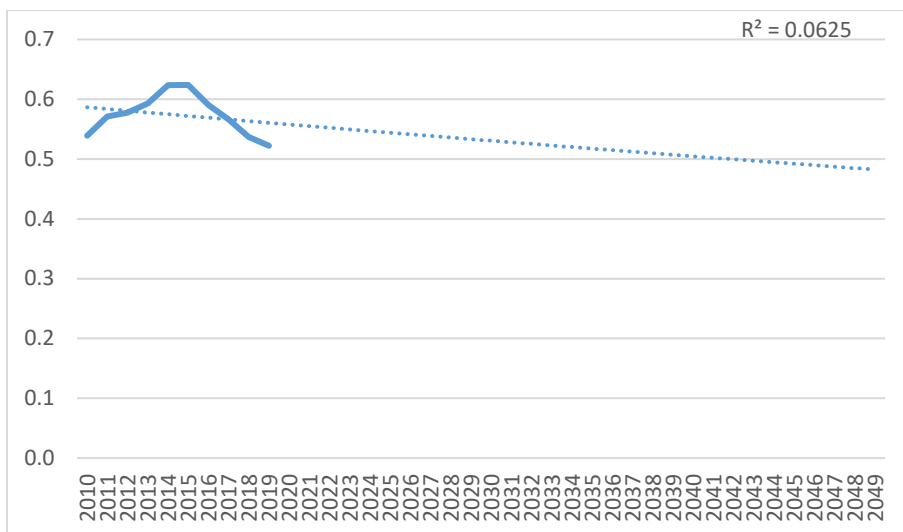


Figure 60: 10 to 14 year-old female motor vehicles fatality rate per 100,000

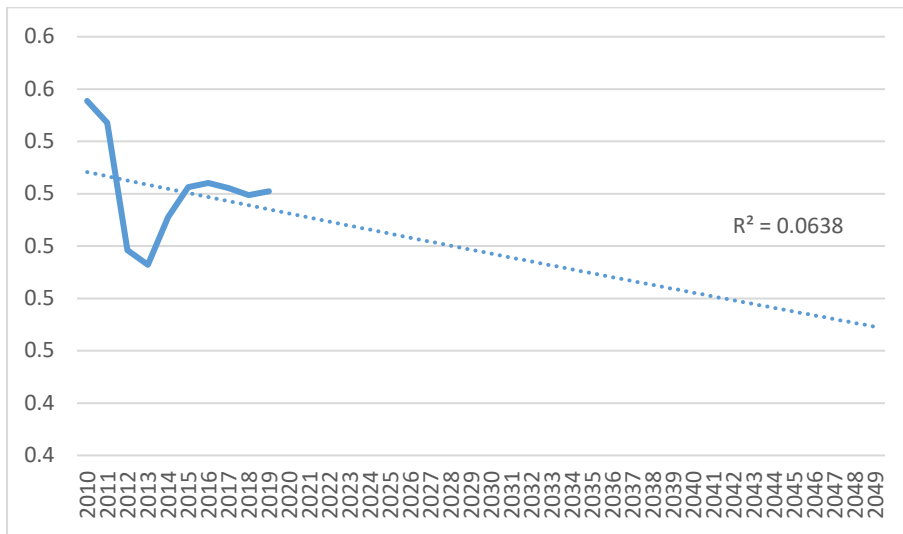


Figure 61: 10 to 14 year-old female other fatality rate per 100,000

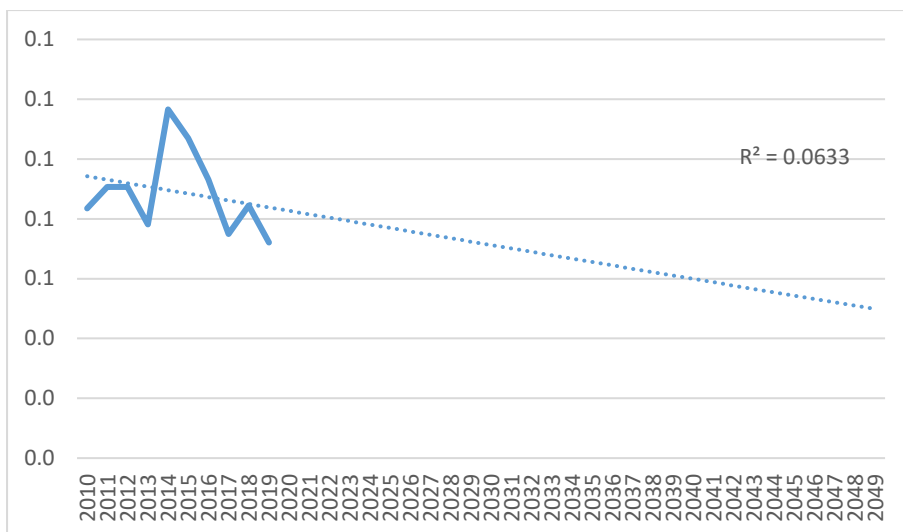


Figure 62: Serious and permanent injury pedestrians males 10 to 14 years old per 100,000

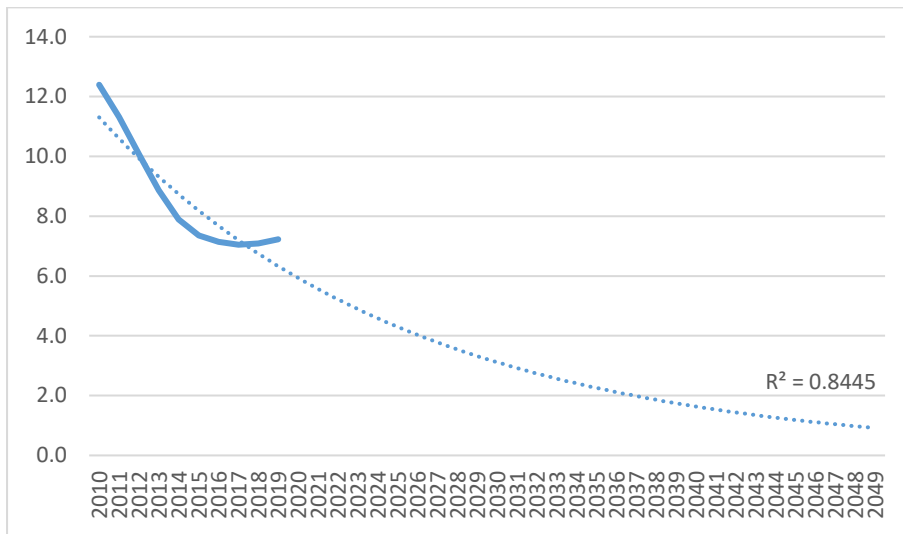


Figure 63: Serious and permanent disability cyclists males 10 to 14 year-old per 100,000

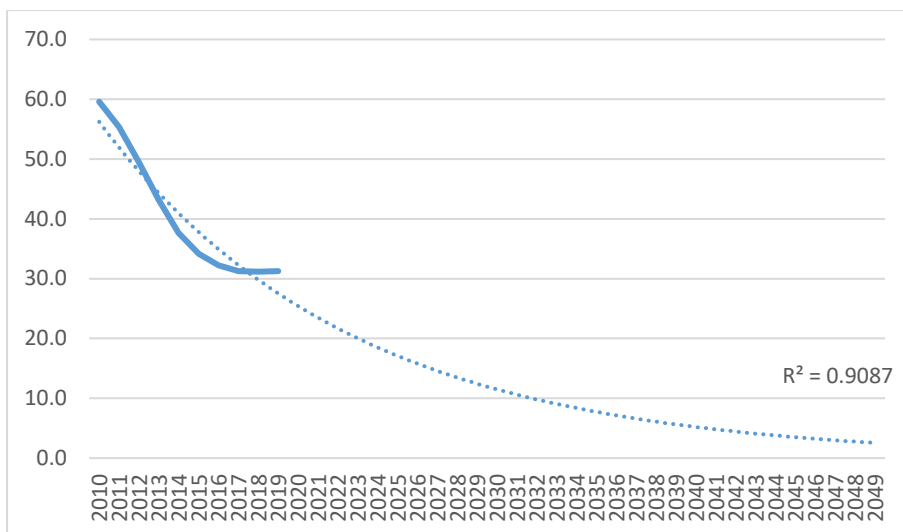


Figure 64: Serious and permanent disability motor cyclists males 10 to 14 year olds per 100,000

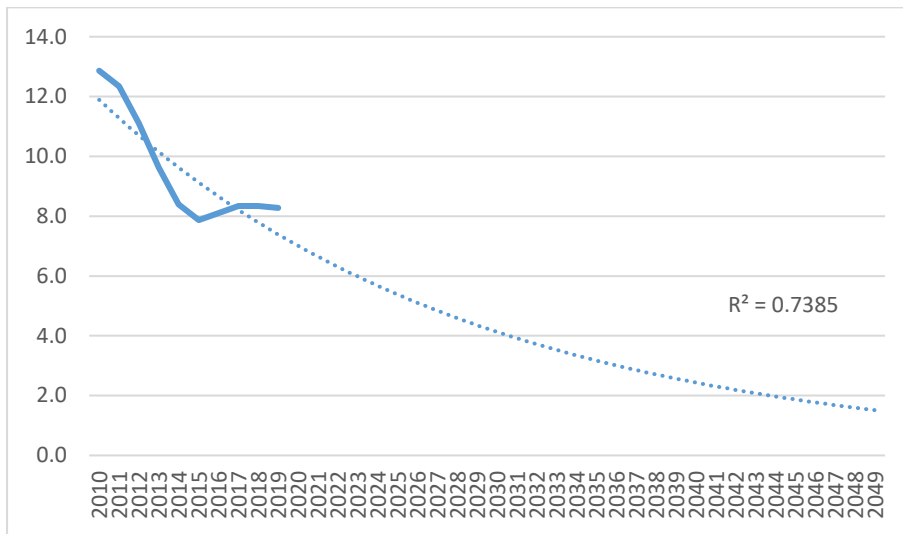


Figure 65: Serious and permanent disability motor vehicles males 10 to 14 years old, per 100,000

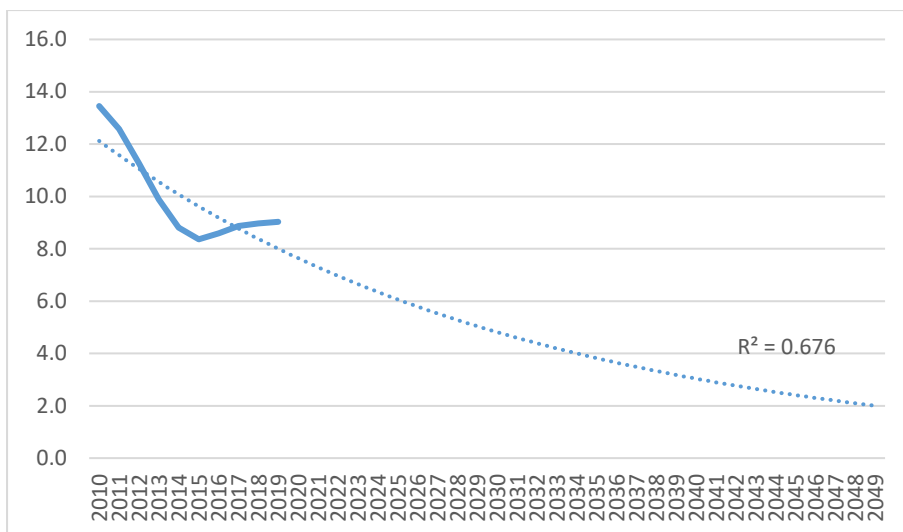




Figure 66: Serious and permanent disability other males 10 to 14 years old per 100,000

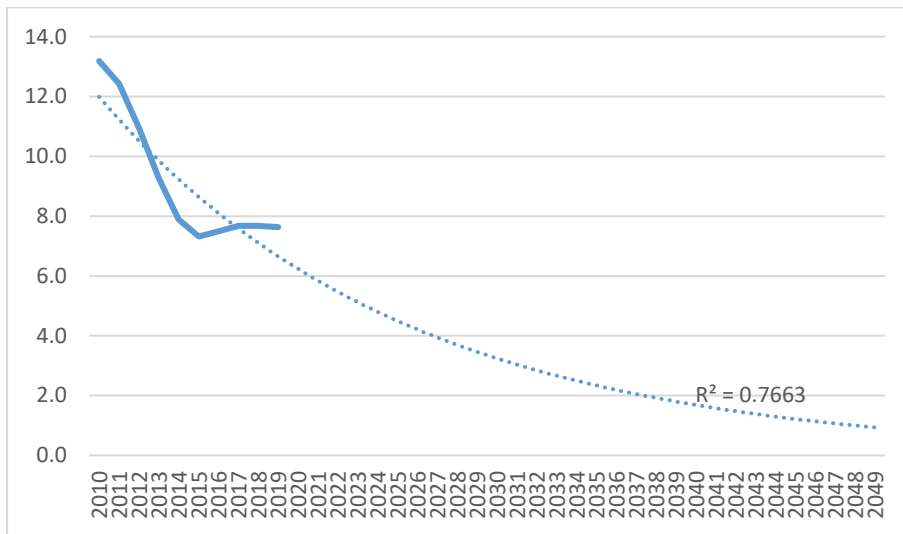


Figure 67: 10 to 14 year-old female pedestrian serious injury rate per 100,000

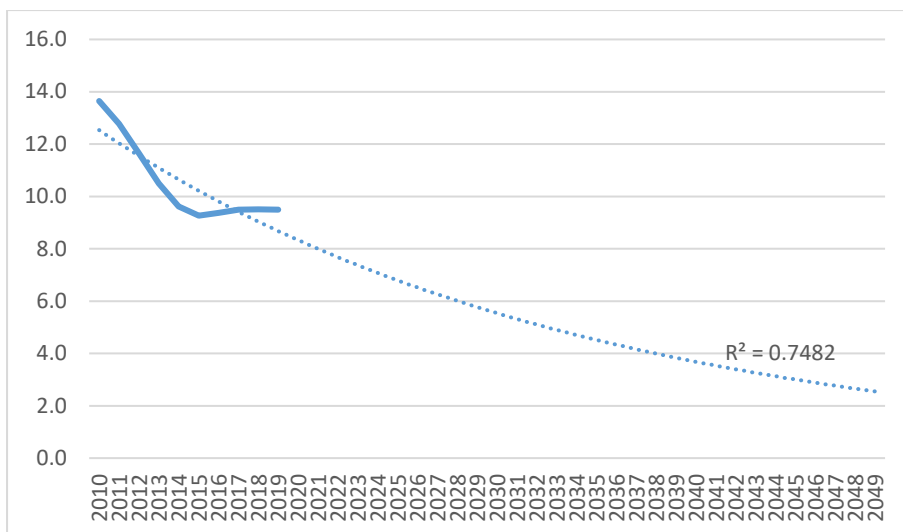


Figure 68: 10 to 14 year-old female cyclists serious injury rate per 100,000

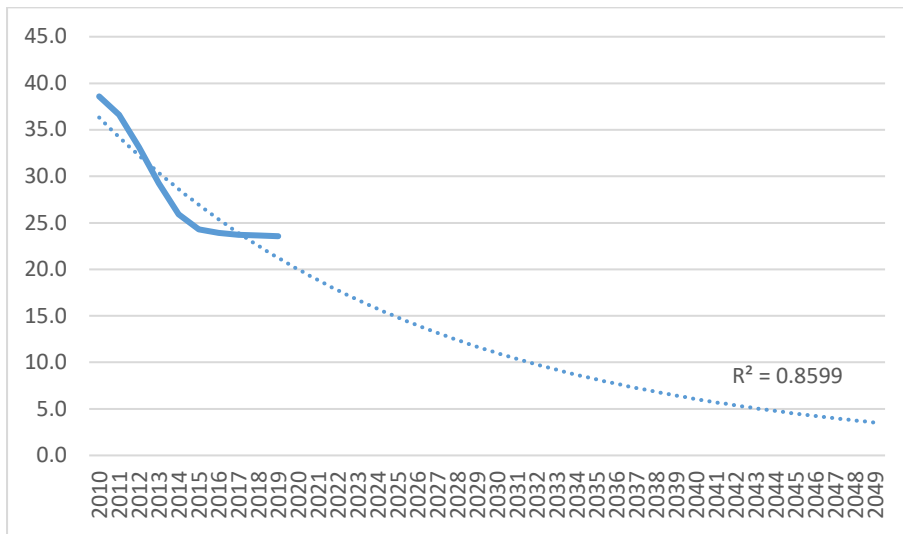


Figure 69: 10 to 14 year-old female motor cyclists serious injury rate per 100,000

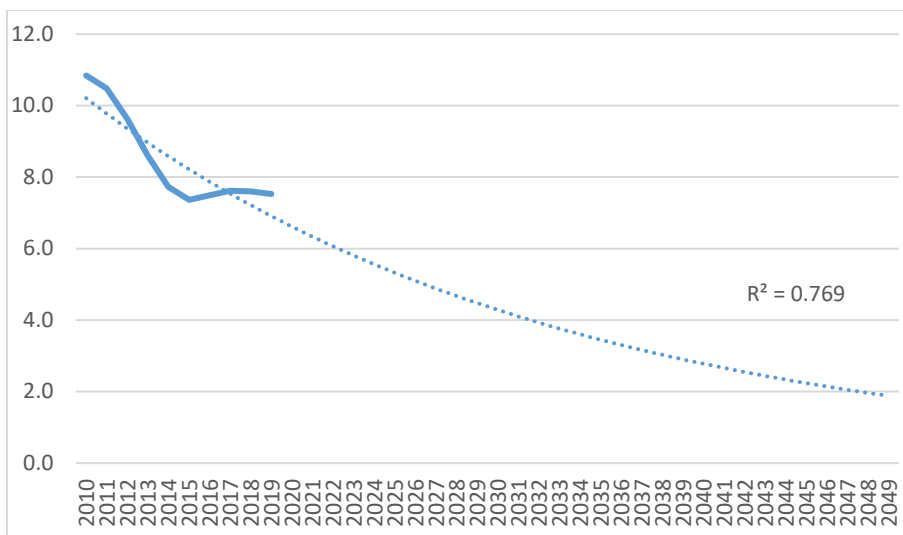


Figure 70: 10 to 14 year-old female motor vehicles serious injury rate per 100,000

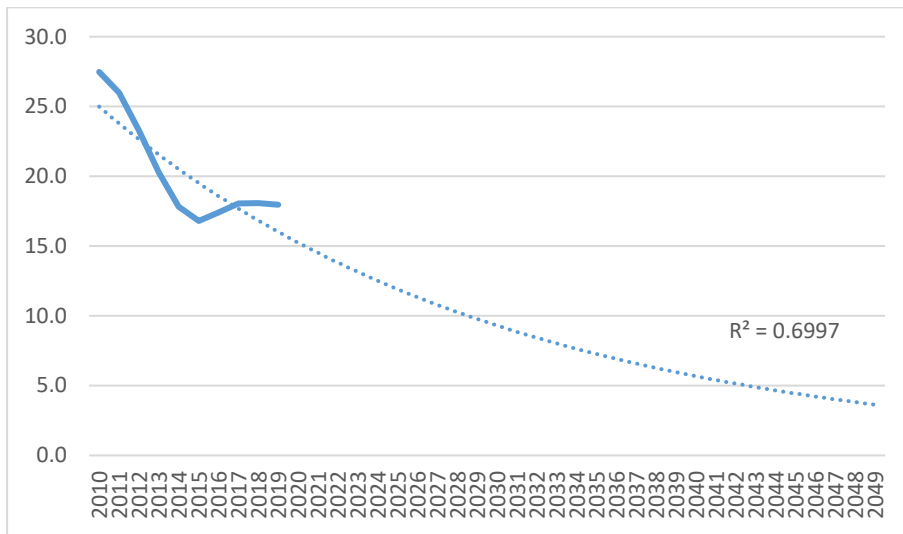


Figure 71: 10 to 14 year-old female other serious injury rate per 100,000

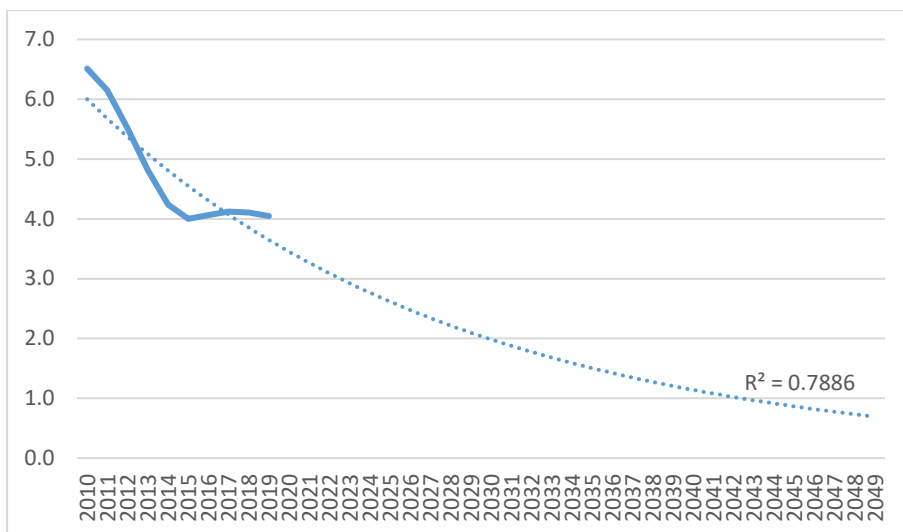


Figure 72: 15 to 19 year-old male pedestrian fatality rate per 100,000

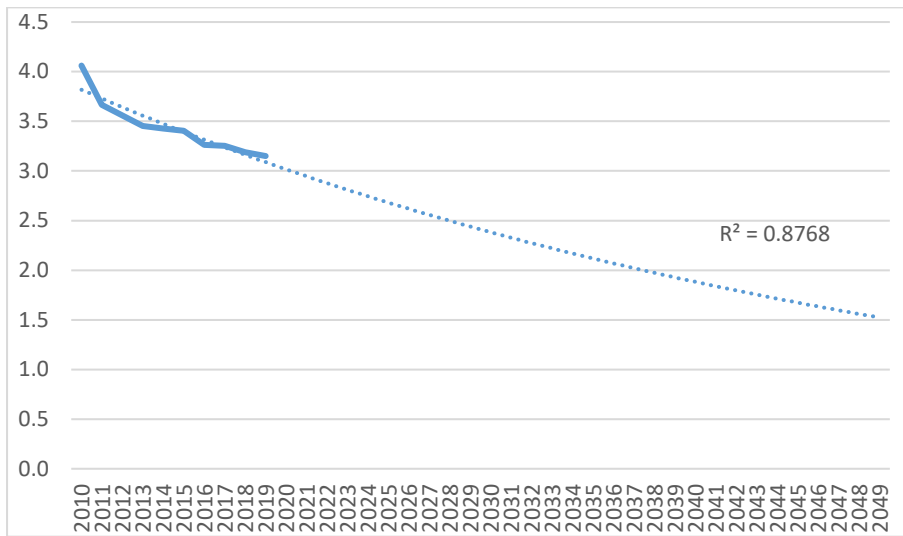


Figure 73: 15 to 19 year-old male cyclists fatality rate per 100,000

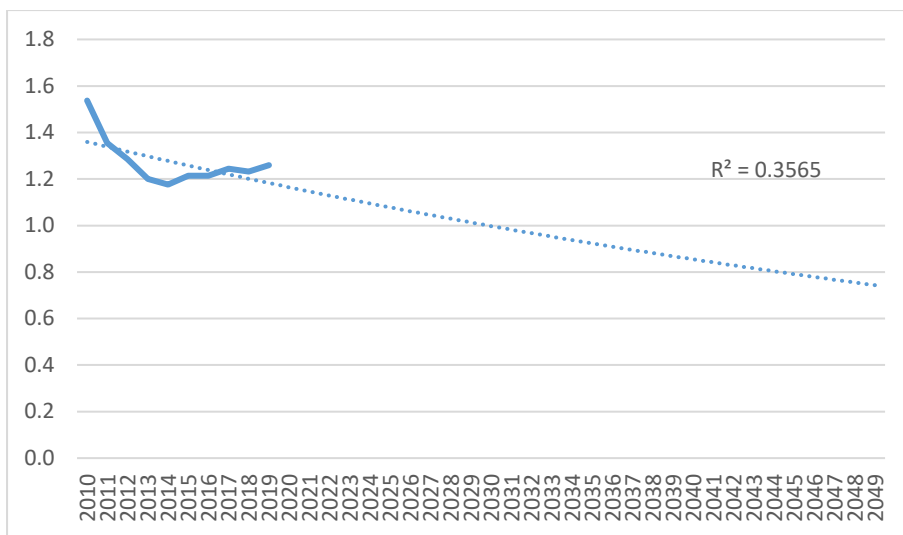


Figure 74: 15 to 19 year-old male motor cyclists fatality rate per 100,000

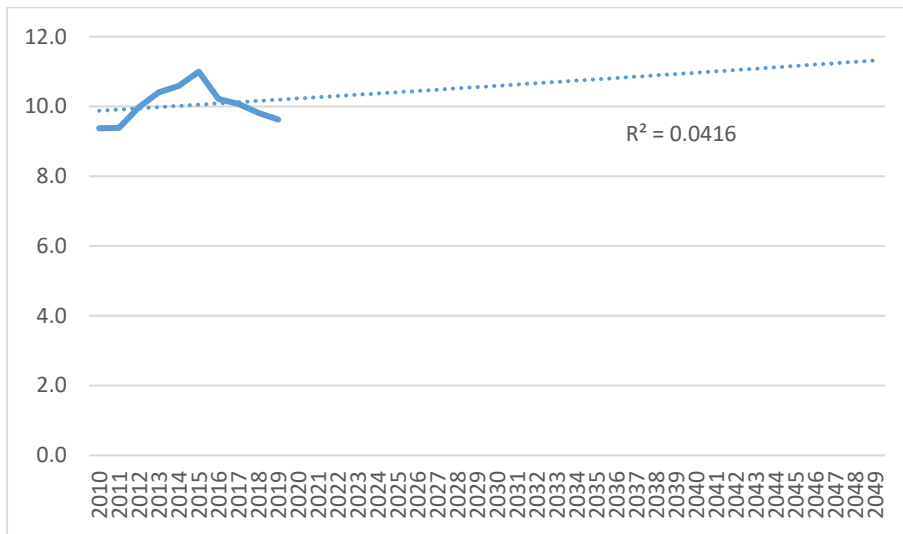


Figure 75: 15 to 19 year-old male motor vehicles fatality rate per 100,000

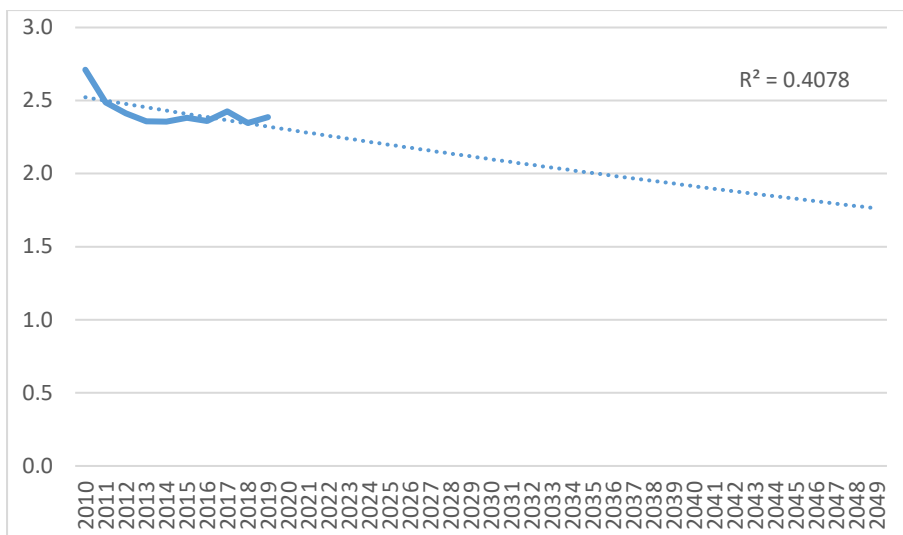


Figure 76: 15 to 19 year-old male other fatality rate per 100,000

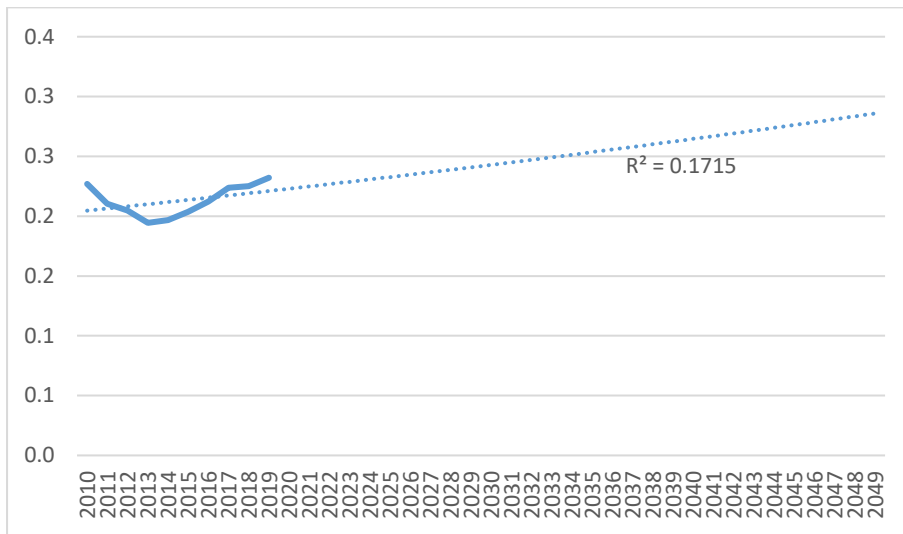


Figure 77: 15 to 19 year-old female pedestrian fatality rate per 100,000

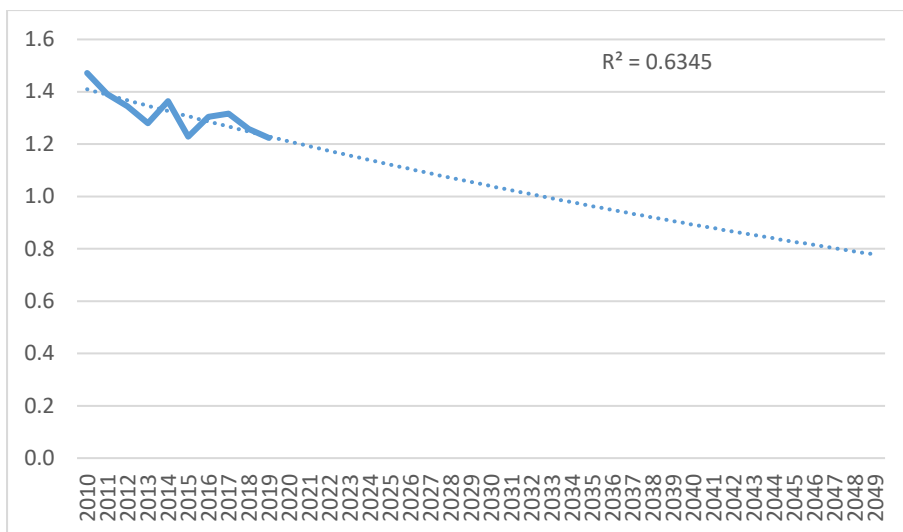




Figure 80: 15 to 19 year-old female motor vehicles fatality rate per 100,000

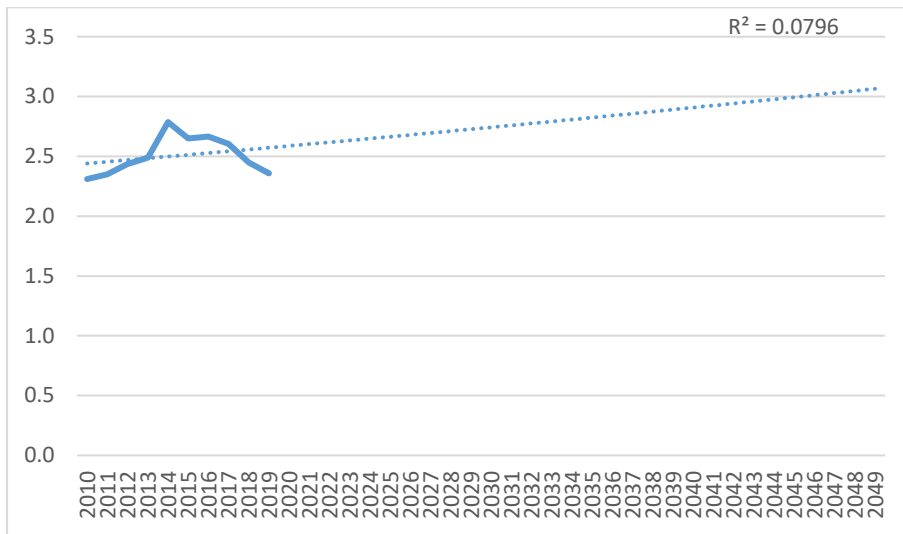


Figure 81: 15 to 19 year-old female other fatality rate per 100,000

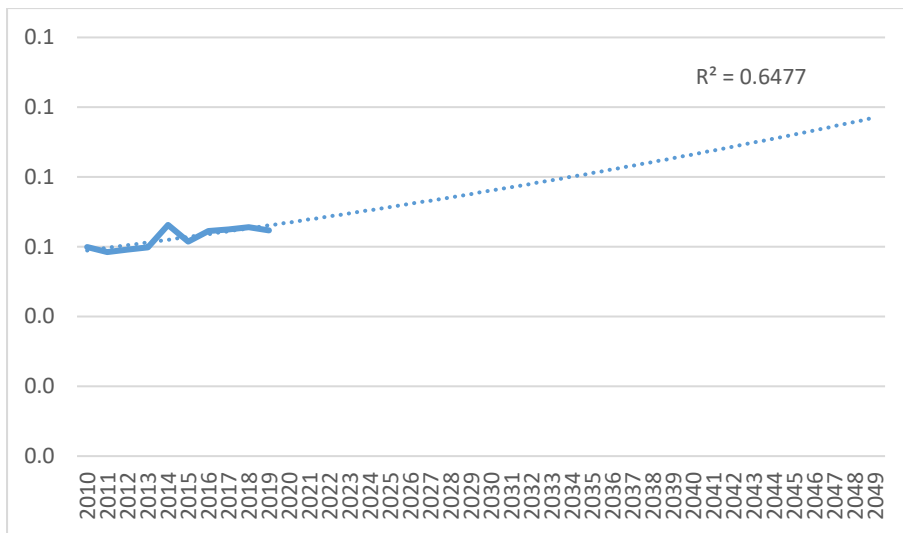




Figure 82: 15 to 19 year-old male pedestrian serious injury rate per 100,000

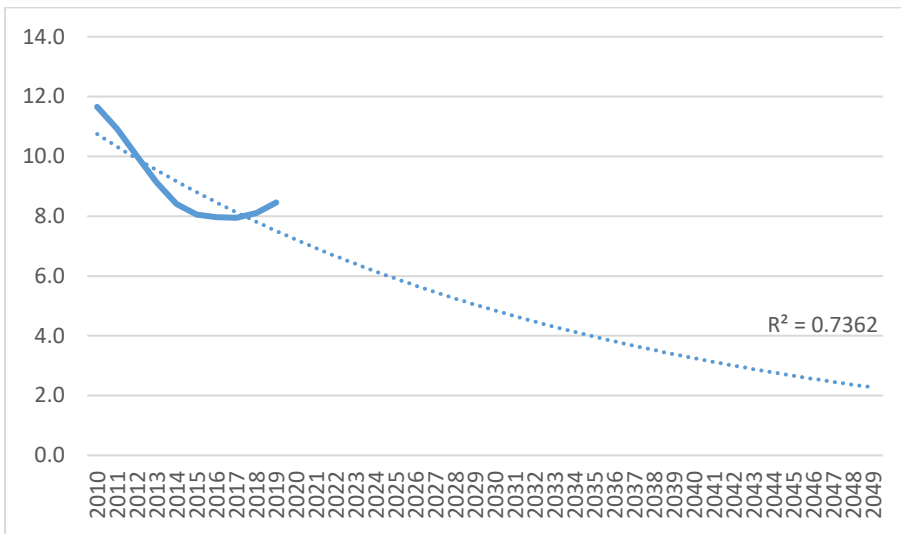


Figure 83: 15 to 19 year-old male cyclists serious injury rate per 100,000

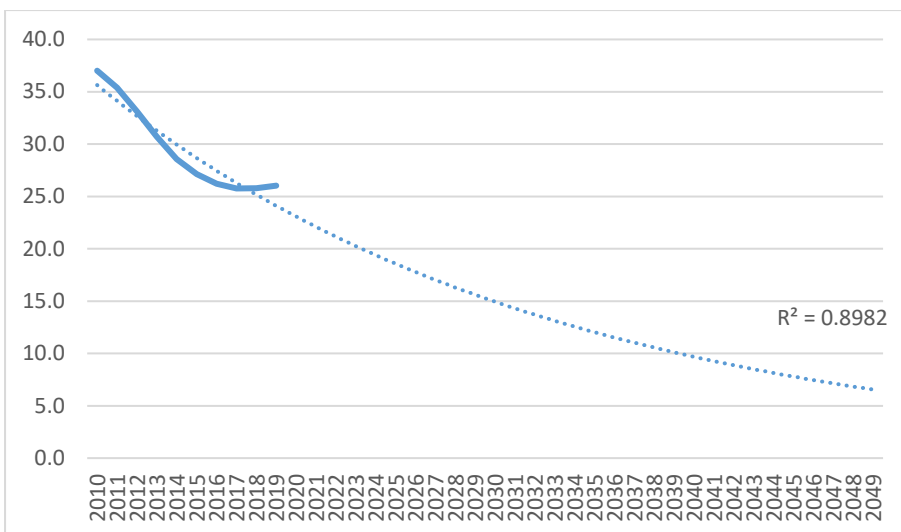


Figure 84: 15 to 19 year-old male motor cyclists serious injury rate per 100,000

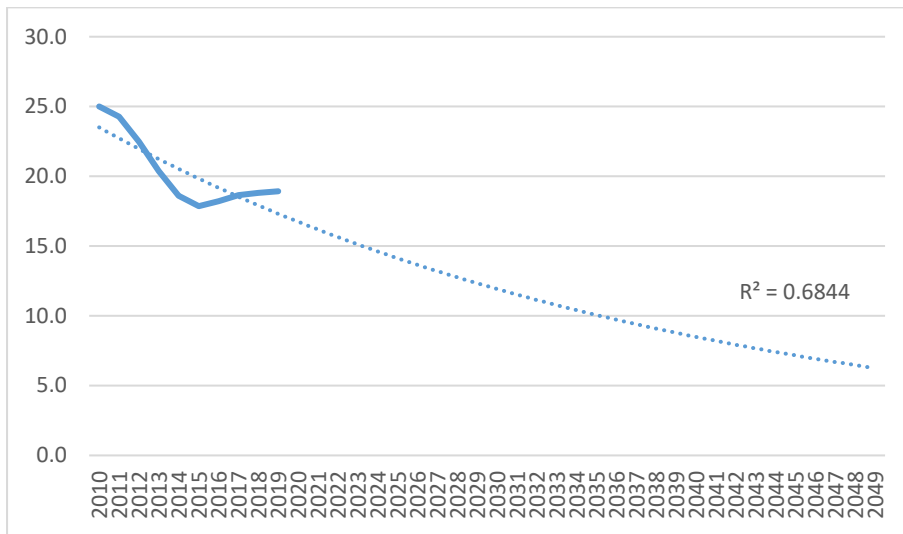


Figure 85: 15 to 19 year-old male motor vehicles serious injury rate per 100,000

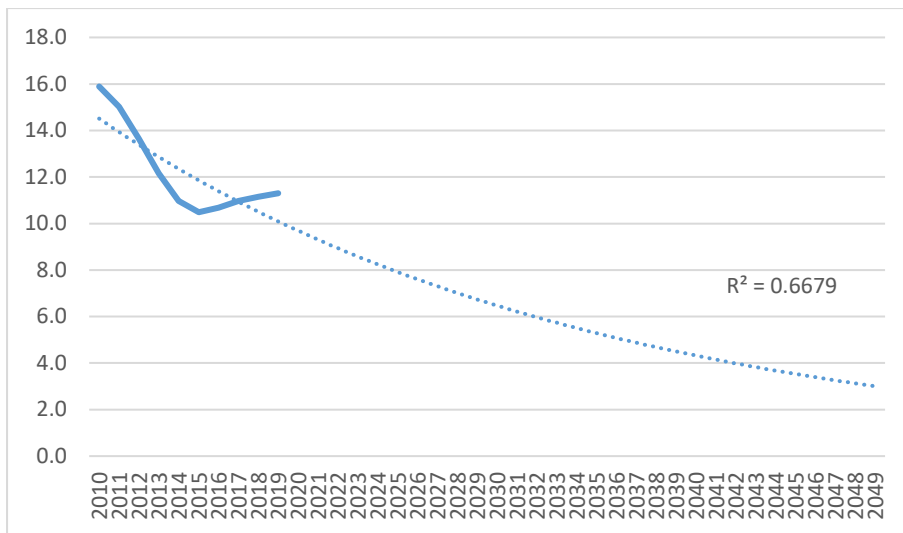


Figure 86: 15 to 19 year-old male other serious injury rate per 100,000

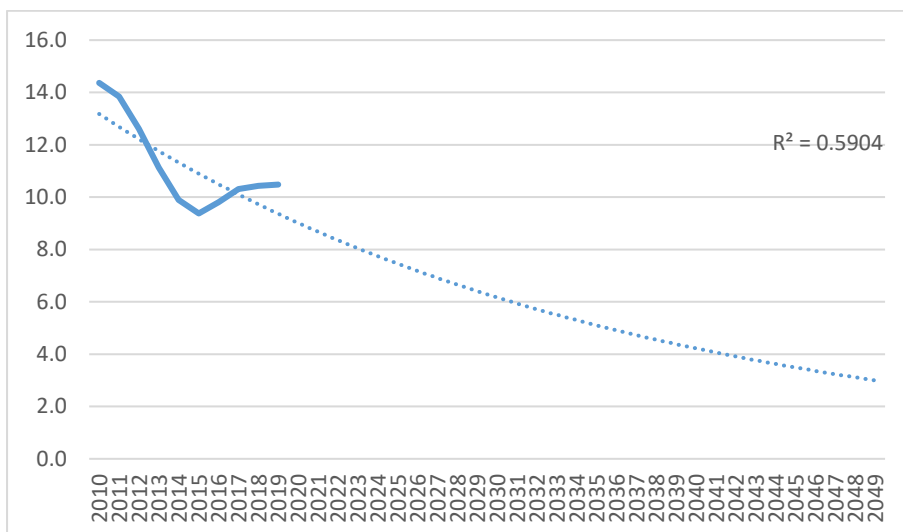


Figure 87: 5 to 19 Female pedestrian serious injury rate per 100,000

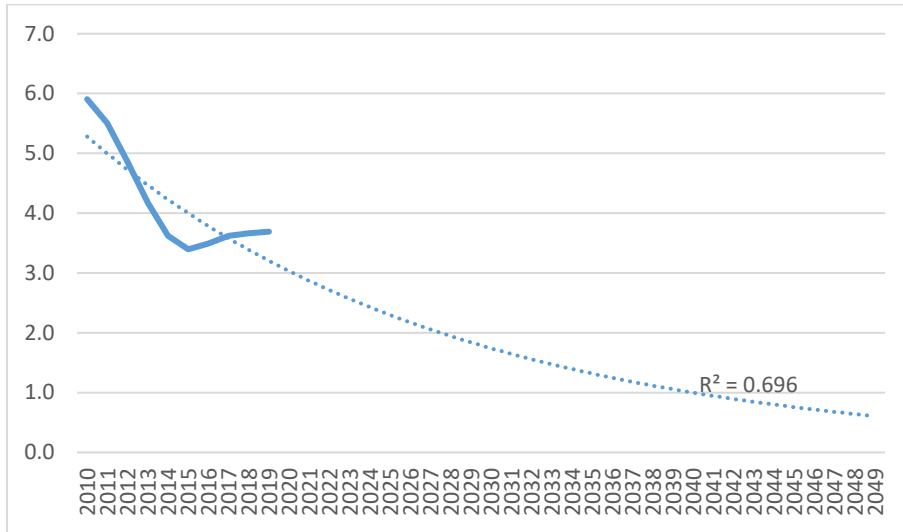


Figure 88: 15 to 19 year-old female cyclists serious injury rate per 100,000

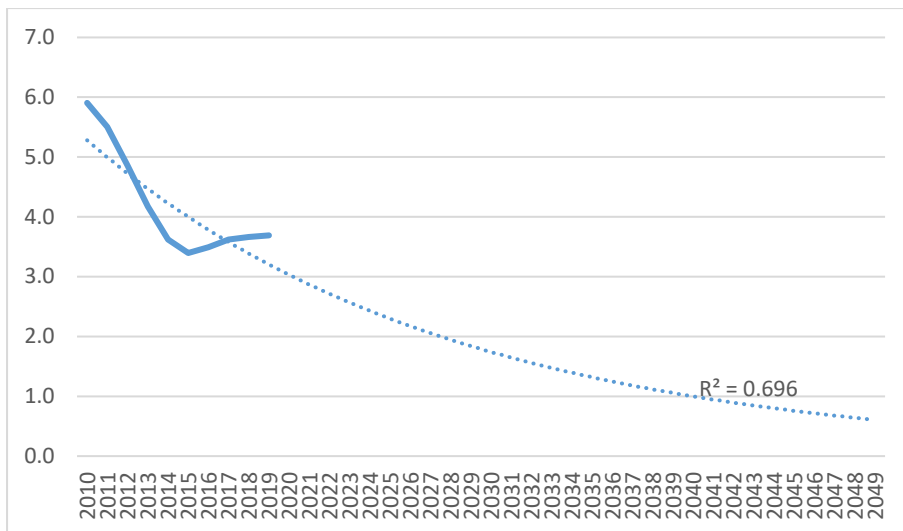


Figure 89: 15 to 19 year-old female motor cyclists serious injury rate per 100,000

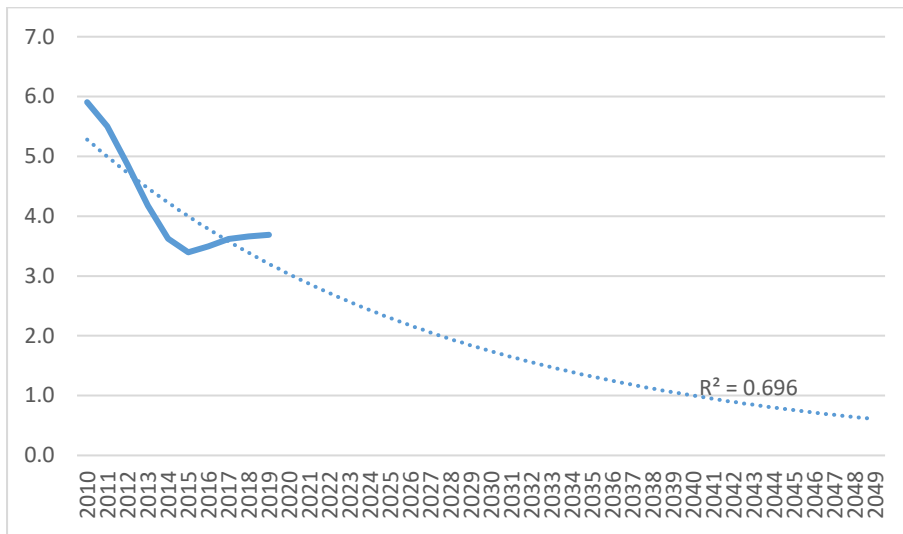


Figure 90: 15 to 19 year-old female motor vehicles serious injury rate per 100,000

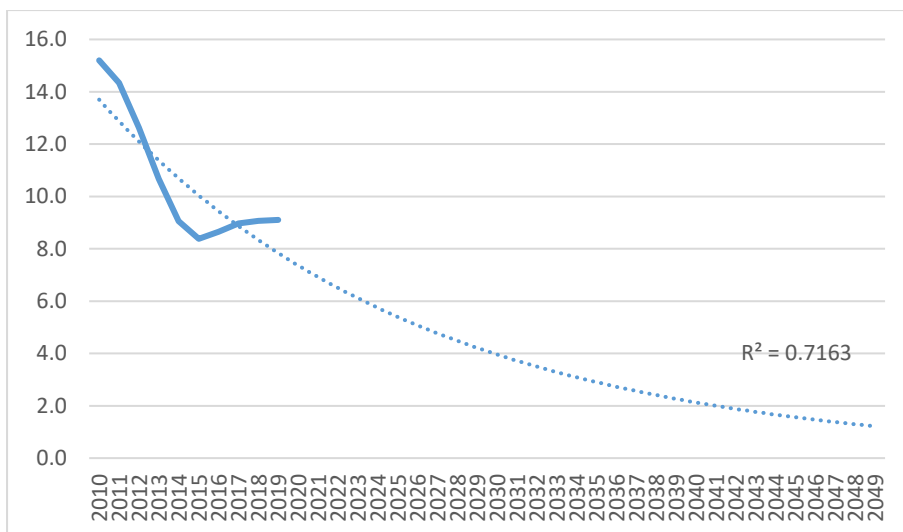


Figure 91: 15 to 19 year-old female other serious injury rate per 100,000

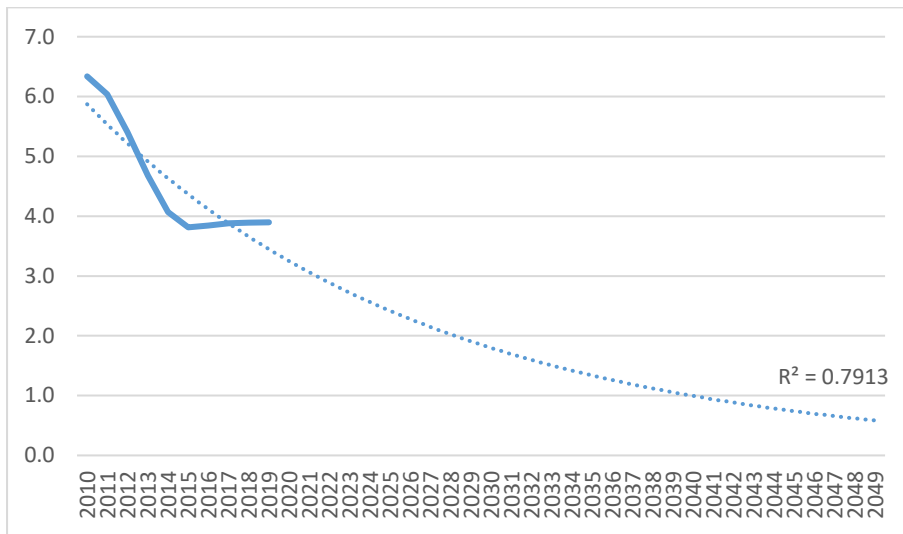


Figure 92: 20 to 24 year-old male pedestrian fatality rate per 100,000

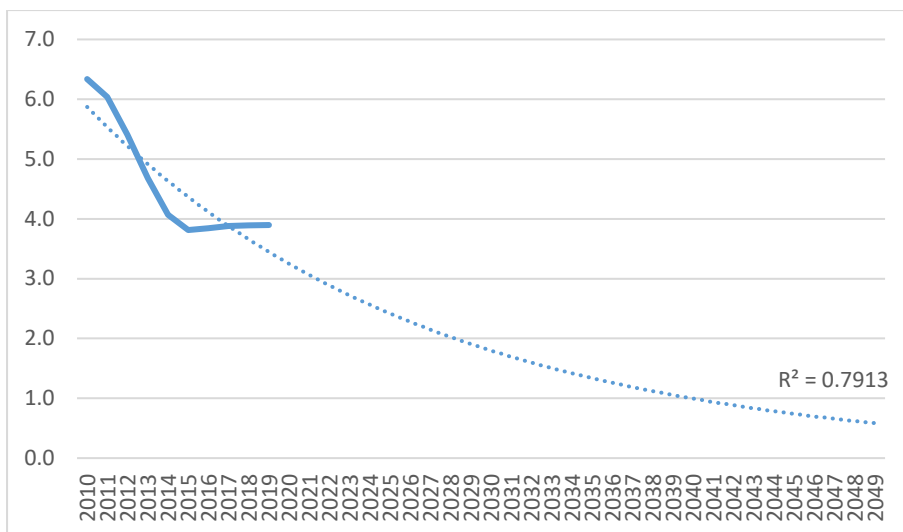


Figure 93: 20 to 24 year-old male cyclists fatality rate per 100,000

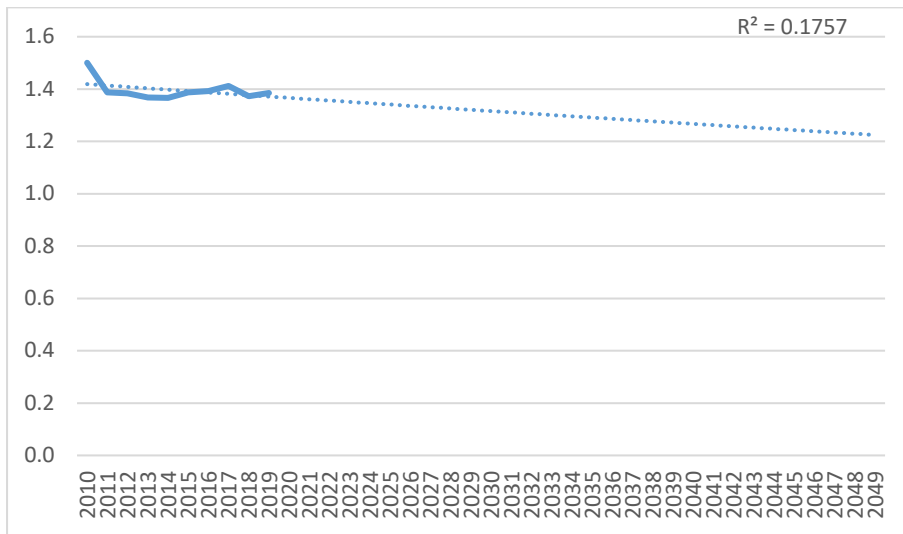


Figure 94: 20 to 24 year-old male motor cyclists fatality rate per 100,000

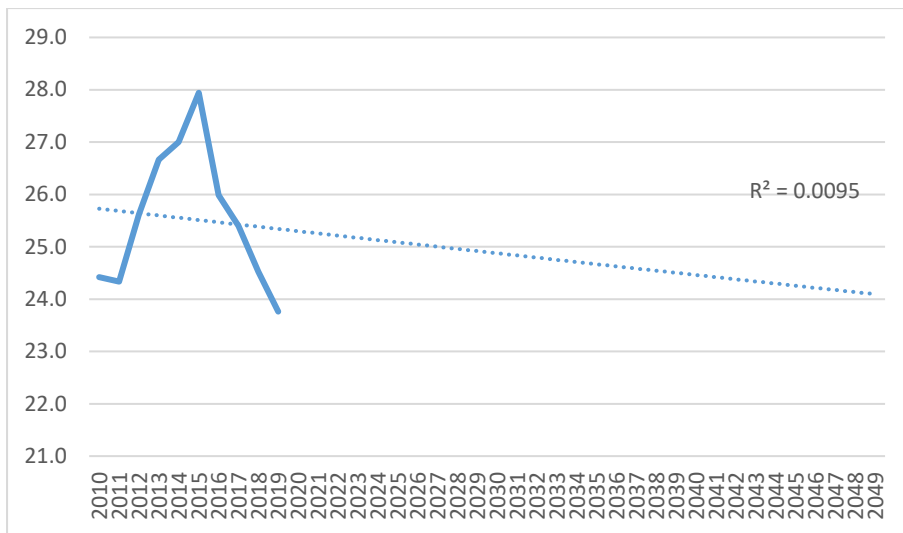


Figure 95: 20 to 24 year-old male motor vehicles fatality rate per 100,000

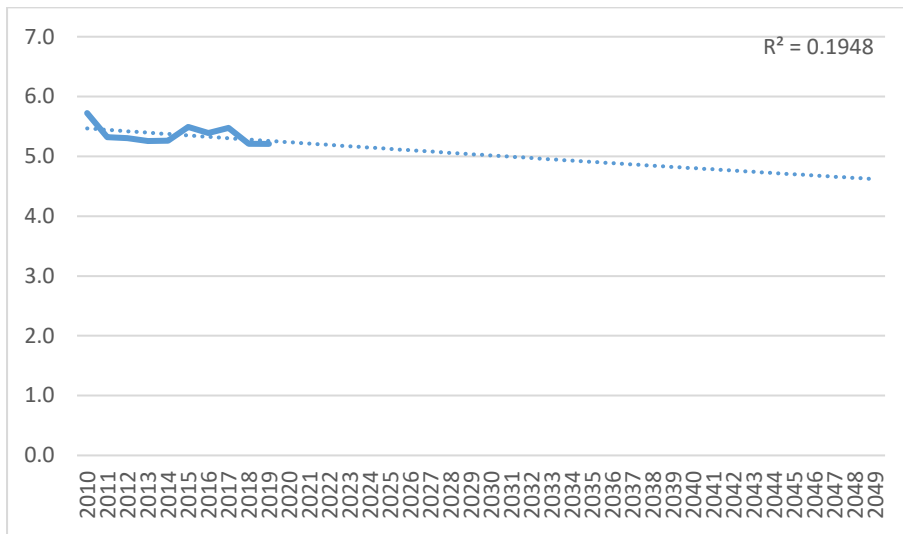


Figure 96: 20 to 24 year-old male other fatality rate per 100,000

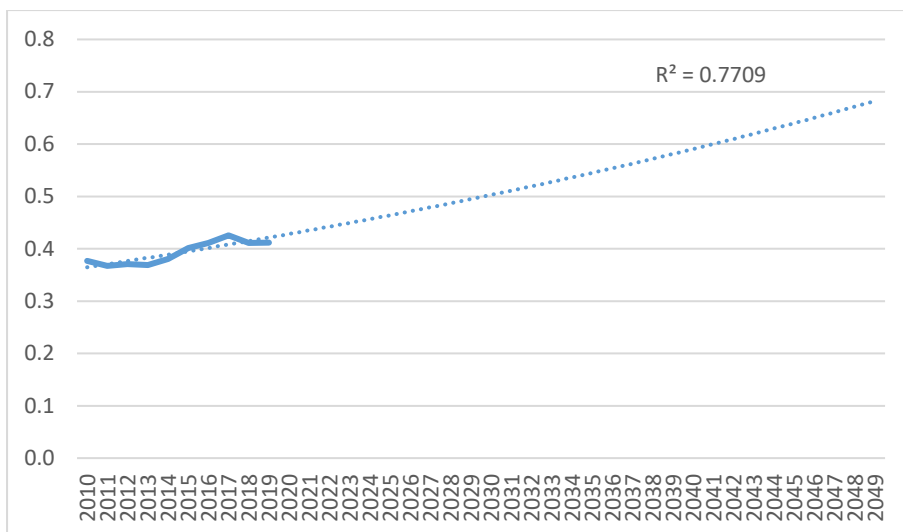


Figure 97: 20 to 24 year-old female pedestrian fatality rate per 100,000

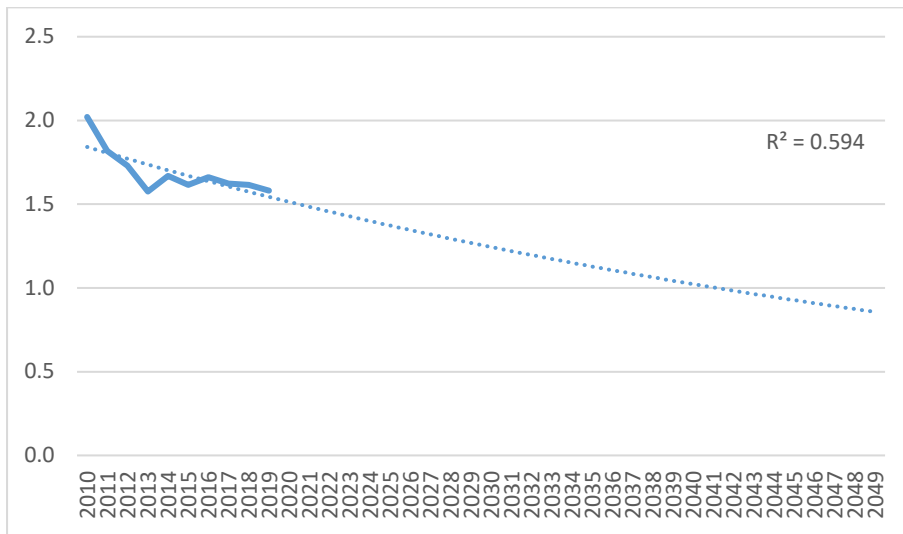


Figure 98: 20 to 24 year-old female cyclists fatality rate per 100,000

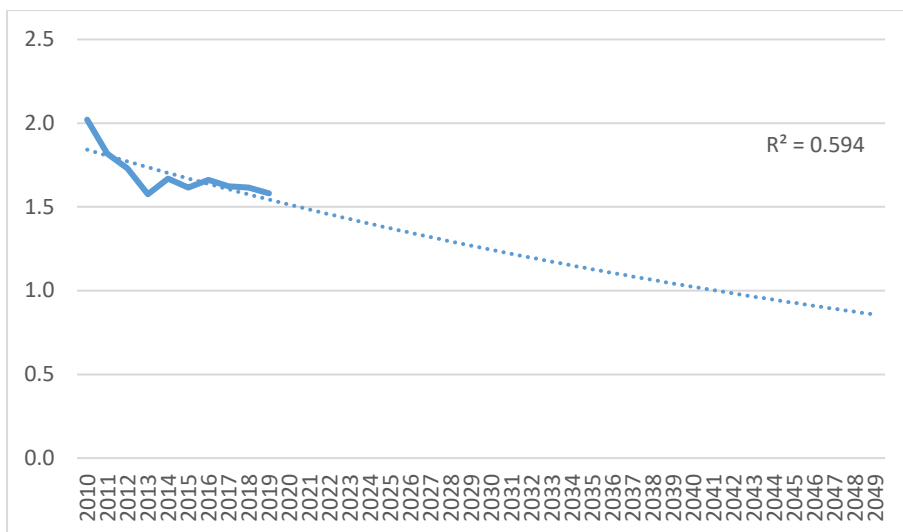




Figure 99: 20 to 24 year-old female motor cyclists fatality rate per 100,000

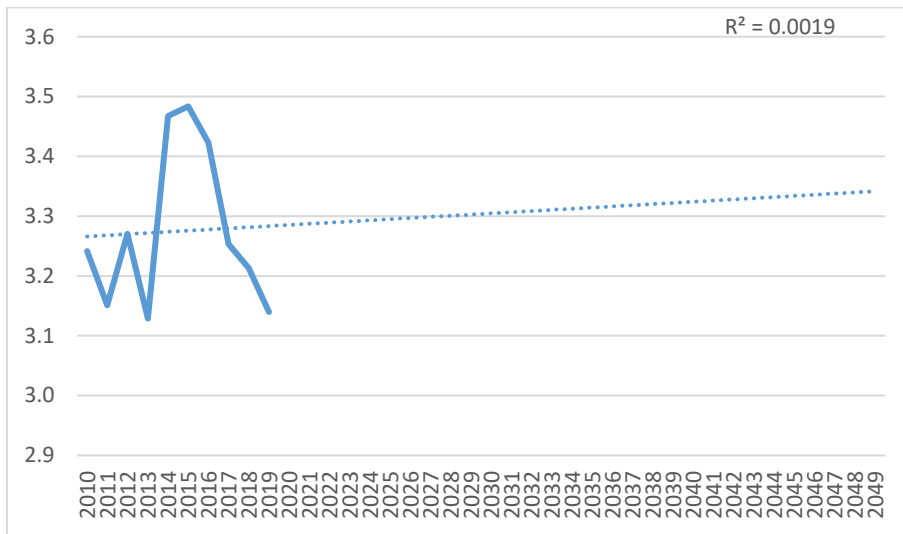


Figure 100: 20 to 24 year-old female motor vehicles fatality rate per 100,000

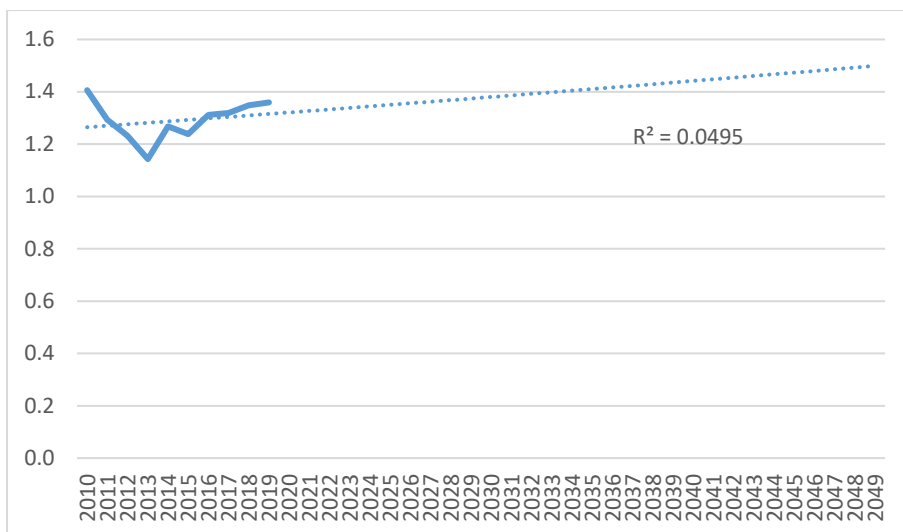


Figure 101: 20 to 24 year-old female other fatality rate per 100,000

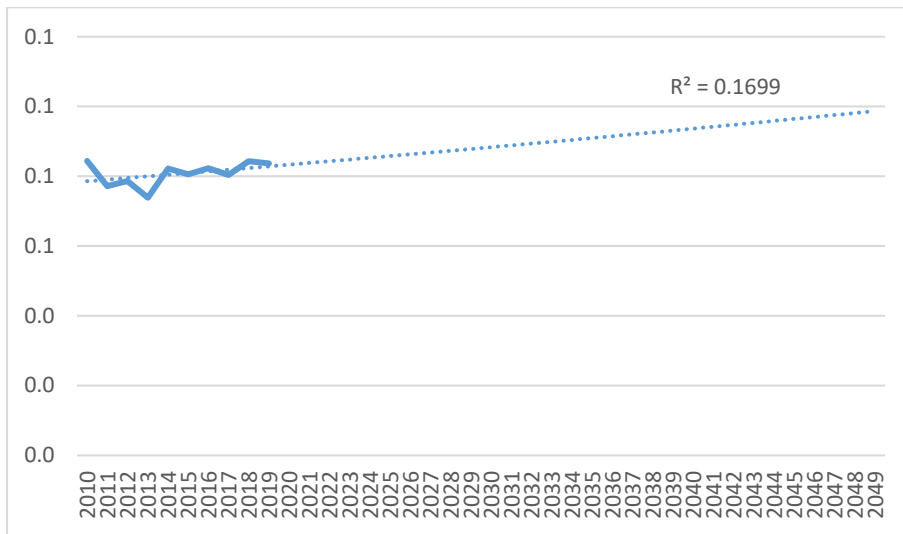


Figure 102: 20 to 24 year-old male pedestrian serious injury rate per 100,000

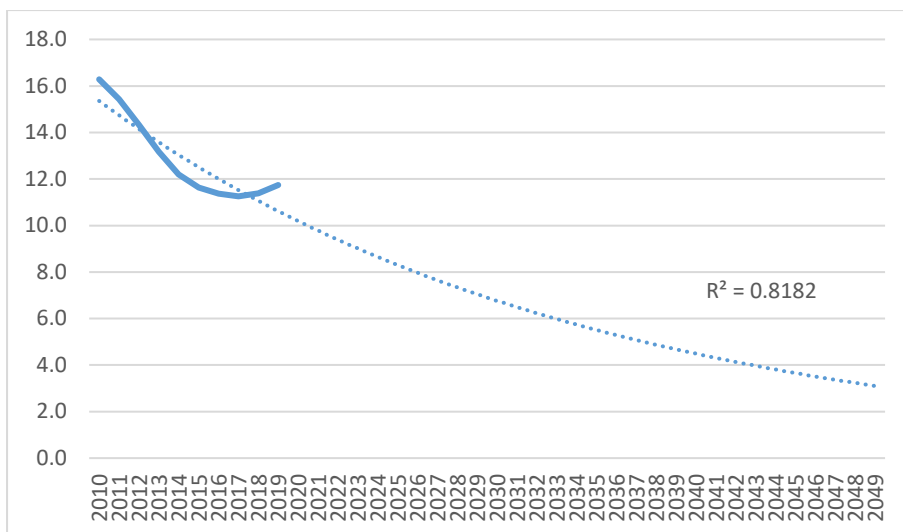


Figure 103: 20 to 24 year-old male cyclists serious injury rate per 100,000

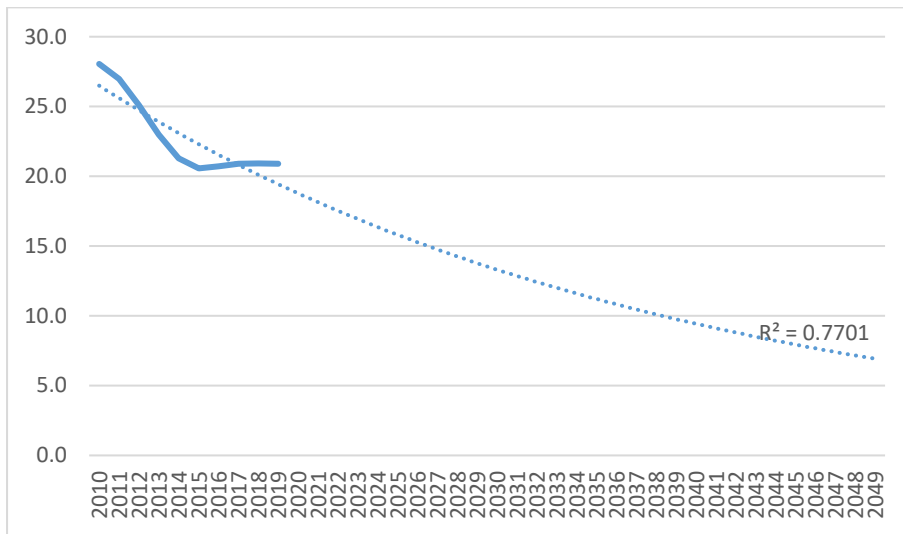


Figure 104: 20 to 24 year-old male motor cyclists serious injury rate per 100,000

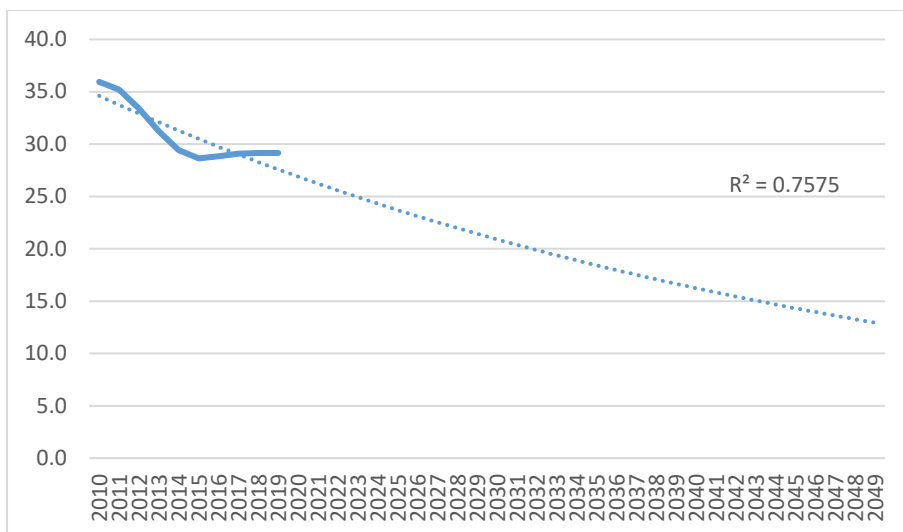


Figure 105: 20 to 24 year-old male motor vehicles serious injury rate per 100,000

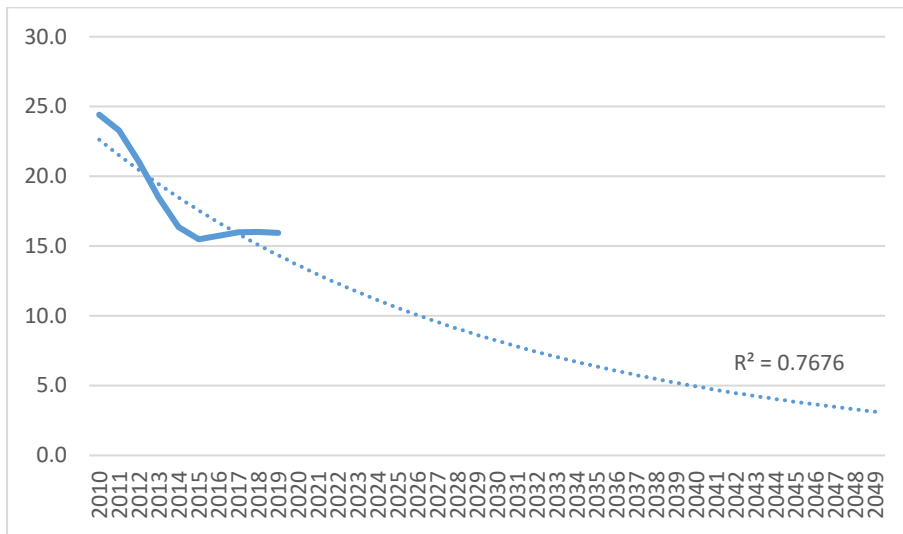


Figure 106: 20 to 24 year-old male other serious injury rate per 100,000

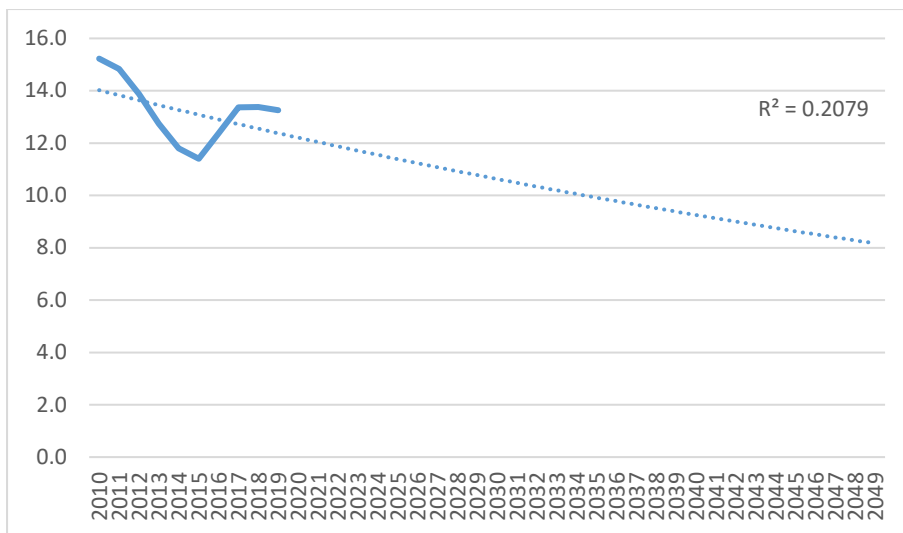


Figure 107: 20 to 24 year-old female pedestrian serious injury rate per 100,000

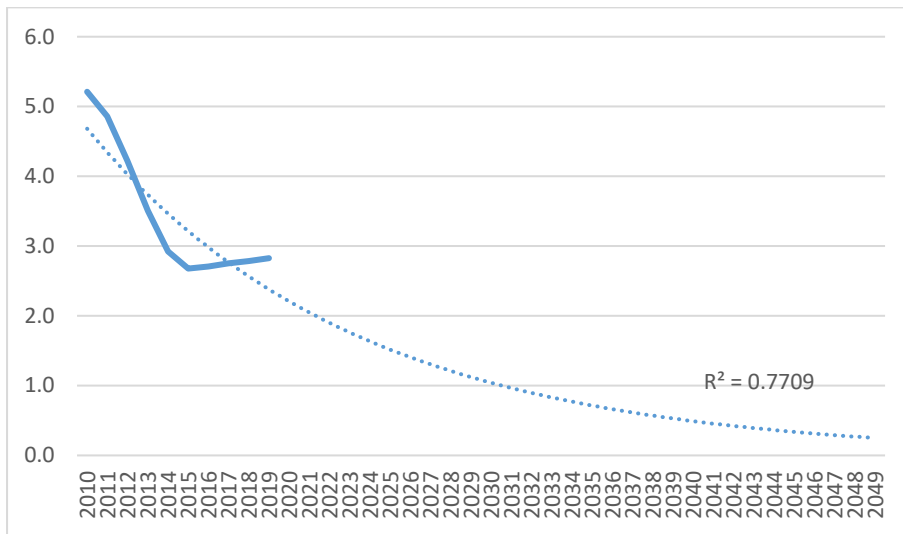


Figure 108: 20 to 24 year-old female cyclists serious injury rate per 100,000

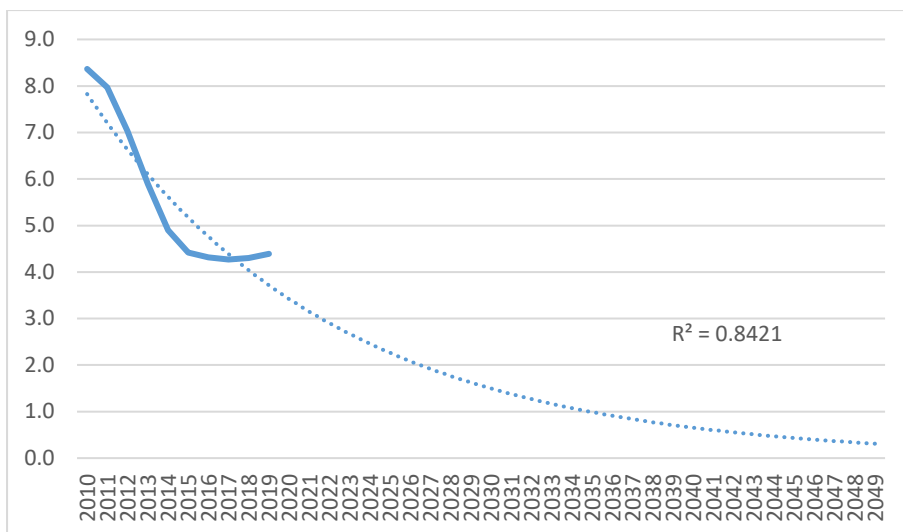


Figure 109: 20 to 24 year-old female motor cyclists serious injury rate per 100,000

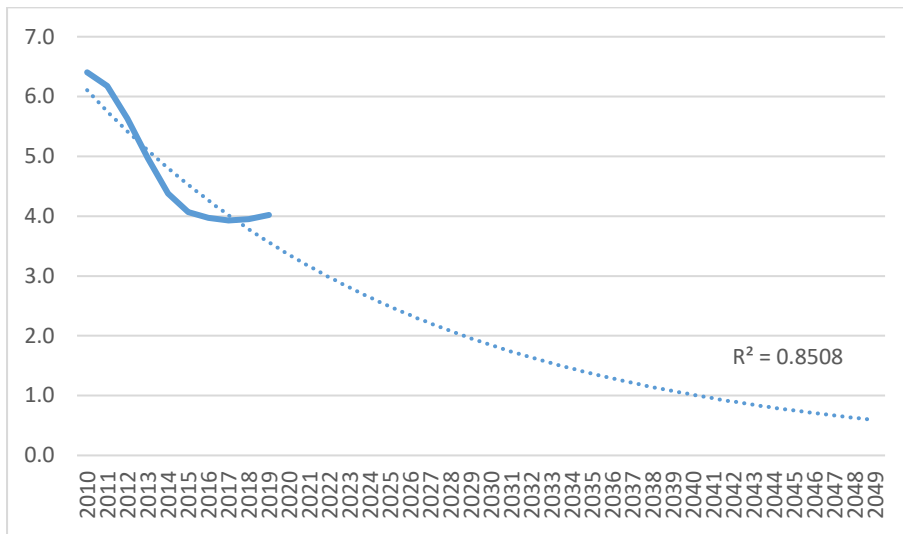


Figure 110: 20 to 24 year-old female motor vehicles serious injury rate per 100,000

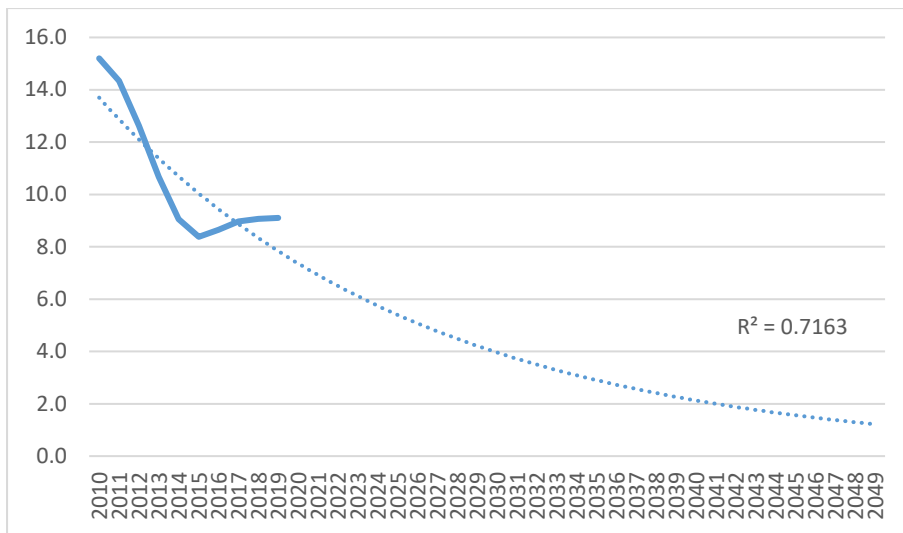


Figure 111: 20 to 24 year-old female other serious injury rate per 100,000

