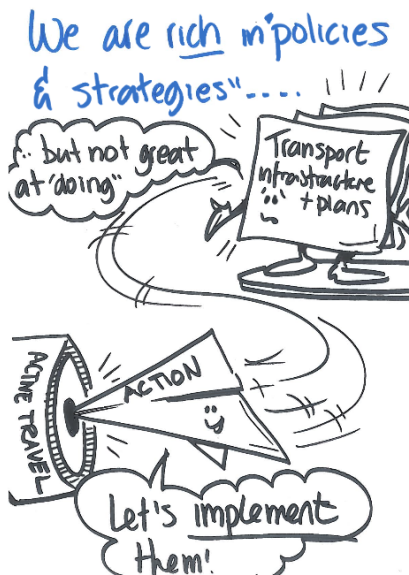


Trends in pedestrian and cyclist road casualties in Scotland

August 2015

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for walking & cycling---



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priority...



Acknowledgements

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Executive summary

This study set out to gain a better understanding of trends in pedestrian and cyclist road casualties in Scotland using road traffic injury data collected through police reports (Stats19) and from hospital admission data (SMR01). Casualty trends by age, gender, deprivation, rurality, injury type and severity of injury have been analysed. Additionally, to provide a context for understanding road casualty trends, trends in different modes of travel have been explored.

Travel trends

The long-term trends in methods used to travel to work in Scotland over the last 45 years are clear:

- Car commuting has risen steadily from 21% in 1966 to 69% in 2011.
- Commuting on foot and by bus has more than halved, dropping to an 11% share for each mode in 2011.
- Train use has risen, slightly, to 4.5% of commuters in 2011.
- The proportion of commuters who cycle to work has been low and relatively static but did rise very marginally from 1.5% in 2001 to 1.6% in 2011.

More recent data provide some evidence of a shift toward higher levels of active travel. Walking journeys, as a percentage of all journeys, are estimated to have risen from 15.6% in 2003 to 23.3% in 2013, while the latest edition of Scottish Transport Statistics quotes a 21% increase in the distance cycled between 2008-09 and 2013-14.

Casualty trends

Our findings highlight a number of important trends relating to pedestrian and cyclist casualties in a Scottish context.

The study reaffirms earlier work, showing that, while pedestrian casualties among adults and children have continued to reduce in the last decade, significantly higher casualty rates are reported in more deprived areas. The pedestrian casualty rate for adults based on police reporting in 2009/2013 was 2.4 times higher in the most deprived quintile compared with the least deprived, and 3.2 times higher for children.

Rates of adult and child pedestrian casualties are highest in large urban areas. It is notable also that the overall child pedestrian casualty rate is over two-and-a-half times higher than the equivalent adult rate.

Adult cyclist casualties, recorded by the police and through hospital statistics, increased from the mid-2000s onwards, both in terms of casualty numbers and as a population-based casualty rate: adult cyclist hospital admission rates increased from 5.5 per 100,000 in 2003/2007 to 7.4 per 100,000 in 2009/2013 (an increase of 34%), while police reported adult cyclist casualty rates increased from 12.9 per 100,000 in 2003/2007 to 16.1 per 100,000 in 2009/2013 (an increase of 25%). The rise in adult cyclist casualties is observed across all deprivation categories, but casualty rates are consistently higher in the more affluent quintiles.

It is principally in large urban areas that this rise has occurred and adult cyclist casualties have risen in all of Scotland's largest cities. Cyclist casualty hospital admission rates have risen for men and women; for men by 34% in the period 2003/2007 – 2009/2013 and for women by 45% from 2004/2008 to 2009/2013, albeit the casualty rate is much higher for men.

It seems plausible that the increase in cyclist casualties is directly associated with an increase in cycling prevalence, although cycling has not increased in all local authority areas. Similarly, it is plausible that the higher adult cyclist casualty rates in the least deprived areas are associated with a greater proportion of regular cyclists commuting from these areas. The continuing rise in licensed vehicles and traffic on our roads may be another contributing factor to the increase in cyclist casualties.

It is notable that motor vehicle casualties have dropped consistently as car use has risen, reflecting the success of efforts to make cars and roads safer. We should not expect or accept that cyclist casualties increase as cycling prevalence increases.

In relation to children, child cyclist casualty rates reported to the police have reduced over the last decade but remain higher in more deprived areas. However, after a prolonged drop, the rate of male child cyclist casualties admitted to hospital has risen slightly since 2007/2011. Boys are three times more likely to be admitted to hospital than girls as a cyclist casualty.

For both pedestrian and cyclist casualties admitted to hospital, the rate of child casualties per head of population is higher than for adults, admission rates for men are greater than for women and greater for boys than for girls. Rates of adult and child pedestrian casualties reported by the police are three to four times higher in large urban areas compared with remote rural areas, while adult cyclist casualty rates are over four times higher in large urban areas compared with remote small towns.

How to make progress

There are a number of clear issues of concern: the rise in adult cyclist casualties; the consistently higher rate of pedestrian casualties in more deprived communities; the higher rate of child cyclist and pedestrian casualties in comparison with adults; and generally, a higher level of cyclist and pedestrian casualties in large urban areas.

To increase levels of active travel and to address these real safety concerns, multiple concurrent approaches are needed. Investment in safe, well-designed and integrated infrastructure and area speed restrictions would reduce the real and perceived risks of accidents for pedestrians and cyclists. Better road maintenance, training programmes for cyclists, bus drivers and other road users and behaviour change campaigns can also play a part. Adopting approaches to neighbourhood design which enable safe walking, cycling and play will help create safer and more sustainable community environments.

In a generally favourable policy context, the challenge is to increase investment in active travel sufficiently to enable significant modal shifts towards walking and cycling to be achieved. Increases in everyday walking and cycling are likely to provide the multiple benefits with increased physical activity leading to better physical and mental health, improved air quality and reduced carbon emissions.

Limitations in available data, and the disparate sources of data on active travel, highlight a need to create an accessible active travel web resource – providing statistics and research on active travel trends, casualties, new infrastructure and related initiatives. Such a resource would provide an improved evidence base for debate, would help to give walking a higher profile and would help inform how further progress can be made to both increase levels of walking and cycling and to reduce pedestrian and cyclist casualties.

Glossary

Body Mass Index (BMI)

Body Mass Index, or BMI, is an estimate of relative size based on the mass and height of an individual and is a measure used to categorise people as underweight, normal weight, overweight, or obese. Among adults, being overweight is defined as having a BMI greater than or equal to 25; adult obesity is defined as having a BMI greater than or equal to 30 <http://www.who.int/mediacentre/factsheets/fs311/en/>

Data zone

Data zones are groupings of 2001 Census output areas with populations of between 500 and 1,000 household residents. There are 6,505 data zones across Scotland, which nest within local authority

boundaries: <http://www.scotland.gov.uk/Publications/2005/02/20697/52626>.

Five-year rolling average

In order to provide providing more stable time trends, five-year rolling averages were calculated for casualty rates by calculating the mean rate over a five year period.

ICD10

ICD-10 is the tenth revision of the International Statistical Classification of Diseases and Related Health Problems (ICD), a medical classification list by the World Health Organization (WHO). It contains codes for diseases, signs and symptoms, abnormal findings, complaints, social circumstances, and external causes of injury or diseases. A list of codes used to identify relevant hospital admissions for road traffic casualties can be found in Table 1.

Stats19

Injury road accidents reported to the police are recorded on a 'Stats19' form. These data are submitted to Transport Scotland by the police. The form can be viewed at: http://www.transportscotland.gov.uk/statistics/data-sources-and-methodology#Stats_19

SMR01

SMR01 is an episode-based patient record relating to all inpatients and day cases discharged from non-obstetric and non-psychiatric specialties. Data collected include a patient's demographic details, episode management details and general clinical information. Currently diagnoses are recorded using the ICD-10 classification.

SMR01 Hospital admission type

An inpatient admission is categorised as an emergency, urgent or routine inpatient admission except for maternity and neonatal admissions. The appropriate admission category depends on the clinical condition of the patient as assessed by the receiving consultant.

The Scottish Index of Multiple Deprivation (SIMD)

This deprivation index identifies small area concentrations of multiple deprivation across Scotland in a consistent way. The SIMD ranks data zones from most deprived (ranked 1) to least deprived (ranked 6,505). The data zones can then be divided into quintile or decile groups using the rankings.

Scottish Government urban/rural classification

This classification provides a consistent way of defining urban and rural areas across Scotland. The classification is based upon two main criteria: (i) population as defined by the National Records of Scotland (NRS), and (ii) accessibility based on drive time analysis to differentiate between accessible and remote areas in Scotland. The classification is available in three forms: a two-fold classification, which distinguishes between urban and rural areas; a six-fold classification, which distinguishes between urban, rural, and remote areas through six categories; and, an eight-fold classification which further distinguishes between remote and very remote regions.

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1. Introduction

In this introduction we set out the benefits of active travel for health, summarise current Scottish trends in physical activity and obesity and describe the policy context in Scotland relating to active travel briefly. Trends in active travel, in as far as they can be described, given a limited information base, are highlighted. This then provides the background context for this study which aims to explore and to gain a better understanding of trends in cyclist and pedestrian casualties in Scotland.

1.1 Health benefits of physical activity and active travel

Active modes of travel such as walking and cycling contribute to regular, moderate physical activity. Physical activity has many known health benefits, for example, protecting against chronic conditions, such as cardiovascular disease, obesity, and type 2 diabetes¹. Mental wellbeing can be improved through physical activity; the Royal College of Psychiatrists recommends exercise as a treatment for depression in adults². Physical activity is associated with better health and cognitive function among older people^{3,4}, and exercise can reduce the risk of falls in older people⁵.

In contrast, physical inactivity is a risk factor for many non-communicable diseases such as cardiovascular disease, diabetes and cancer⁶ and has been identified as the fourth leading risk factor for global mortality⁷. Physical activity is a key determinant of energy expenditure, and thus is fundamental to energy balance and weight control; while physical inactivity is implicated in obesity.

In relation to active travel there is evidence that not only has declining functional active travel contributed to population-level decreases in physical activity⁸ but countries with the lowest levels of active travel generally have the highest obesity rates⁹. In contrast, lower levels of BMI and fat have been associated with active commuting¹⁰ (and commuting by public transport) compared with commuting by private transport (cars and taxis). A recent European study found that being moderately physical active was more protective against mortality than avoiding obesity, and that even a modest increase in physical activity, such as a brisk 20-minute walk each day, could have significant health benefits¹¹.

1.2 Current trends in obesity and physical activity

Obesity and overweightⁱ trends are of growing concern in Scotland. Population levels of obesity and overweight among adults have risen steadily since 1995 – the first year of the Scottish Health Survey. In 2013, obesity prevalence was higher among women than men (29.3%, compared with 24.9%), whereas men were more likely to be overweight including obese (68.3%, compared with 61.0% of women)¹².

In relation to physical activity, the adult guideline for aerobic physical activity of at least 150 minutes of moderate activity or 75 minutes of vigorous activity over a week was met by two thirds of Scottish adults in 2013 with men significantly more likely than women to meet the guideline on aerobic activity (71%, compared with 58%).

ⁱ See glossary, under BMI, for definitions.

1.3 Policy

It is clear that active travel can contribute to increasing physical activity at both an individual and at a population level. In 2003, the then Scottish Executive introduced a physical activity strategy, Lets Make Scotland More Active¹³, which provided a broad set of objectives and priorities for the promotion of physical activity in Scotland. Nowadays, it is the Active Scotland Outcomes Framework that sets out the Scottish Government's ambitions for sport and physical activity, including key outcomes aimed at encouraging a more physically active population over the next ten years¹⁴. Actions to achieve this are outlined in the Scottish Government's first ever National Physical Activity Implementation Plan¹⁵, which is built around the Toronto Charter for Physical Activity¹⁶, adapted to a Scottish setting.

In addition, there is policy specifically focused on active travel. The 2010 Cycling Action Plan for Scotland aims to increase levels of cycling so that "by 2020, 10% of all journeys taken in Scotland will be by bike"¹⁷. A subsequent national walking strategy, published by the Scottish Government in 2014, outlines a vision of a Scotland where everyone benefits from walking¹⁸. Later in 2014, the Scottish Government published a long-term vision for active travel in Scotland, which aims to encourage more people to walk and cycle for shorter, everyday journeys¹⁹.

Across a range of government policy there is recognition of the positive contribution active travel can make to addressing obesity²⁰, climate change²¹ and air quality²². Additionally, there is growing awareness (and evidence) of the social²³ and economic benefits²⁴ of active travel and conversely of the adverse effects on quality of life associated with high volumes of motor vehicle traffic²⁵.

1.4 Trends in active travel

In Scotland, despite recent supportive policies and good evidence of the benefits of walking and cycling, long-term trends in active travel have, in the main, been downward. Levels of walking in Scotland – as measured by commuting to work – have fallen in successive censuses over the last 45 years (in 2011 only 11% of adults walked to work). There has been a slight increase in cycling to work between 2001 and 2011, but still less than 2% of commuters travel by bicycle as their main method of travel (see Section 4 of this report for further detail)ⁱⁱ.

More recent surveys provide some evidence of a shift toward higher levels of active travel. Walking journeys, (as a percentage of all journeys over a quarter of a mile – based on Scottish Household Survey data) are estimated to have risen from 15.6% in 2003 to 23.3% in 2013, while bicycle journeys made up 1% of all journeys (in 2013), a modal share that has not changed significantly in the last decade. Together walking (23%) and cycling (1%) account for almost a quarter of all journeys²⁶.

There is other evidence though that suggests cycling is increasing. The distance cycled on all roads is estimated to have increased from 310 million vehicle kilometres in 2012 to 329

ⁱⁱ **Transport and Travel Scotland 2013** quotes figures from a different source – the Scottish Household Survey – that 13% of journeys to work were on foot and 2.5% were by bicycle in 2013.

million vehicle kilometres in 2013 – the average cycling journey is 4.4 km in length – and the latest edition of Scottish Transport Statistics quotes a 21% increase in the distance cycled between 2008-09 and 2013-14²⁷. In Glasgow, the city's annual cordon count surveys have shown a 78% increase in cycle trips into and out of the city over the period 2009 to 2014²⁸, and a more modest 11% increase in pedestrian trips over the same period²⁹.

1.5 Pedestrian and cyclist casualties

There has been a large reduction in road casualties in Scotland over recent decades. The total number of casualties on Scottish roads fell by 10% between 2012 and 2013 and overall casualty numbers are at their lowest level since records began over 50 years ago.

However, in the course of monitoring levels of active travel at a local and national level, we have noted concerning casualty trends in relation to active travel. In Glasgow, there has been a rising number and rate of cyclist casualties since the mid-2000s both in terms of cyclist casualties reported via police recording of road traffic accidents involving injuries (Stats19) and cyclist casualties requiring admission to hospital (SMR01)³⁰. In a previous study, the GCPH highlighted a strong social gradient in pedestrian road traffic casualties; much higher rates of child and adult pedestrian casualties were observed in more deprived areas compared with less deprived areas of the Greater Glasgow and Clyde region^{31,32}.

In this study we set out to explore child and adult casualty trends among pedestrians and cyclists in Scotland in order to document clearly these trends and to better understand the factors underlying these trends.

2 Aims

The aim of this work is to consider trends in pedestrian and cyclist road casualties, as recorded by the police and through hospital admissions. Trends by age, gender, deprivation, rurality and type and severity of injury have been analysed in order to better understand changes over time. Additionally, trends in the prevalence of different modes of transport have been considered, in order to provide a context for understanding the road casualty trends.

In a public health context, it is important to understand casualty trends as they represent part of the health impact of growth in active travel. Safety is a specific barrier to increasing levels of cycling and walking. For example, people often do not cycle, or let their children out on busy streets, because of real and perceived safety concerns. Better intelligence on casualty and travel trends is needed to inform how increases in active travel can be achieved safely and sustainably.

3 Methodology

3.1 Data sources

3.1.1 Data on mode of travel to work or study

A number of sources were considered for the analysis of mode of travel trends. The census was chosen due to its population-wide coverage, the level of quality assurance carried out on census data and the depth of demographic detail that can be obtained from the results. It also enabled comparison of trends over long periods of time.

In both 2001 and 2011, census results were published relating to the question “How do you usually travel to your main place of work or study (including school)?” Only one mode of travel could be specified in response with participants prompted to pick the mode reflecting the longest part of their usual journey to work or study. In this study we have chosen to include all persons aged 4 and over who were studying, and people aged 16-74 who were in employment. Possible modes of transport recorded included driving a car or van, being a passenger in a car or van, using a motorcycle or moped, (taking the) bus, train, underground, taxi, walking and cycling. Additional data from earlier censuses are used in one graph (Figure 2) to illustrate long-term Scottish commuting trends to work.

In the Introduction and Discussion, figures for other sources are also quoted. For example modal share trends, published by Transport Scotland, based on Scottish Household Survey data; and, Glasgow City Council’s annual cordon count of walking and cycling into Glasgow city centre. Both provide more up-to-date trends than the census.

3.1.2 Road casualty data

Two main sources were used for road casualty data. Police Stats19 data were sourced from Transport Scotland. These data are based on the Stats19 accident reporting form which is filled out by police officers to record details of road traffic accidents involving personal injury on public roads. The casualty data from this source are based on the data zoneⁱⁱⁱ within which the accident occurred. In our study we have used data available from 1999-2013.

The other road casualty data analysed were ISD-held SMR01 hospital activity data, which are based on acute hospital admissions. Road casualties were identified by the type of hospital admission type on SMR01 – Type 32, Patient Injury – Road Traffic Accident (RTA). These data only include road casualties who are admitted to hospital as inpatients or day cases; patients who are discharged directly from accident and emergency departments are not included. Casualties are counted based on their data zone of residence, as opposed to where the accident occurred (Stats19). Further information on how the various road casualty diagnoses were selected can be found in the next section of the report. The SMR01 based casualty data were compiled and analysed over the period 1998-2013.

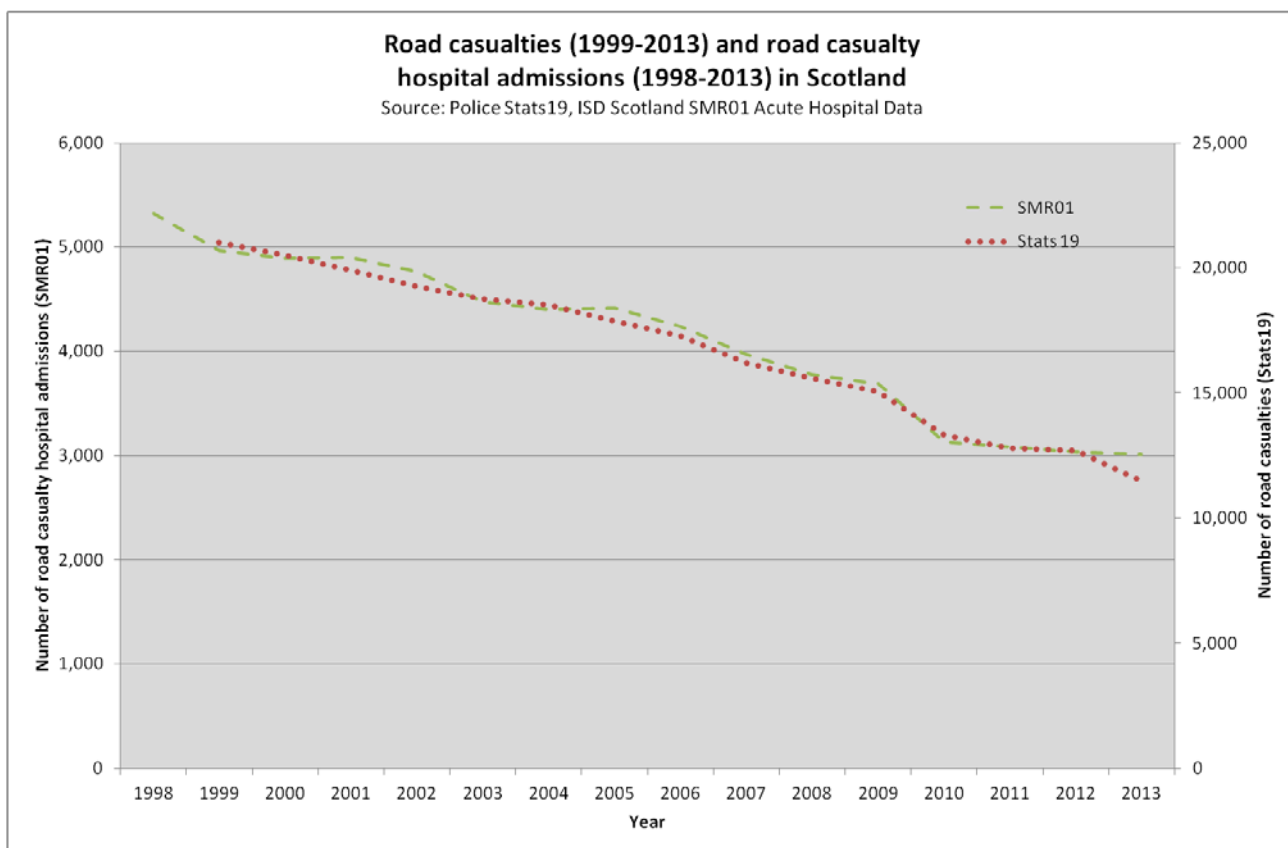
It is important to bear in mind the difference between these two data sources, particularly the nature of the casualty recording, and how the location is recorded, when comparing results from each source.

ⁱⁱⁱ See glossary for a description of data zones.

Population estimate data were used as a denominator in the calculation of casualty rates. These data were sourced from National Records of Scotland small area population estimates^{iv}.

Figure 1 shows the raw number of road casualties observed based on Stats19 and SMR01 data. Note that this chart has two vertical axes with different scales, one on the left for the SMR01 hospital admission data, and one on the right for Stats19 casualty data.

Figure 1: Road casualty trends (1999-2013) and road casualty hospital admissions (1998-2013) in Scotland.



The acute hospital admissions reported in SMR01 are clearly just a fraction of the number of casualties recorded via Stats19, the proportion is consistently around 24%. Both sources report a similar decrease in casualties year on year.

^{iv} National Records for Scotland (NRS), formerly the General Register Office for Scotland, publish small area population estimates (SAPE) annually at a data zone level across Scotland.

3.2 Pre-processing

The Stats19 data and SMR01 data on road casualties accessed for this study included information on the following:

- Age of casualty
- Gender (SMR01 only)
- Mode of transport
- Data zone (based on accident site in Stats19, and patient's residence in SMR01)
- Severity of injury (fatal, severe or slight)

The following variables were derived based on the data zone:

- Scottish Index of Multiple Deprivation (SIMD) deprivation quintile (Scotland level, 2012)
- Scottish Government urban/Rural indicator (two-fold and six-fold classification)

With the SMR01 data, the mode of transport and also the type of injury were determined using the following codes relating to the International Classification of Diseases tenth revision (ICD10), selected from any of the six SMR01 diagnosis positions:

Table 1. ICD10 codes used in identification of road casualties in SMR01 data

Description	Codes
Mode of transport – pedestrian	V01 – V09
Mode of transport – pedal cycle	V10 – V19
Mode of transport – motorcycle	V20 – V29
Mode of transport – car occupant	V40 – V49
Head injury	S00 – S19
Torso/arm injury	S20 – S69
Leg/ankle/foot injury	S70 – S99

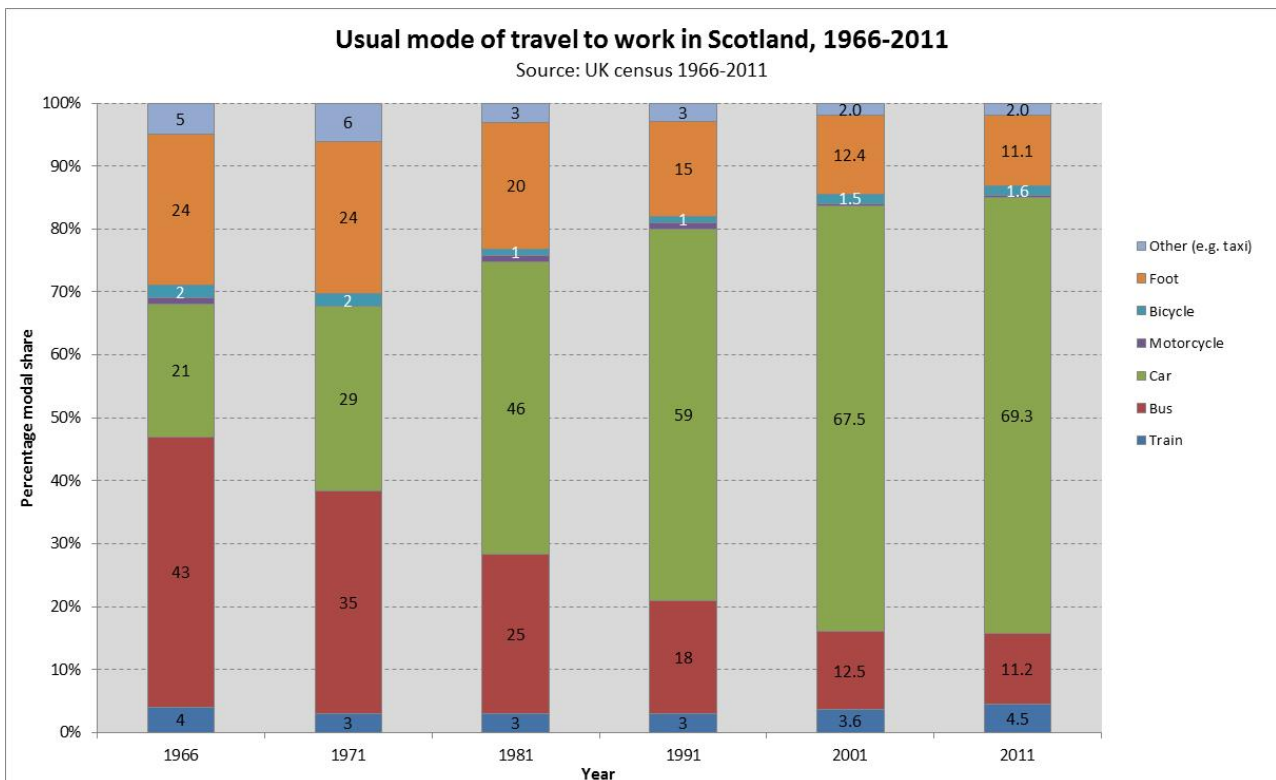
Due to potentially small counts of casualties compared with the population, rates of casualties have been calculated using five-year rolling averages. This involves calculating a separate rate for each rolling five-year period (e.g. 1999/2003, 2000/2004, 2001/2005) which consists of the annualised mean of five years of casualty data, divided by the mean of the corresponding populations. This method helps to smooth out short-term fluctuations, and highlight longer-term trends.

4 Analysis of trends in mode of travel to work or study^v

Trends in mode of travel can be followed over a 45-year period using the census. This analysis is based on responses from employed adults regarding their usual mode of travel to work. There are important caveats to be borne in mind when comparing data across the different censuses due to changes in the question asked and those included in the published results^{vi}.

Despite these caveats, Figure 2 highlights important overall trends over half a century. It is apparent that in Scotland the use of a car to commute to work has risen significantly, from 21% in 1966 to 69% in 2011. In contrast, commuting on foot and by bus have reduced dramatically. In 1966, commuting by bus was the most popular method of travelling to work (43%) but by 2011 only 11% of commuters used this method. The proportion of employed people commuting on foot halved in the period from 24% to 11%. Train use, which in this graph includes travelling by the underground, increased slightly between 1991 to 2011 (from 3% to 4.5% of commuters). Bicycle use remained low and static over most of the period with a very marginal increase from 1.5% in 2001 to 1.6% in 2011.

Figure 2: Usual mode of travel to work in Scotland, 1966-2011.

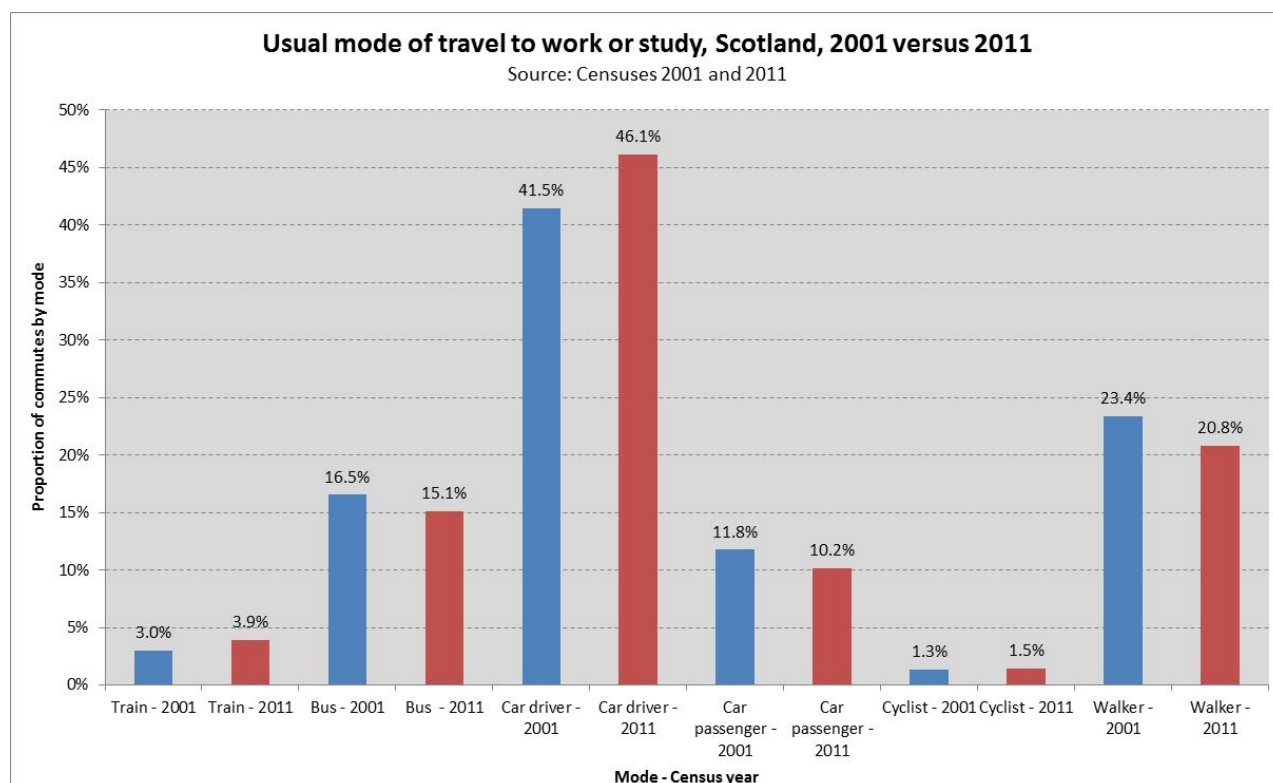


^v Figures 1-7, which are referred to in this section, are included in Appendix A available on the GCPH website.

^{vi} Figures from 1981 onwards exclude those who worked at home (who were not identified separately in the 1966 and 1971). Commuting by underground is aggregated within train use, taxi use is shown in the 'Other' category. Data for 2001 and 2011 include all people aged 16 to 74 in employment in the week before the census (excluding full-time students). Sources – Table 12.18, STS No. 28 2009 edition, Table ST204 (2001 Census) and Table QS701SC (2011 Census)

It is important to note that the foregoing analysis was limited to trips to work – in order to match with historic census reporting. In 2001 and 2011, the census question was broader, including journeys to place of study, thus including students. Figure 3 illustrates how mode of travel to work and study changed between 2001 and 2011.

Figure 3: Usual mode of travel to work or study, Scotland, 2001 versus 2011^{vii}.



This graph includes all people aged four and over who are studying, and all adults aged 16-74 in employment the week before the census and thus provides a more comprehensive picture of commuting than Figure 2, although the trends shown are similar. In 2011 – compared with 2001 – slightly more people took the train to work or study, but less people travelled by bus. Car driving increased to 46% and is by far the most common method of commuting. Slightly fewer people travelled as passengers in a car in 2011. Only 1.5% of those who commute to work or study did so by bicycle in 2011, although this has risen marginally since 2001. The proportion of pedestrian commuters dropped; approximately one-in-five people usually walked to work or study in 2011.

Examining travel trends between 2001 and 2011 at a local authority level reveals consistency with many of the national trends, although some local authorities stand out as following quite distinct and different trajectories:

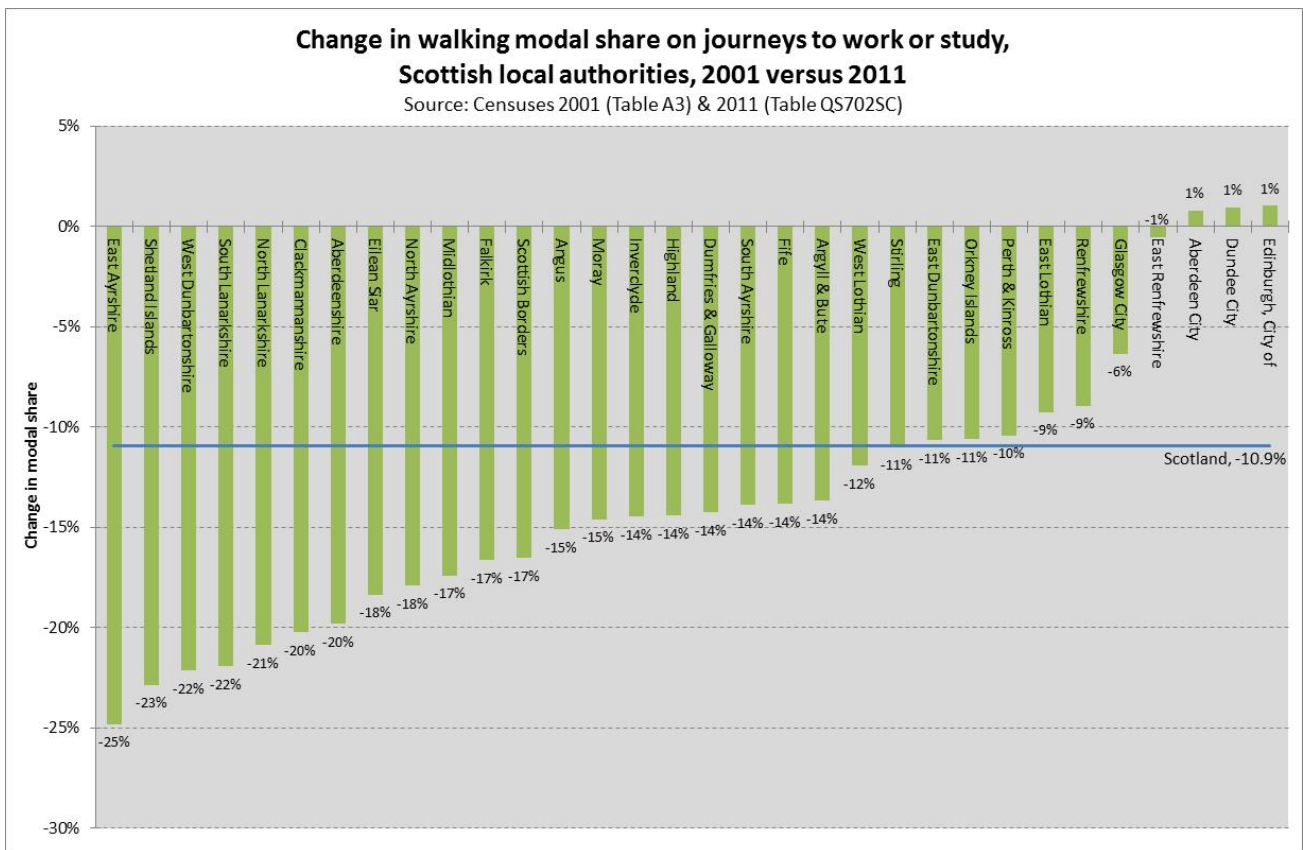
- Train use increased in all council areas with a train line.
- Underground use, principally by Glasgow residents, reduced slightly.
- Bus use reduced in 28 local authorities and increased in four (Edinburgh, Midlothian, Perth & Kinross and Stirling).

^{vii} This graph excludes the following commuting categories which are relatively low at a national level: underground (0.3%, 2011), taxi (0.7%, 2011); motorcycle (0.3%, 2011) and other modes (1%, 2011).

- Car driving increased in every local authority, except Edinburgh, while the proportion of people who were car passengers reduced in all authorities.
- Walking to work or study decreased overall and in the majority of local authorities, but did rise in three local authorities (Aberdeen, Dundee and Edinburgh) – see Figure 4^{viii}.
- Across Scotland, cycle commuting increased from 1.3% to 1.5% of commuters (an increase of 4,870 people) and there was an increase in cycle commuters in 19 local authorities – see Figure 5.
- The proportion of ‘active travel’ commuters – those walking or cycling – increased in only four local authorities (Aberdeen, Dundee, Edinburgh and East Renfrewshire).

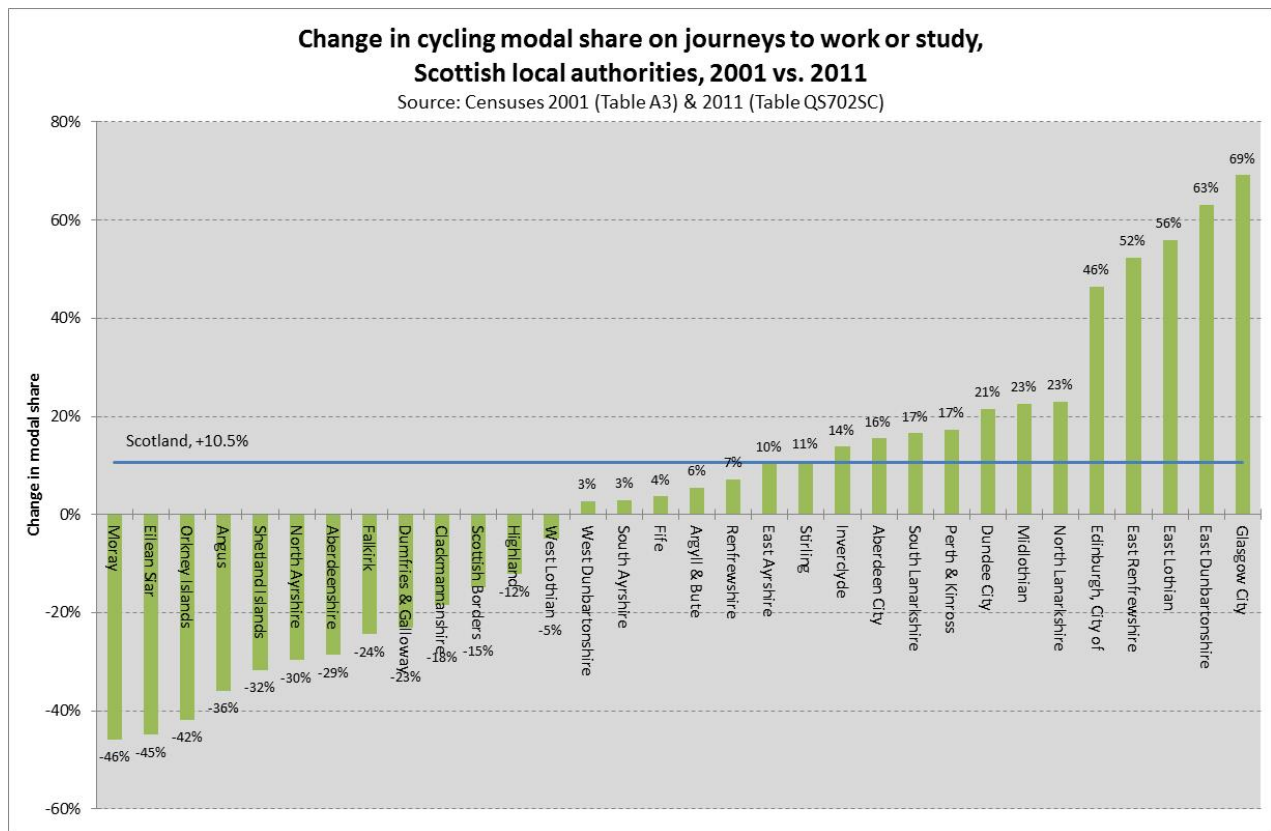
Table T4 in Appendix A (on GCPH website) provides details of the commuting trends in individual local authorities.

Figure 4: Change in walking modal share on journeys to work or study by local authority, 2001 versus 2011.



^{viii} Figures 4 and 5 are based on changes in the modal share of walking and cycling journeys to work or study and exclude people who usually work or study at home.

Figure 5: Change in cycling modal share on journeys to work or study, Scottish local authorities, 2001 versus 2011.



The census also provides an opportunity to analyse trends in active travel in relation to socioeconomic circumstance at an area level. Figure 6 shows the modal share of walking to work or study by SIMD deprivation decile. The proportion of commuters who walk varies between 17% and 25% by deprivation decile and there is some evidence of a 'U-shaped' distribution with more people walking to work or study in the most deprived and in the least deprived areas.

Figure 6: Modal share of walking to work or study by deprivation decile, 2011.

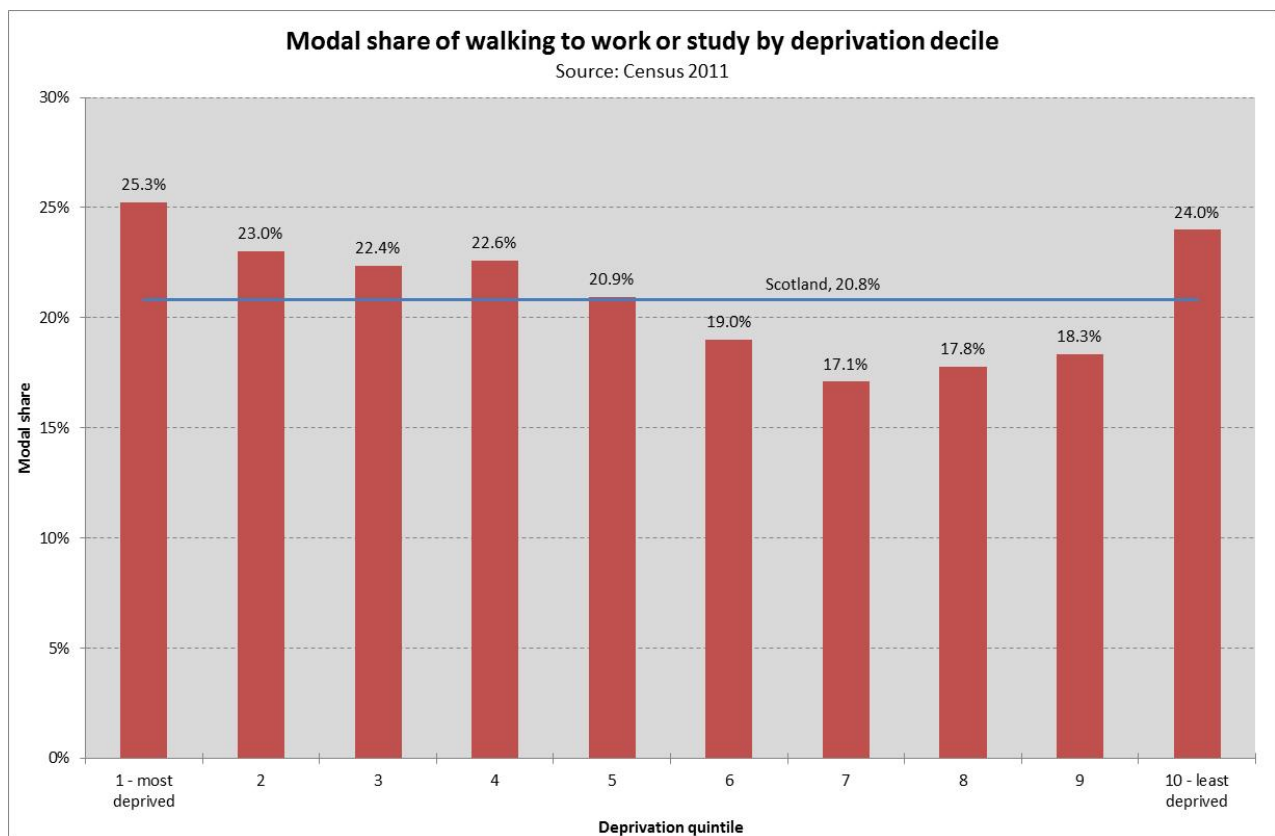


Figure 6 is based on 2011 Census Table QS702SC, which includes all people aged 4 and over who are studying or aged 16 to 74 in employment the week before the census.

In contrast there is a clear social gradient in those cycling to work or study as illustrated in Figure 7. While only 1.5% of people commute by bicycle on average, commuting by bicycle is lowest in the most deprived areas, rises gradually in increasingly less deprived deciles and then increases more markedly in the least deprived decile where 2.7% of commuters cycle.

Figure 7: Modal share of cycling to work or study by deprivation decile, 2011.

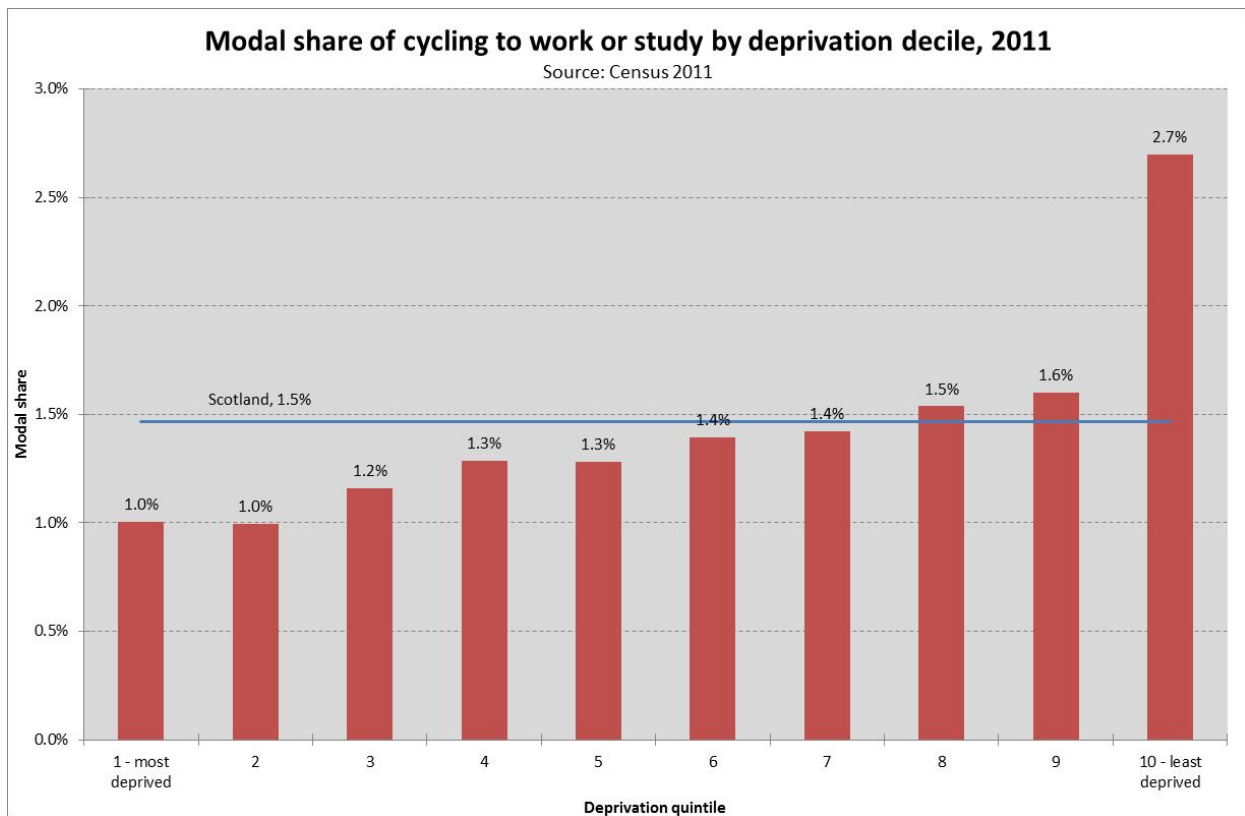


Figure 7 is based on 2011 Census Table QS702SC, which includes all people aged 4 and over who are studying or aged 16 to 74 in employment the week before the census.

5 Analysis of trends in road traffic casualties^{ix}

Road casualty data indicate that there has been a decrease in the overall number of road casualties over the last 50 years in Scotland. However more recent casualty trends differ by mode of transport and this is investigated in more depth in this section.

5.1 Mode of transport breakdown

5.1.1 Children (aged 5-15)

Figure 8 shows the rate of child road casualties recorded in Police Stats19 data broken down by mode of transport. Stats19 data has been used here as it provides the most detailed breakdown by mode of transport. The 'Other' category includes casualties for modes of transport such as heavy goods vehicles and minibuses.

Figure 8: Rate of child (age 5-15) road casualties per 100,000 population in Scotland, by mode of transport, 1999/2003 - 2009/2013^{x,xi}.

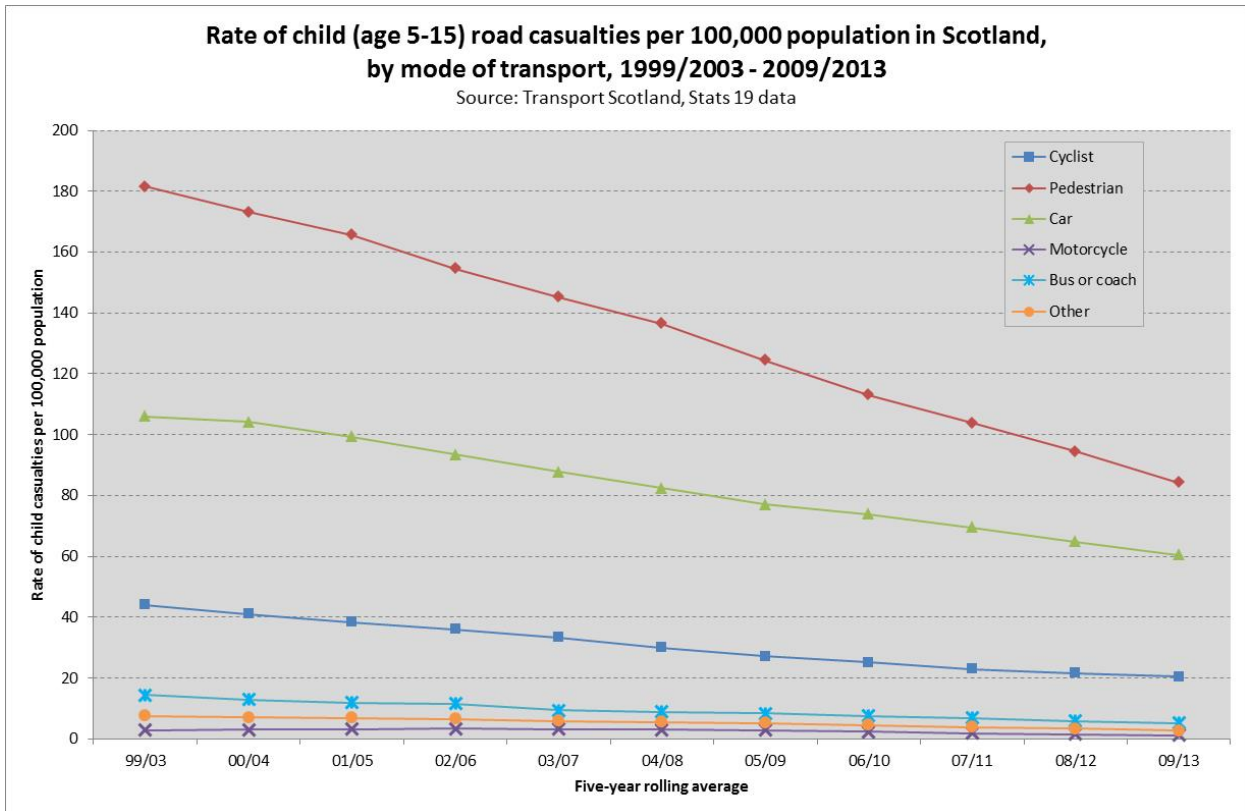


Figure 8 shows that over the whole decade from 1999/2003– 2009/2013, there was a higher rate of child pedestrian casualties than for any other mode of transport. Child

^{ix} Figures 8-22, which are referred to in this section, are included in Appendix B (along with other charts not shown in the report) available on the GCPH website.

^x Given two sources of casualty data have been analysed, each graph title indicates the specific source of data used.

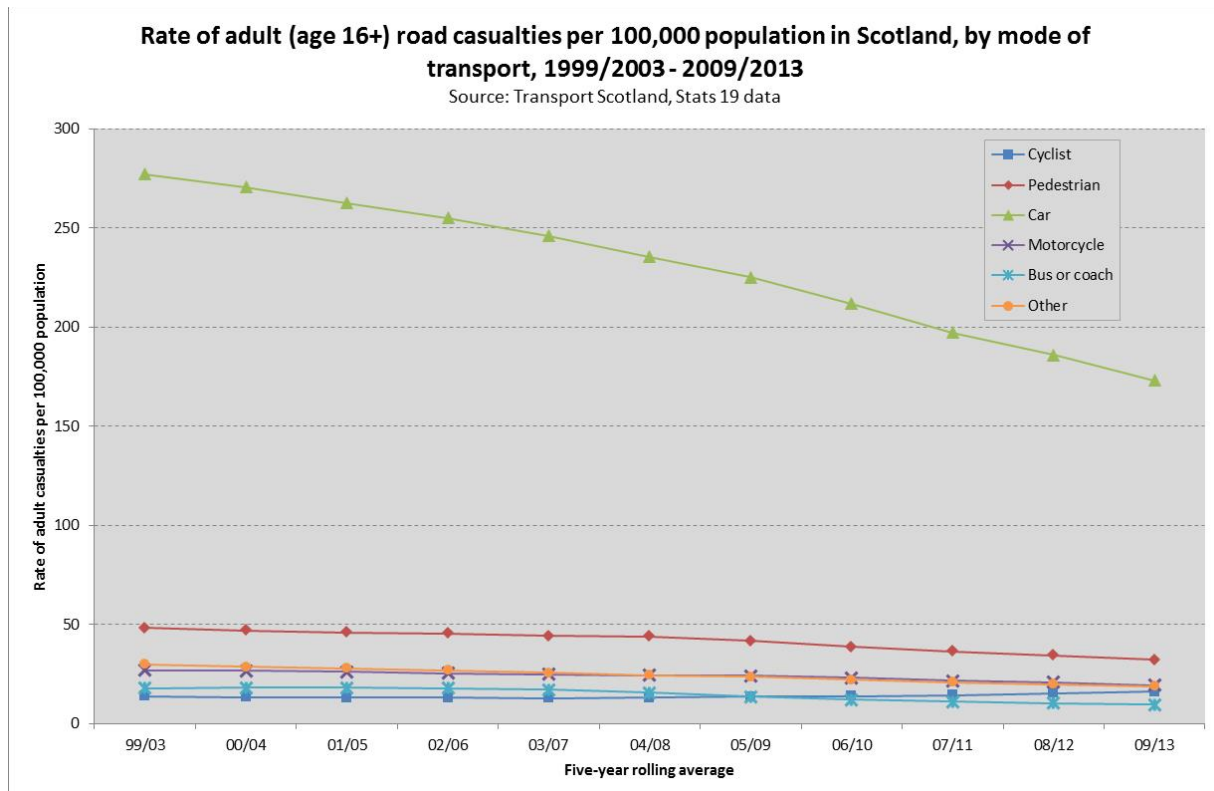
^{xi} Casualty trends in each of the graphs are based on five year moving averages e.g. the 1999/2003 casualty rate, is an annualised average based on 5 years of casualties from the period 1999 to 2003 divided by the average population in that 5-year period.

casualty rates for all modes of transport, with the exception of car casualties, show a decrease over the time period of over 50%; the rate of car casualties did decrease also, but to a slightly lesser degree, by 43% between 1999/2003 and 2009/2013.

5.1.2 Adults (aged 16 and over)

Figure 9 shows the rate of adult road accident casualties by mode of transport.

Figure 9: Rate of adult (age 16+) road casualties per 100,000 population in Scotland, by mode of transport, 1999/2003 - 2009/2013).



Over the whole time period (1999/2003 – 2009/2013), the majority of adult road casualties were those travelling by car. All modes of transport, apart from cycling, experienced a decrease in the casualty rate of between 27% and 47%. The adult cyclist casualty rate, however, rose overall during the decade by 16%, with the increase occurring between 2003/2007 and 2009/2013 – representing a 25% increase over that most recent period.

5.2 Pedestrian casualties

The rate of pedestrian casualties, as recorded in Stats19 data, decreased over the period 1999/2003 – 2009/2013 by 54% among children and by 34% among adults.

5.2.1 Pedestrian casualties by severity of injury

Figures 10 and 11 show pedestrian casualty rates by severity, as recorded in Stats19 data.

Figure 10: Rate of child (age 5-15) pedestrian casualties per 100,000 population in Scotland, by severity of injury, 1999/2003 - 2009/2013.

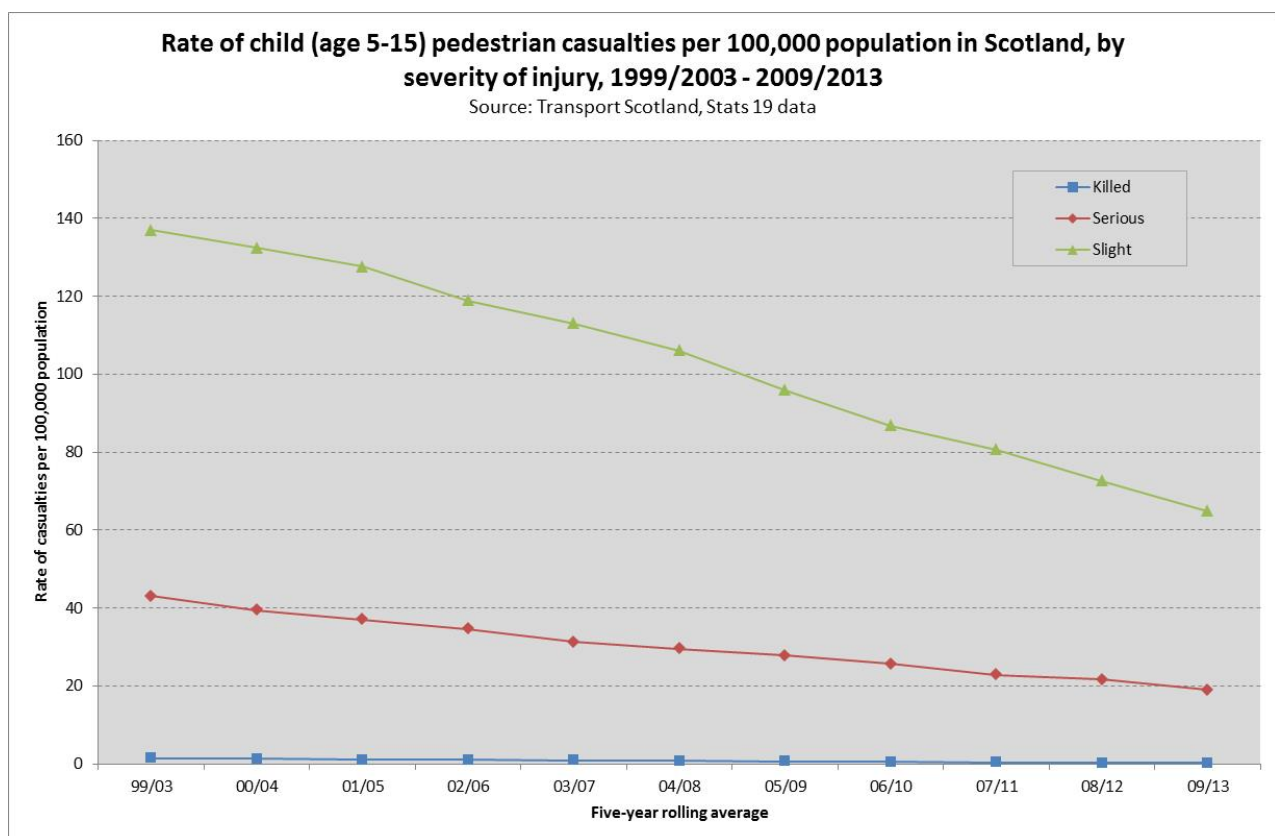


Figure 10 shows that casualty rates for child pedestrians in each severity category have decreased consistently in Scotland in the last decade, with each category of casualty having fallen by over 50%. The rate of child pedestrians being killed in road accidents has dropped by 81%. It should be noted that the number of children killed in road accidents as pedestrians is small compared with other accident severities, ranging from one to 16 deaths in individual years between 1999 and 2013.

Over the time period, there were consistently at least three times as many child pedestrian casualties with slight injuries compared with casualties who were killed or had serious injuries.

Figure 11: Rate of adult (age 16+) pedestrian casualties per 100,000 population in Scotland, by severity of injury, 1999/2003 - 2009/2013.

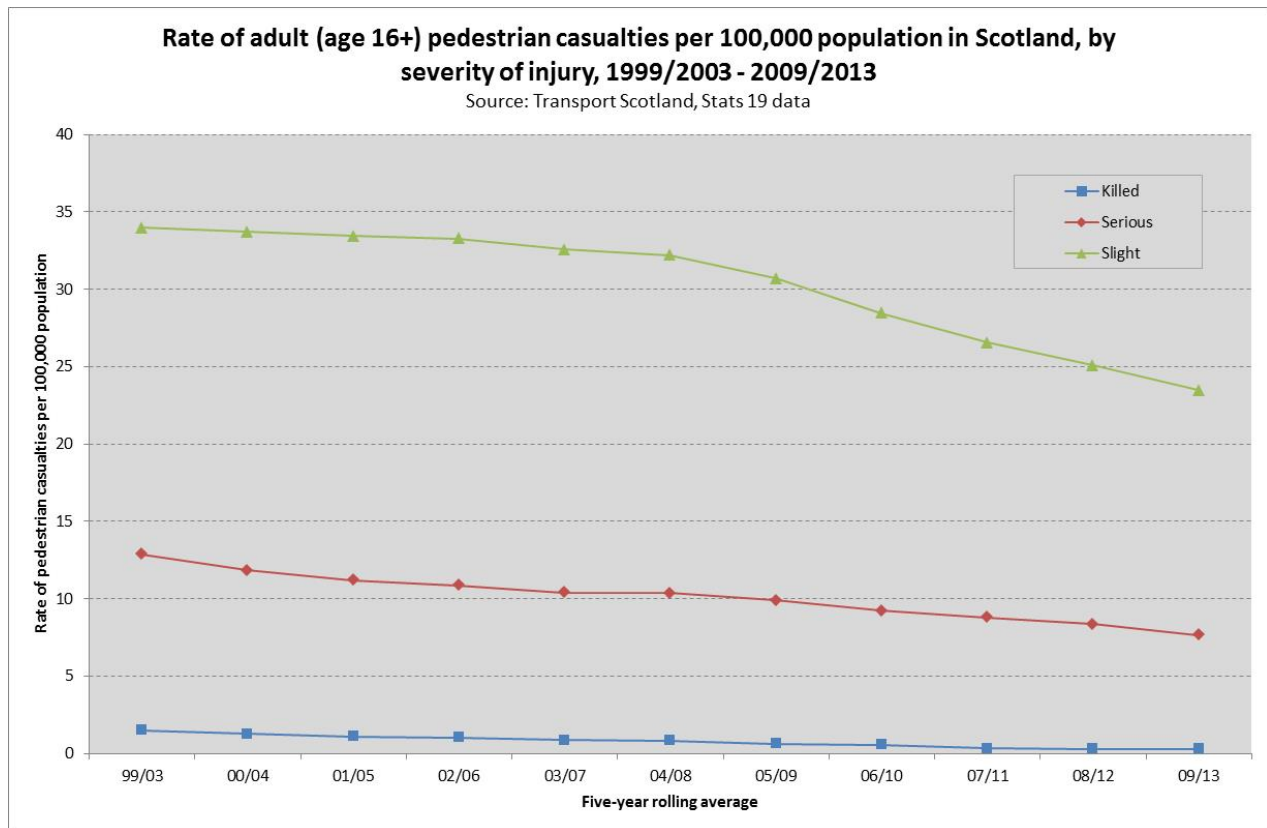


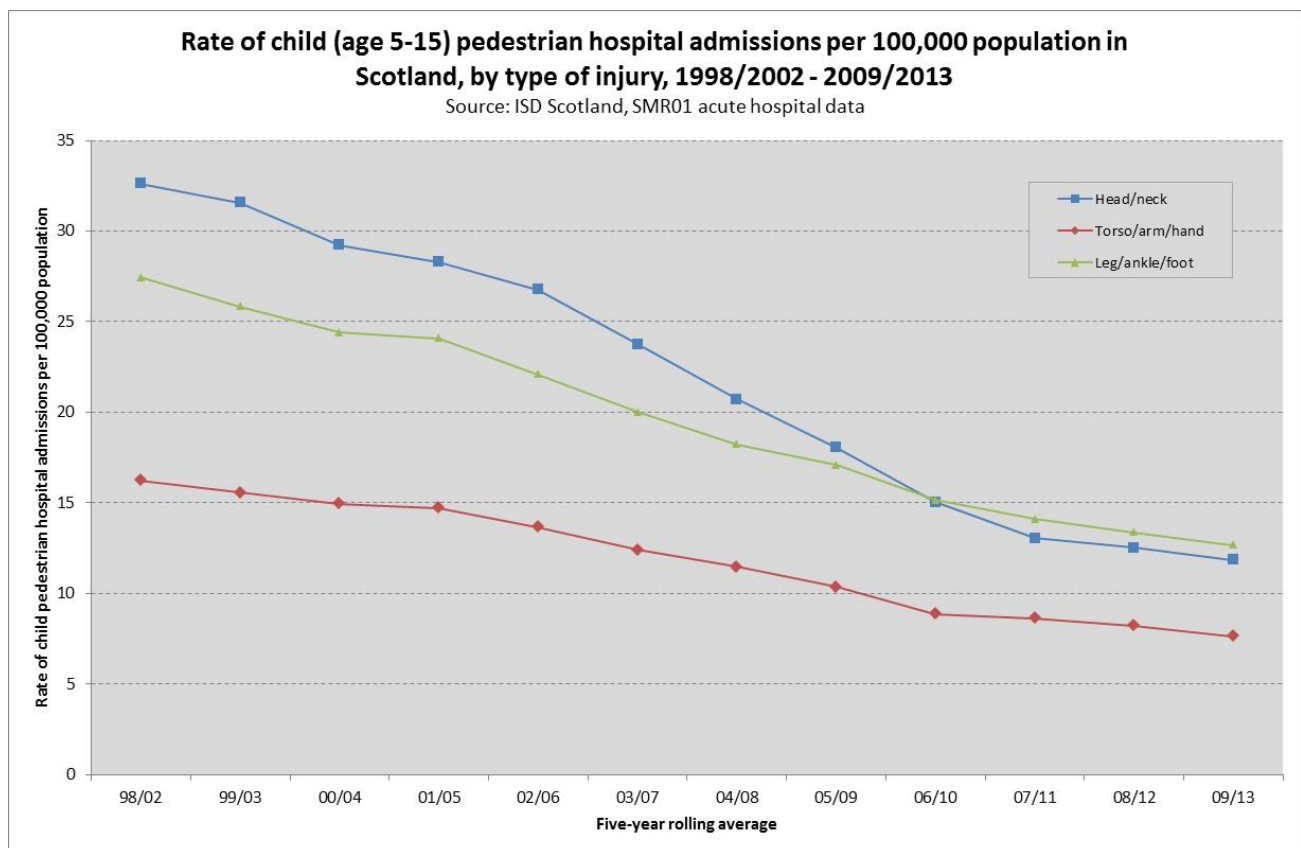
Figure 11 shows that pedestrian casualty rates among adults in each severity category have decreased consistently in Scotland, with casualties in each category having fallen by 30-40% between 1999/2003 and 2009/2013. The rate of adult pedestrian casualties who were slightly injured decreased slowly until the 2004/2008 period, at which point a steeper decrease becomes apparent.

Over the time period, there were consistently approximately two-and-a-half times as many adult casualties with slight injuries, as casualties who were killed or had serious injuries.

5.2.2 Pedestrian casualties by type of injury

This section considers pedestrian casualty rates by the type of injury sustained. Patients who were diagnosed with multiple injuries in more than one part of the body are counted in each relevant category.

Figure 12: Rate of child (age 5-15) pedestrian hospital admissions per 100,000 population in Scotland, by type of injury, 1998/2002 - 2009/2013.



From Figure 12, a general downward trend can be observed in child pedestrian injury rates for each type of injury (head/neck, torso/arm/hand and leg/ankle/foot). *Head and neck* injuries show the biggest decrease, decreasing by 64% between the 1998/2002 and 2009/2013 five year periods. Although in the earliest periods, head and neck injuries are the most common injury among children, by 2009/13 *leg, ankle and foot injuries* had become more common. *Torso, arm and hand injuries* were consistently the least common.

Figure 13: Rate of adult (age 16+) pedestrian hospital admissions per 100,000 population in Scotland, by type of injury, 1998/2002 - 2009/2013).

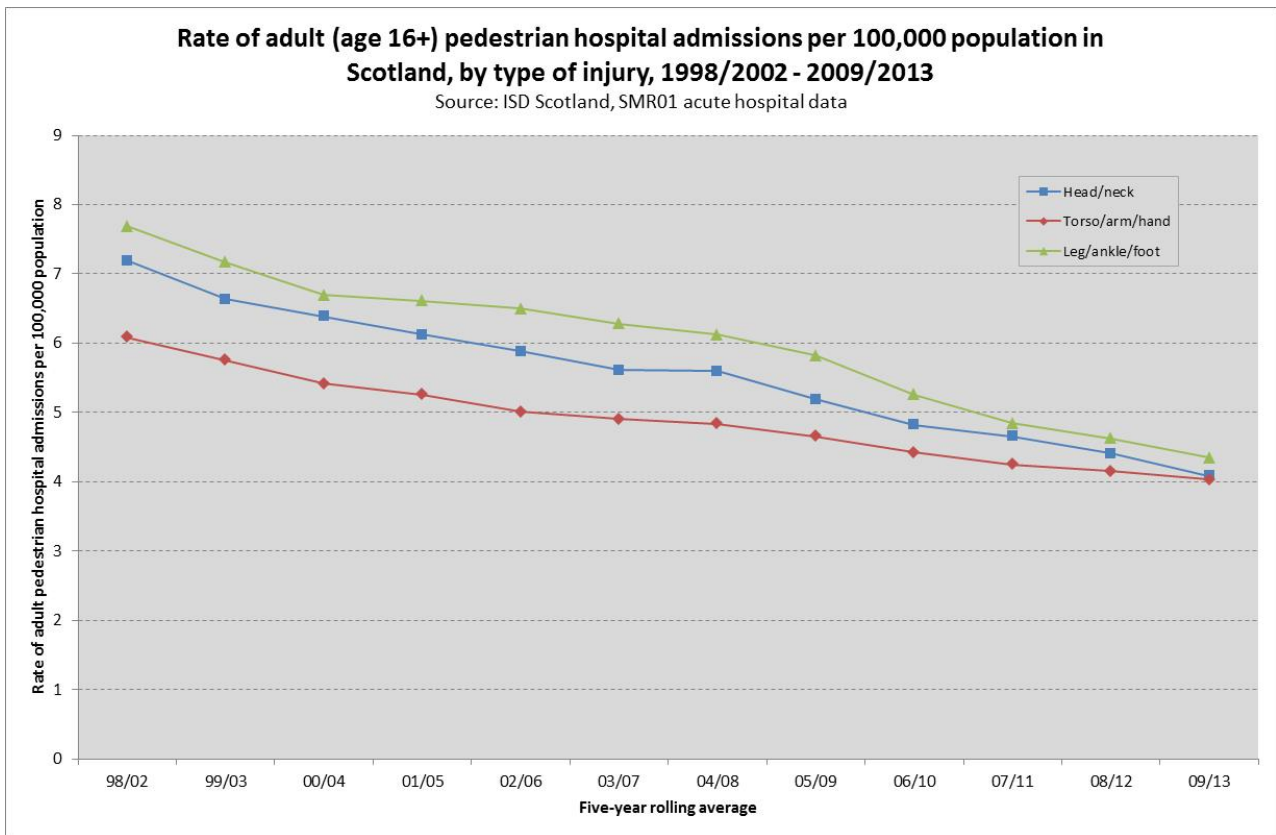


Figure 13 shows that among adult pedestrian casualties, the most common injury area to be diagnosed in hospital has consistently been *leg, ankle and foot injuries*. The rate of injuries has dropped for each category, dropping most steeply for *head and neck* and *leg, ankle and foot injuries*, with both rates falling by approximately 43% between 1998/2002 and 2009/2013.

5.2.3 Pedestrian casualties by gender

Casualty rate data by gender were analysed using hospital admission data.

Figure 14: Rate of pedestrian hospital admissions per 100,000 population in Scotland, by age and gender, 1998/2002 - 2009/2013.

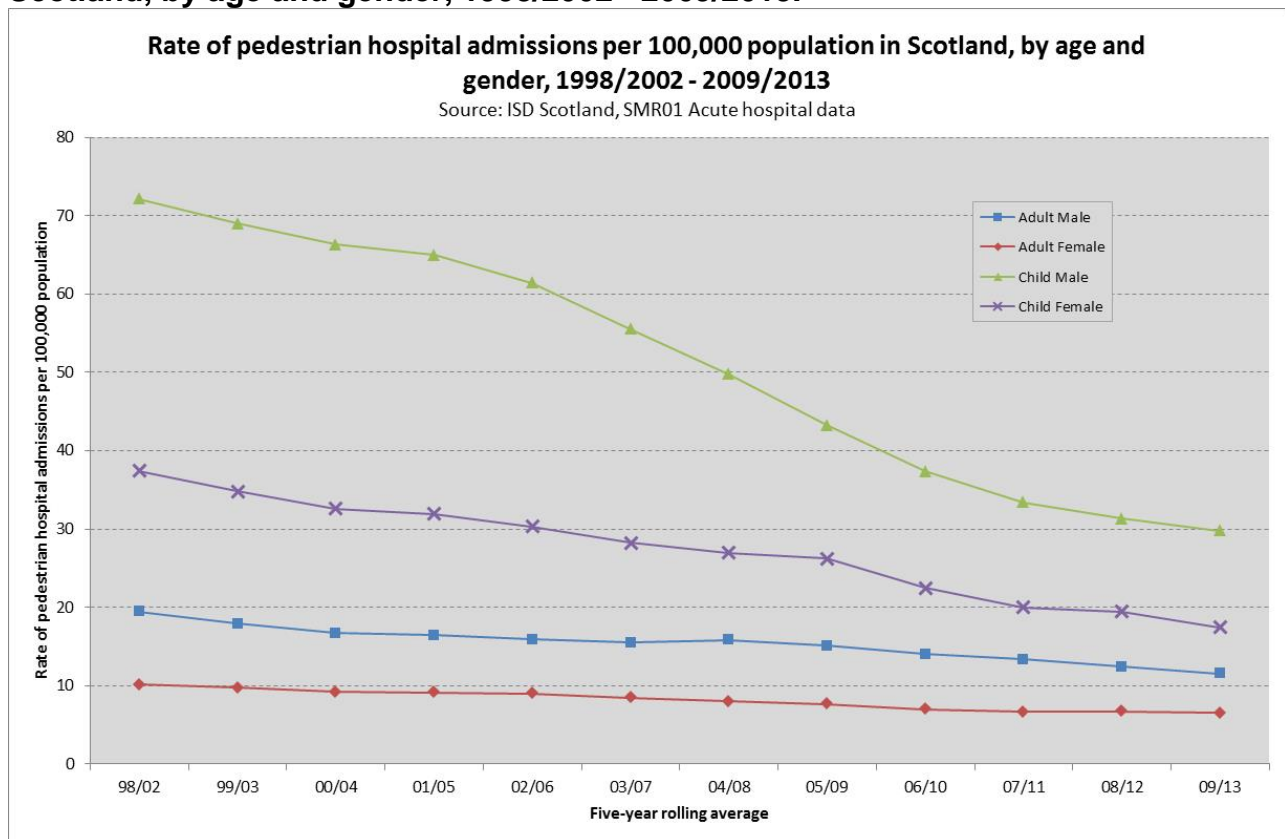


Figure 14 shows that hospital admission rates for pedestrian casualties have fallen consistently for males and females among both adults and children between 1998/2002 and 2009/2013. Child pedestrian casualty rates for both males and females dropped the most steeply, falling by over 50%. Adult male and female casualties also showed a consistent decrease, of 40% and 35%, respectively. However, child pedestrian casualty rates were consistently higher than adult pedestrian casualty rates.

Pedestrian casualty rates among both adult males and boys showed a bigger decrease over the time period than the equivalent rates for females. Nevertheless, among adults and children, males were more than one-and-a-half times more likely to be a pedestrian casualty compared with females over the time period.

5.2.4 Pedestrian casualties by urban/rural classification

Figure 15 shows trends in child pedestrian casualties by the Scottish Government's six-fold urban/rural classification.

Figure 15: Rate of child (age 5-15) pedestrian casualties per 100,000 population in Scotland, by six-fold urban/rural classification, 1999/2003 - 2009/2013.

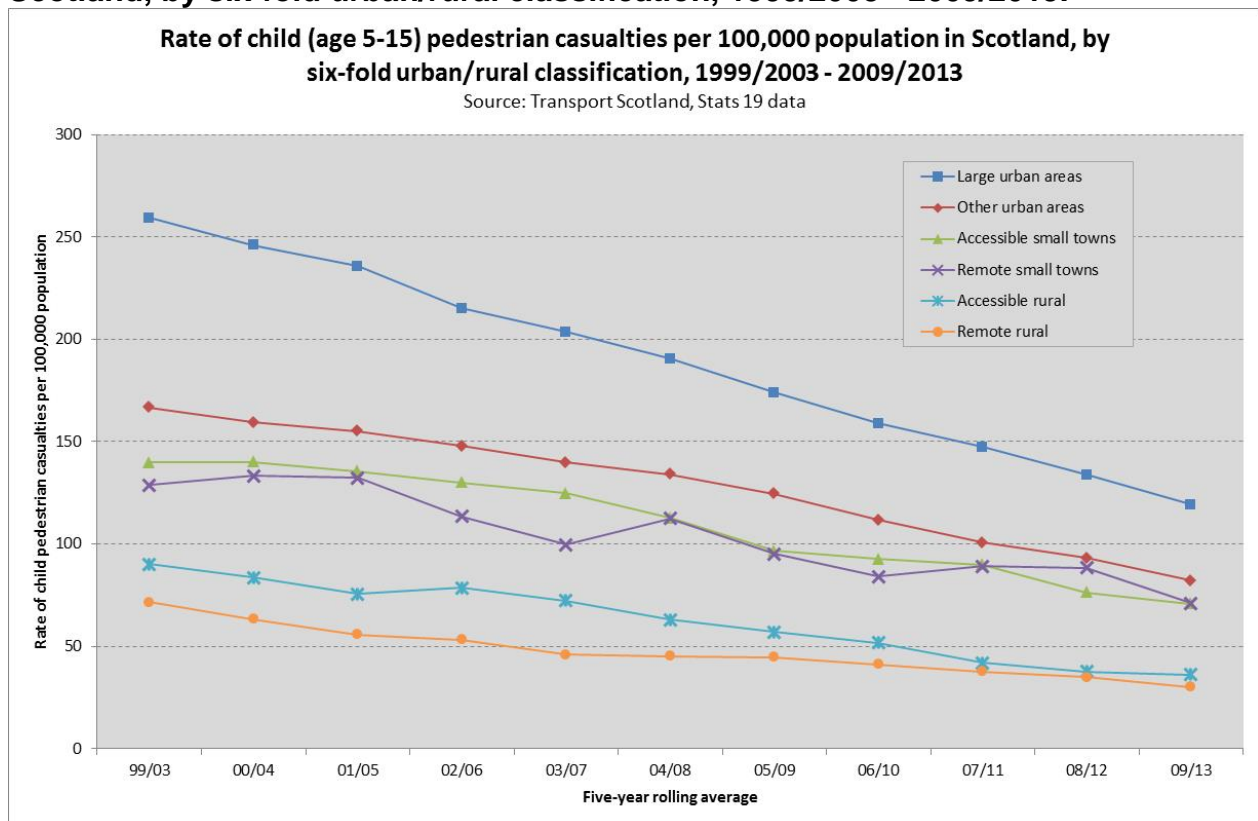


Figure 15 shows a general downward trend in child pedestrian casualties across all six urban rural categories. The most noticeable drop has been in large urban areas, although this category has consistently had the highest rate of child pedestrian casualties.

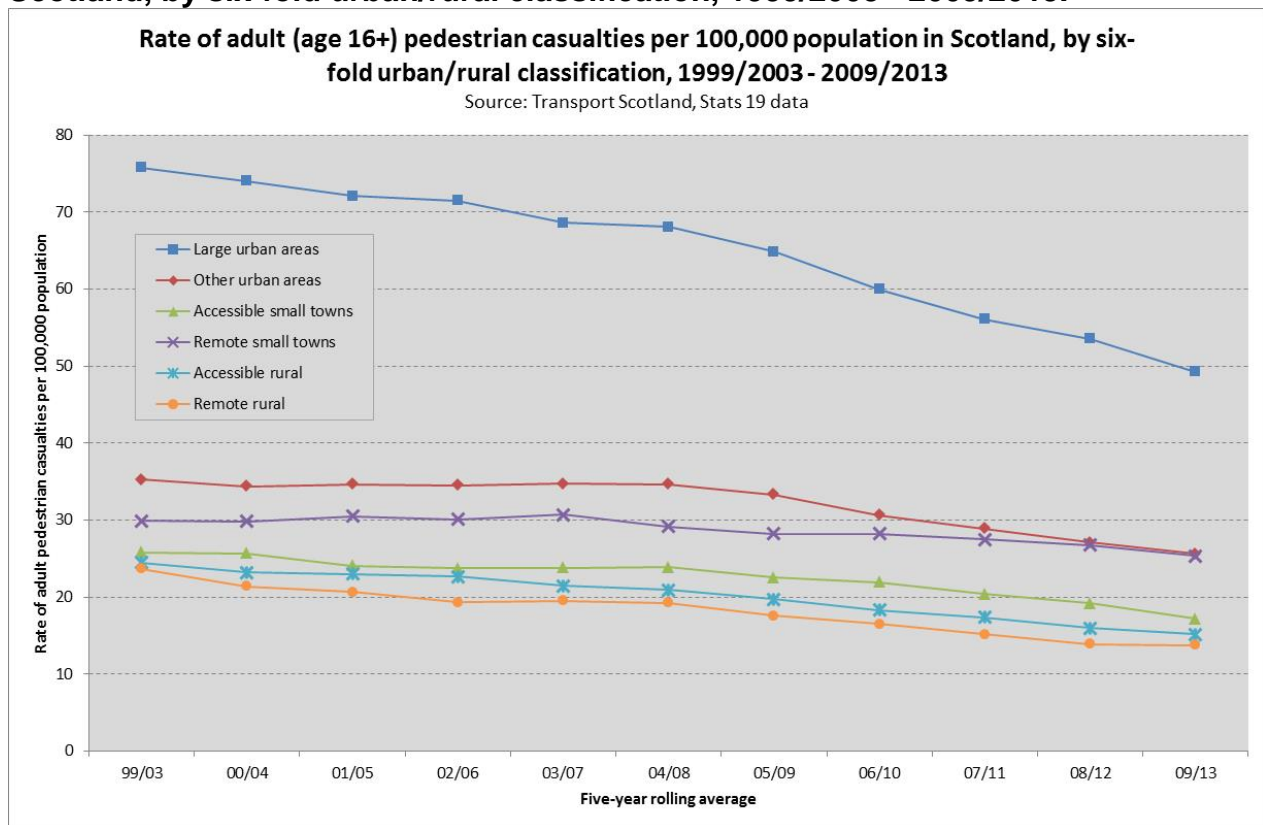
The casualty rates follow a fairly consistent pattern with the highest casualty rates in the most urban areas and the lowest in the most rural areas, apart from categories 3 and 4 (accessible small towns and remote small towns), which cross each other, suggesting less variation in child pedestrian casualty rates in small towns.

The gap between large urban areas and remote rural areas stays reasonably consistent between 1999/2003 and 2009/2013, with children in large urban areas being approximately four times more likely to have been injured as a pedestrian compared with children in remote rural areas.

Child pedestrian hospital admissions – not shown – have a similar ordering, with admission rates consistently highest for those residing in large urban areas. There is also a downward trend notable across all the urban/rural classifications.

Figure 16 shows rates of adult pedestrian casualties by urban/rural classification.

Figure 16: Rate of adult (age 16+) pedestrian casualties per 100,000 population in Scotland, by six-fold urban/rural classification, 1999/2003 - 2009/2013.



The most pronounced decrease in adult pedestrian casualty rates is in large urban areas, although casualty rates remain highest in these areas. The rate of adult pedestrian casualties in the rest of the urban/rural categories appears to reduce with increasing rurality, apart from the accessible and remote small towns categories, where the remote small towns have consistently higher adult pedestrian casualty rates than the accessible small towns.

The gap in the adult pedestrian casualty rate between large urban areas and remote rural areas remained reasonably consistent between 1999/2003 and 2009/2013, with adults in large urban areas being three times more likely to be a pedestrian casualty as adults in remote rural areas.

Trends in the rate of adult pedestrian hospital admissions – not shown – have a similar ordering, with admission rates consistently highest in large urban areas and there is a similar downward trend in each of the urban/rural classifications.

5.2.5 Pedestrian casualties in selected Scottish cities

In this section pedestrian casualties recorded by the police and via hospital admissions are compared for adults and children in the four largest cities in Scotland – Glasgow, Edinburgh, Aberdeen and Dundee. It is worth noting that the previous section showed that the prevalence of walking for commuting varied between these four cities, and over time.

Figure 17: Rate of child (age 5-15) pedestrian casualties per 100,000 population in selected Scottish cities, 1999/2003 - 2009/2013.

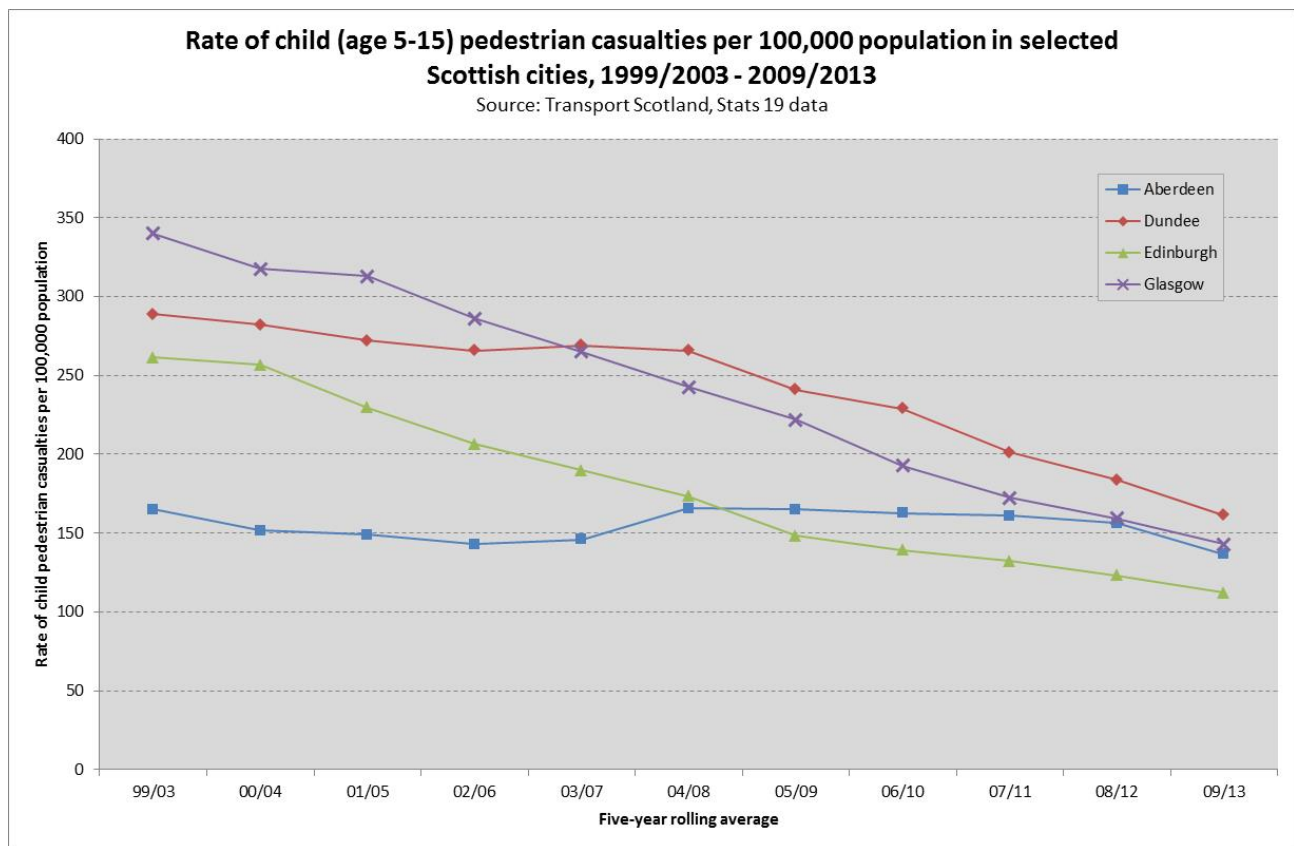
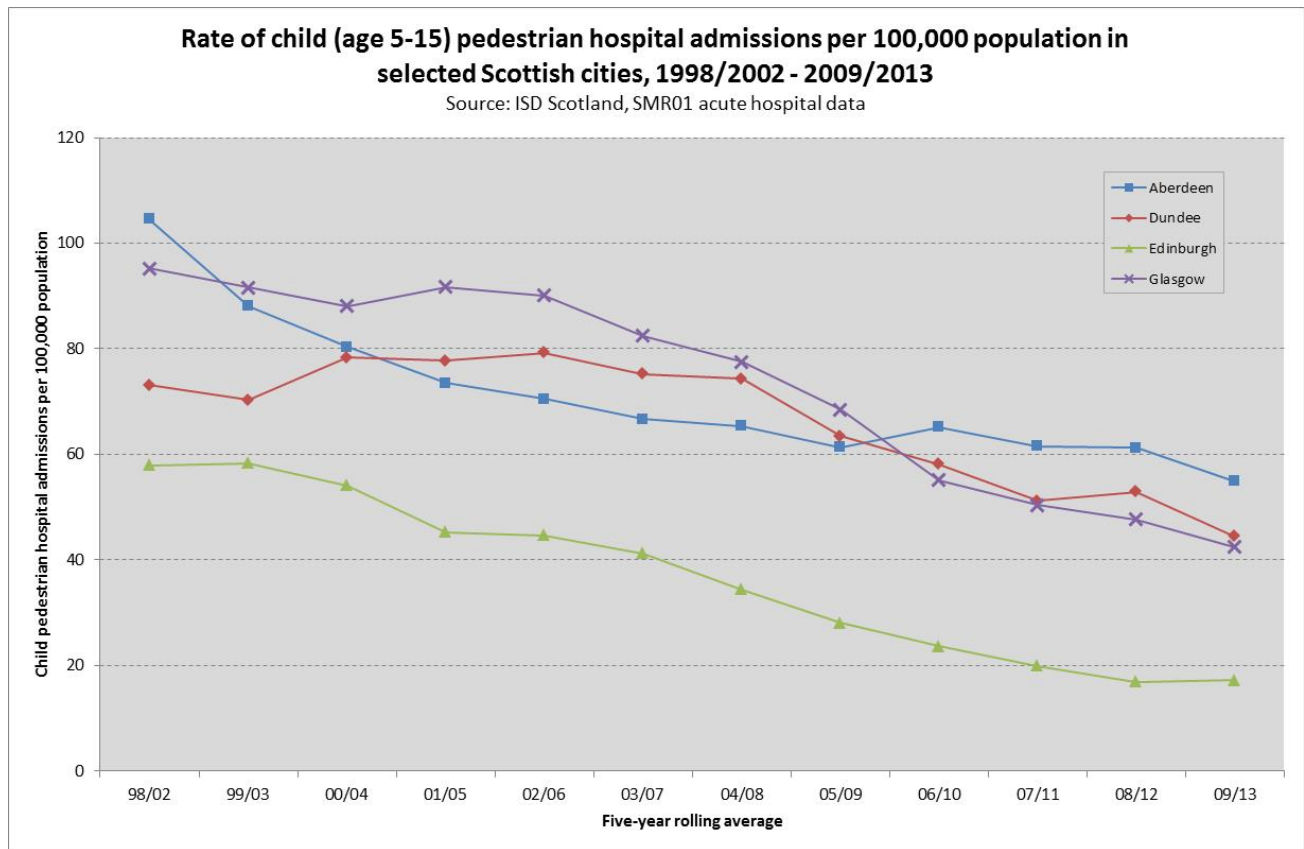


Figure 17 shows that in terms of casualty recording based on police reporting, there have been notable reductions in child pedestrian casualties in all the cities with the exception of Aberdeen, where the casualty rate has fluctuated and there has only been a modest overall reduction in casualties in the period. Edinburgh and Glasgow recorded the biggest decreases in child pedestrian casualty rates over the time period, with both showing reductions of over 50%.

The raw numbers of casualties represented by the rates shown are relatively small, but not insignificant; for example, the Glasgow rate was equivalent to 300 pedestrian casualties in 1999 and 61 in 2013.

Figure 18 shows child pedestrian hospital admissions based on the SMR01 dataset.

Figure 18: Rate of child (age 5-15) pedestrian hospital admissions per 100,000 population in selected Scottish cities, 1998/2002 - 2009/2013.



The trend in casualties based on this source was also downward, with drops over the period of at least 39% across all the cities, and by 70% in Edinburgh, where the rate of child pedestrian hospital admissions was consistently the lowest of the four cities. The relative difference in casualty rates comparing the four cities is likely, at least in part, to be due to different recording processes in the four cities and between the two data sources.

Figure 19 shows adult pedestrian casualty rates for selected Scottish cities based on police records.

Figure 19: Rate of adult (age 16+) pedestrian casualties per 100,000 population in selected Scottish cities, 1999/2003 - 2009/2013.

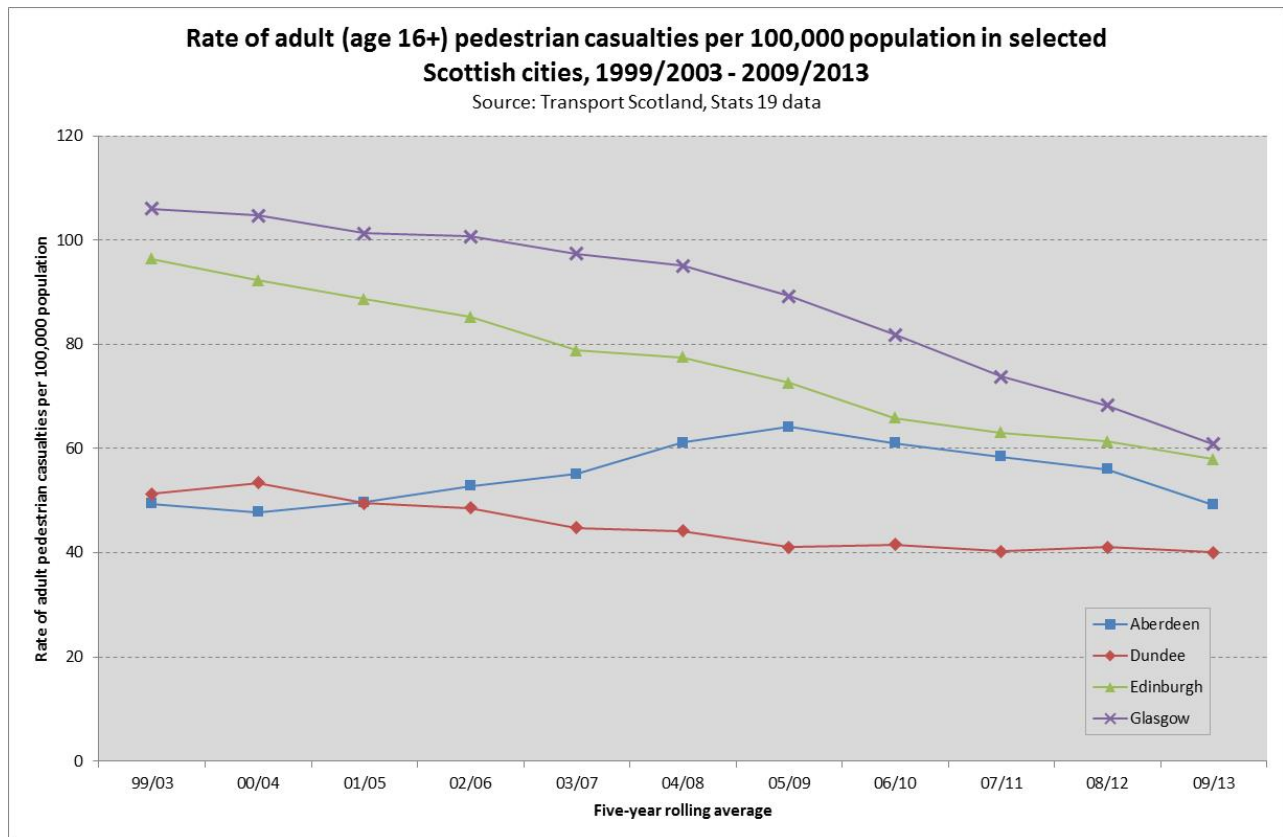


Figure 19 shows that among adults, police recorded pedestrian casualty rates decreased notably in Glasgow and Edinburgh, by 43% and 40%, respectively between 1999/2003 and 2009/2013. Aberdeen and Dundee show a much smaller decrease, 1% and 22% respectively. As a result of these different trajectories, the differences in the adult pedestrian casualty rate between the four cities have narrowed over the time period.

Figure 20 shows the rate of hospital admissions for adult pedestrian casualties.

Figure 20: Rate of adult (age 16+) pedestrian hospital admissions per 100,000 population in selected Scottish cities, 1998/2002 - 2009/2013.

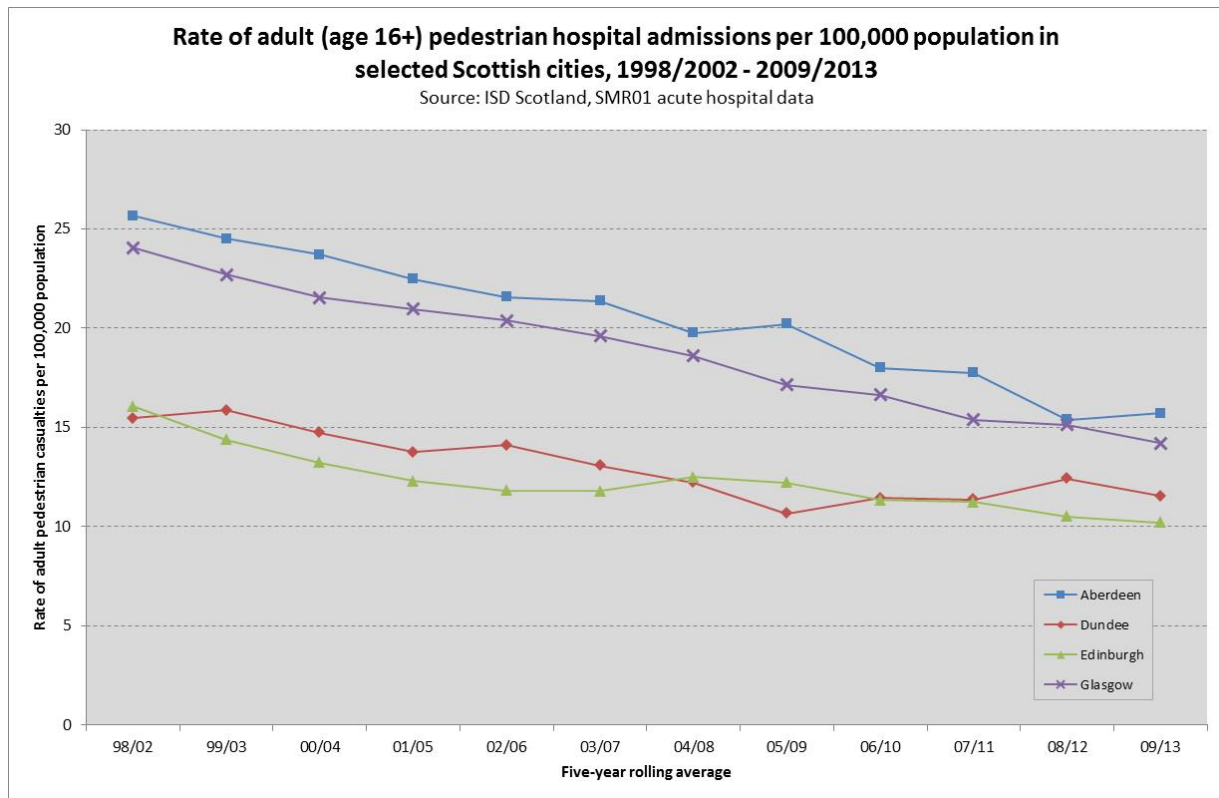
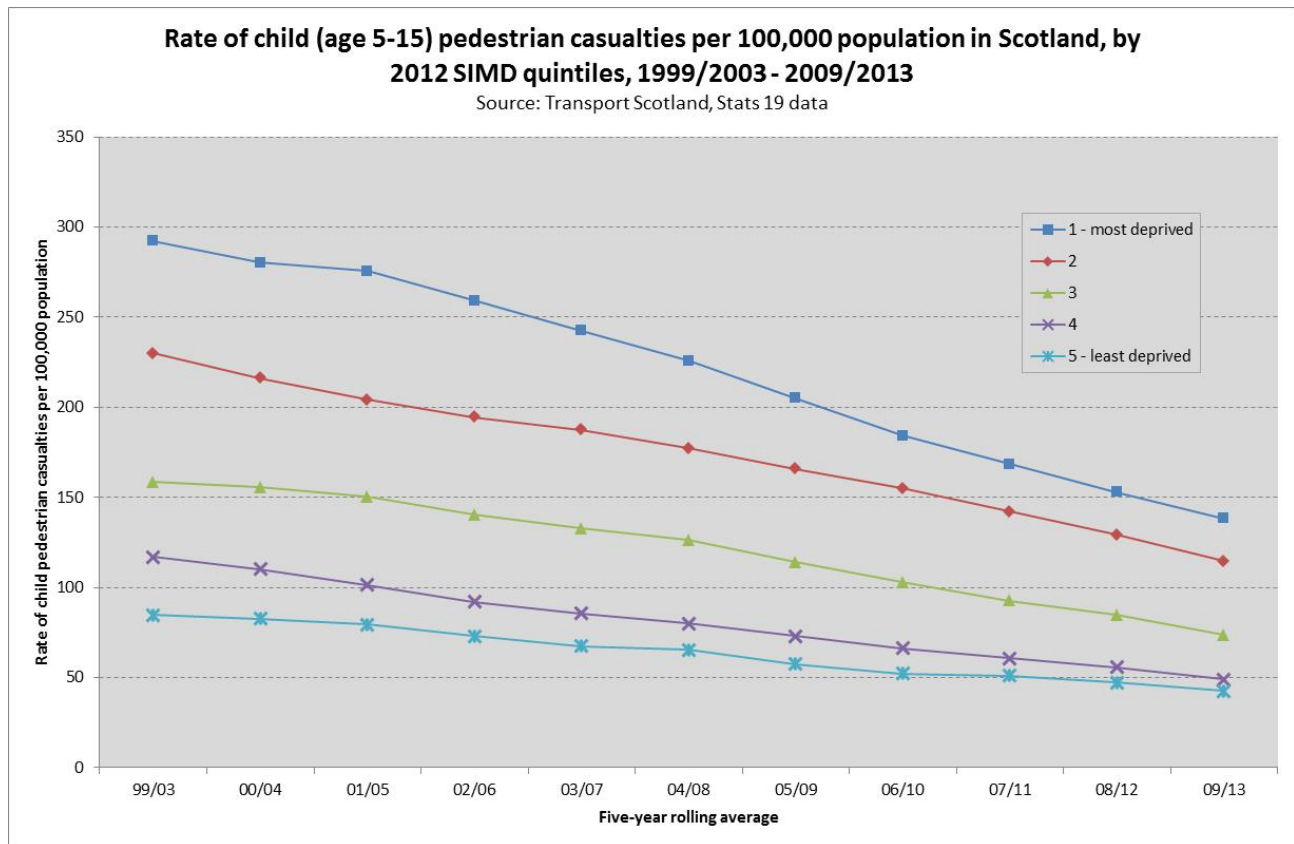


Figure 20 shows that adult pedestrian casualty admission rates have fallen in all the cities but have been consistently higher in Aberdeen than in the three other Scottish cities over the period 1998/2002 – 2009/2013. Glasgow showed the largest reduction in the casualty rate over the time period, falling by 41%. The inconsistency in relative ranking of casualty rates by city comparing between the two data sources suggests that there are different recording processes operating in the four cities and between the two data sources.

5.2.6 Pedestrian casualties by deprivation

Figure 21 shows trends in child (age 5-15) pedestrian casualties by deprivation category, as observed from data derived from police recorded Stats19 data.

Figure 21: Rate of child (age 5-15) pedestrian casualties per 100,000 population in Scotland, by 2012 SIMD quintiles, 1999/2003 - 2009/2013.



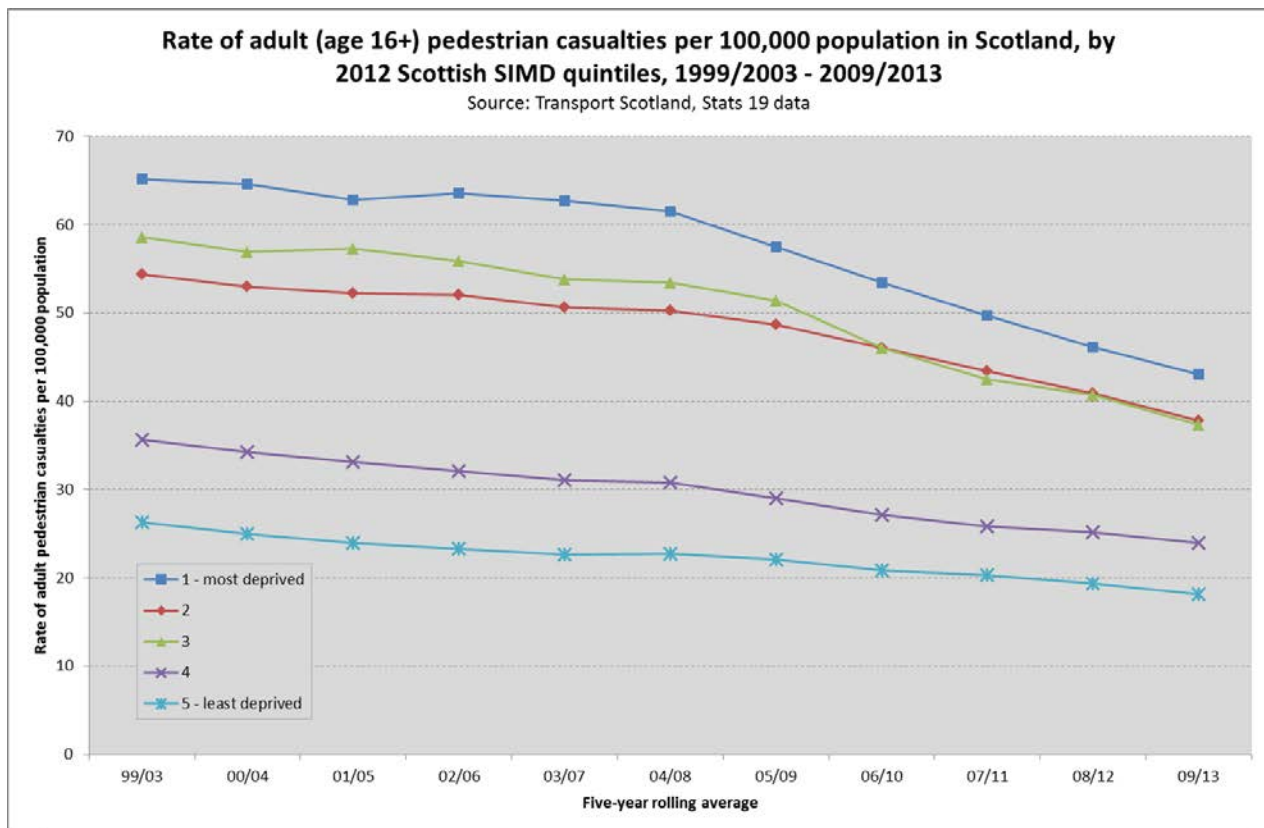
The rate of child pedestrian casualties fell by 50-60% in each of the SIMD deprivation quintile categories shown over the period 1999/2003 - 2009/2013. Across each five-year period the casualty rates by deprivation category (based on the location of the accident) appear in a consistent numerical order, with category 1 (representing the 20% most deprived areas) having the highest rate of casualties, and category 5 (representing the 20% least deprived areas) having the lowest rate of casualties.

Over the time period, there were consistently between three to four times as many child pedestrian road casualties occurring in the most deprived areas as in the least deprived areas based on police reporting.

A similar analysis of casualty hospital admission data – not shown – shows that there were between three to four times as many child pedestrian hospital admissions for children residing in the most deprived areas compared with the least deprived areas between 1998/2002 and 2009/2013.

Figure 22 shows trends in adult (age 16 and over) pedestrian casualties by deprivation category, as observed by the police in Stats19 data.

Figure 22: Rate of adult (age 16+) pedestrian casualties per 100,000 population in Scotland, by 2012 Scottish SIMD quintiles, 1999/2003 - 2009/2013.



The trend in adult pedestrian casualties by deprivation is similar to that for child casualties, displaying a general downward trend in the casualty rates across all deprivation quintiles. For adults, the reduction in the adult pedestrian casualty rate is not as pronounced, with the decrease over the time period from 1999/2003 – 2009/2013 being around 30-40% in each category. The adult pedestrian casualty rates based on police recording are consistently two-and-a-half times higher in the most deprived areas compared with the least deprived areas.

SMR01 hospital admission data – not shown – highlight a similar pattern. The rate of adult pedestrian casualties admitted to hospital from the most deprived areas was between 2.7 and 3 times higher than the rate in the least deprived areas over the period 1998/2002 and 2009/2013.

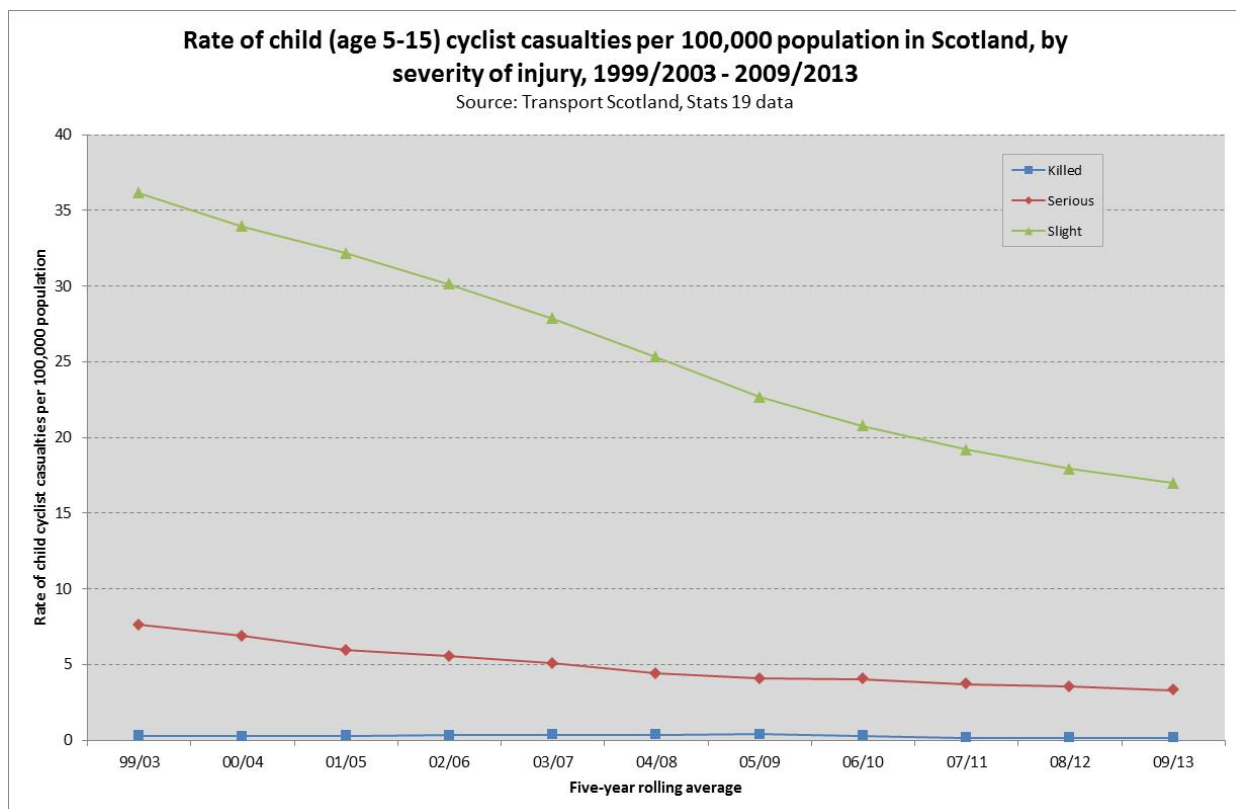
5.3 Cyclist casualties^{xii}

The rate of child cyclist casualties, as recorded in Stats19 data, decreased by 54% over the period 1999/2003 - 2009/2013. However, over the same period the rate of adult cyclist casualties rose by 16%.

5.3.1 Cyclist casualties by severity of injury

Figures 23 and 24 show cyclist casualty rates by injury severity for children and adults.

Figure 23: Rate of child (age 5-15) cyclist casualties per 100,000 population in Scotland, by severity of injury, 1999/2003 - 2009/2013.

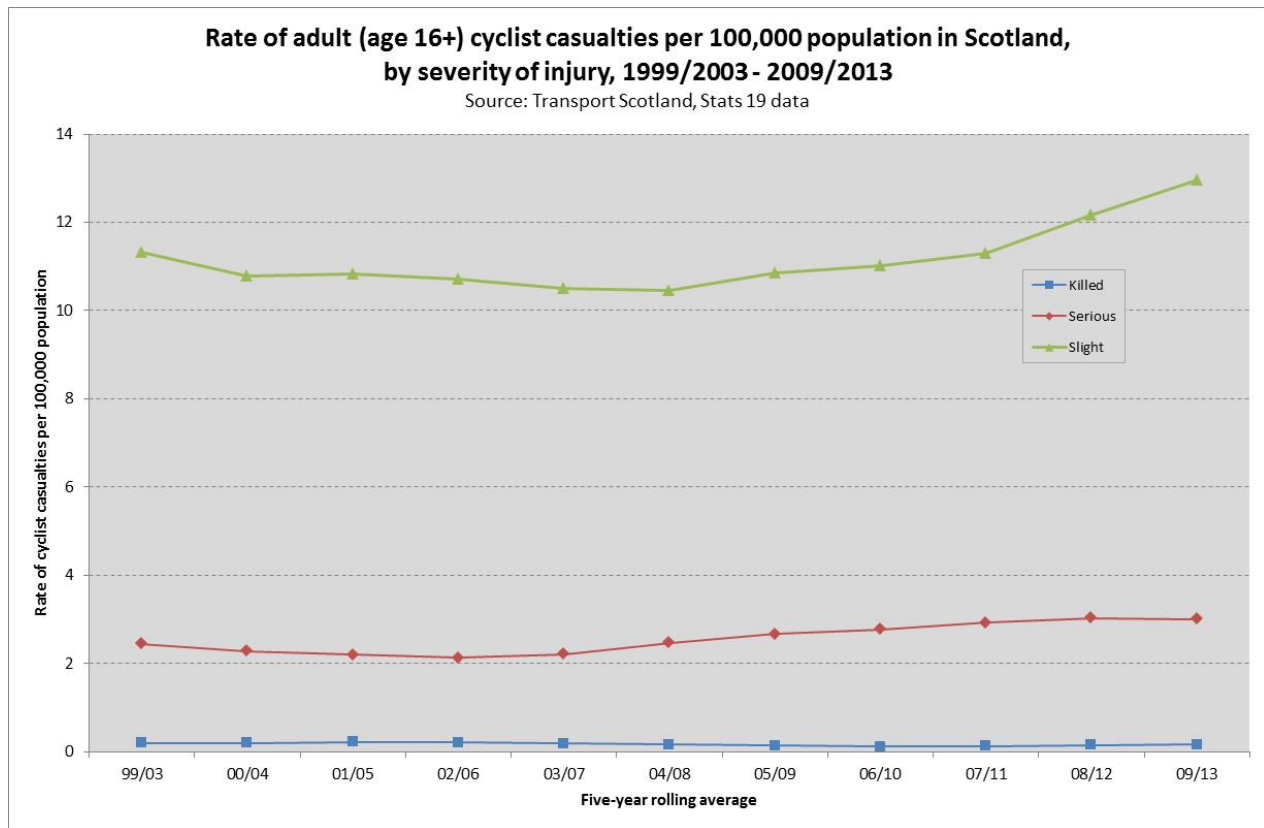


Severe and slight child cyclist casualties both decreased consistently over the time period, with each dropping by around 55% between 1999 and 2013. The underlying number of child cyclists who were killed ranged from 0 to 5 per year over the time period.

Over period studied, approximately five times as many child cyclists were injured slightly in road traffic accidents as were seriously injured or killed.

^{xii} Figures 23-37, which are referred to in this section, are included in Appendix C (along with other charts not shown in the report) available on the GCPH website.

Figure 24: Rate of adult (age 16+) cyclist casualties per 100,000 population in Scotland, by severity of injury, 1999/2003 - 2009/2013.



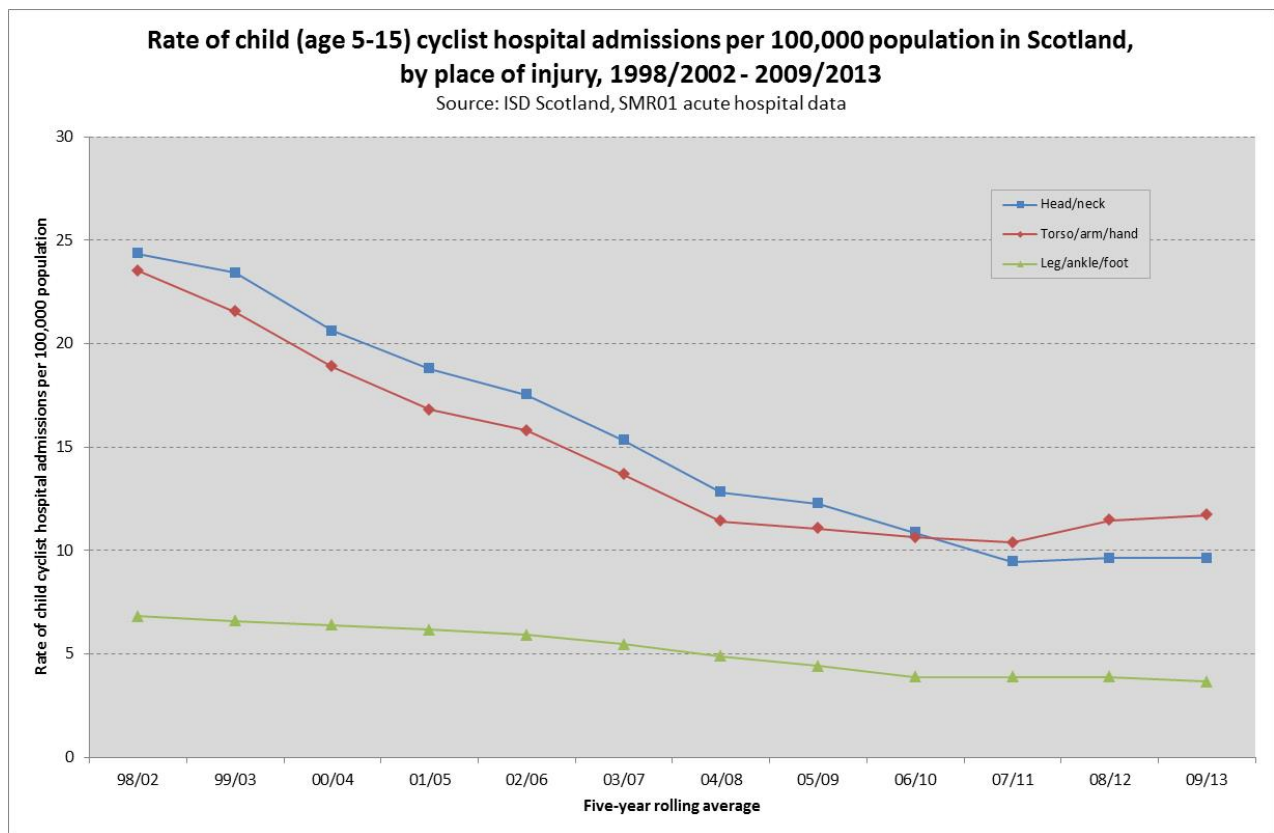
Adult cyclist casualties started to rise midway through the time period, from 2004/2008 onwards. The largest increase was in adult cyclist casualties who were slightly injured, for whom the casualty rate rose by 24% in the period 2004/2008 to 2009/2013.

Over the time period of analysis there was a consistent pattern of approximately four times as many adults being slightly injured each year in cycling accidents as were seriously injured or killed.

5.3.2 Cyclist casualties by type of injury

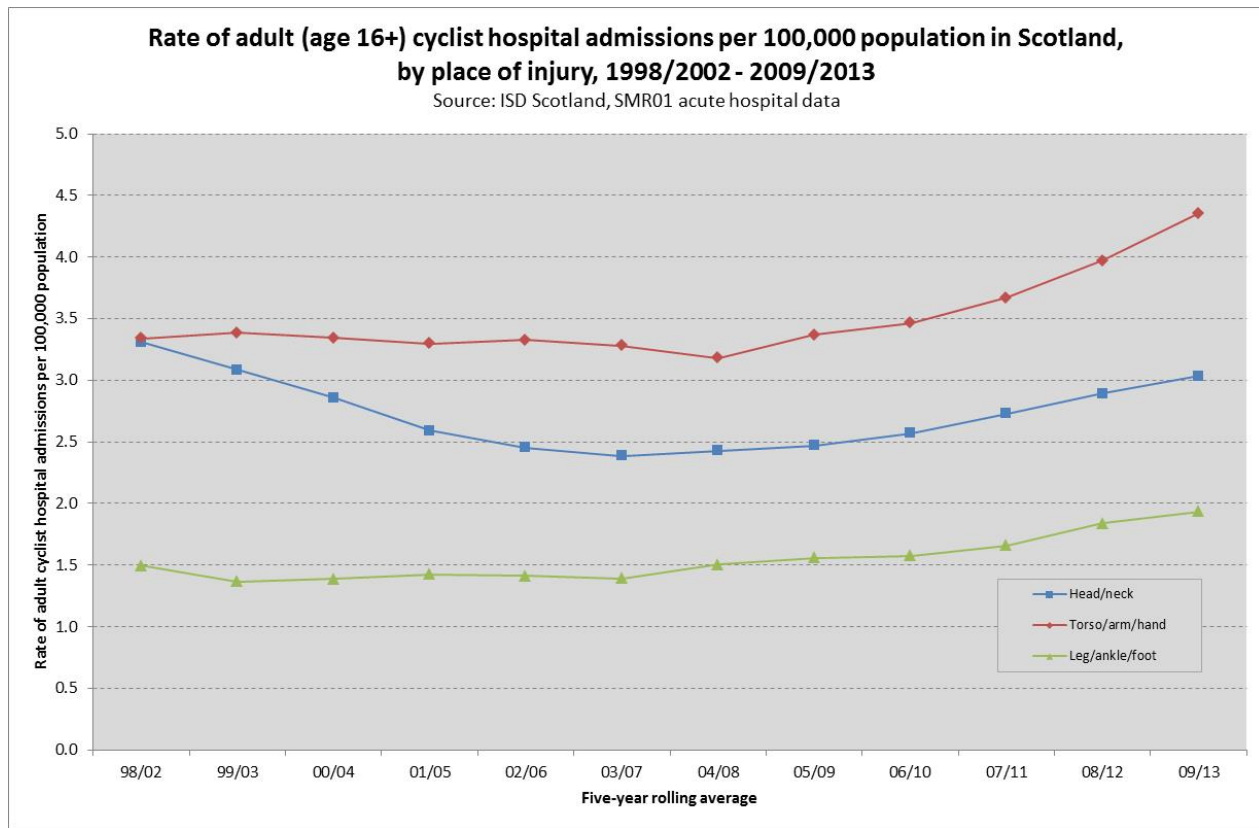
Figures 25 and 26 show cyclist hospital admission rates for children and adults respectively, by type of injury, as recorded by hospital admission data (SMR01).

Figure 25: Rate of child (age 5-15) cyclist hospital admissions per 100,000 population in Scotland, by type of injury, 1998/2002 - 2009/2013.



Among child cyclist casualties admitted to hospital, injuries to the upper body and head area have occurred at a consistently higher rate than injuries to the *legs, ankles and feet*. The upper body and head injury rates for child cyclists decreased steeply until the 2004/2008 five year period, after which rates have tended to level out and in the case of upper body injuries have increased slightly in the most recent years. Casualties with *head and neck injuries* showed the largest decrease over the period, falling by around 60%.

Figure 26: Rate of adult (age 16+) cyclist hospital admissions per 100,000 population in Scotland, by type of injury, 1998/2002 - 2009/2013.



Adult cyclist casualty admission rates for all three injury locations began to rise from approximately 2004/2008 onwards. This is particularly noticeable for *torso, arm and hand* injuries, which account for the highest rates of hospital admissions, and increased by 37% between 2004/2008 and 2009/2013.

5.3.3 Cyclist casualties in Scotland by gender

Figure 27 shows cyclist casualty hospital admission rates by gender for adults and children.

Figure 27: Rate of cyclist hospital admissions per 100,000 population in Scotland, by age and gender, 1998/2002 - 2009/2013.

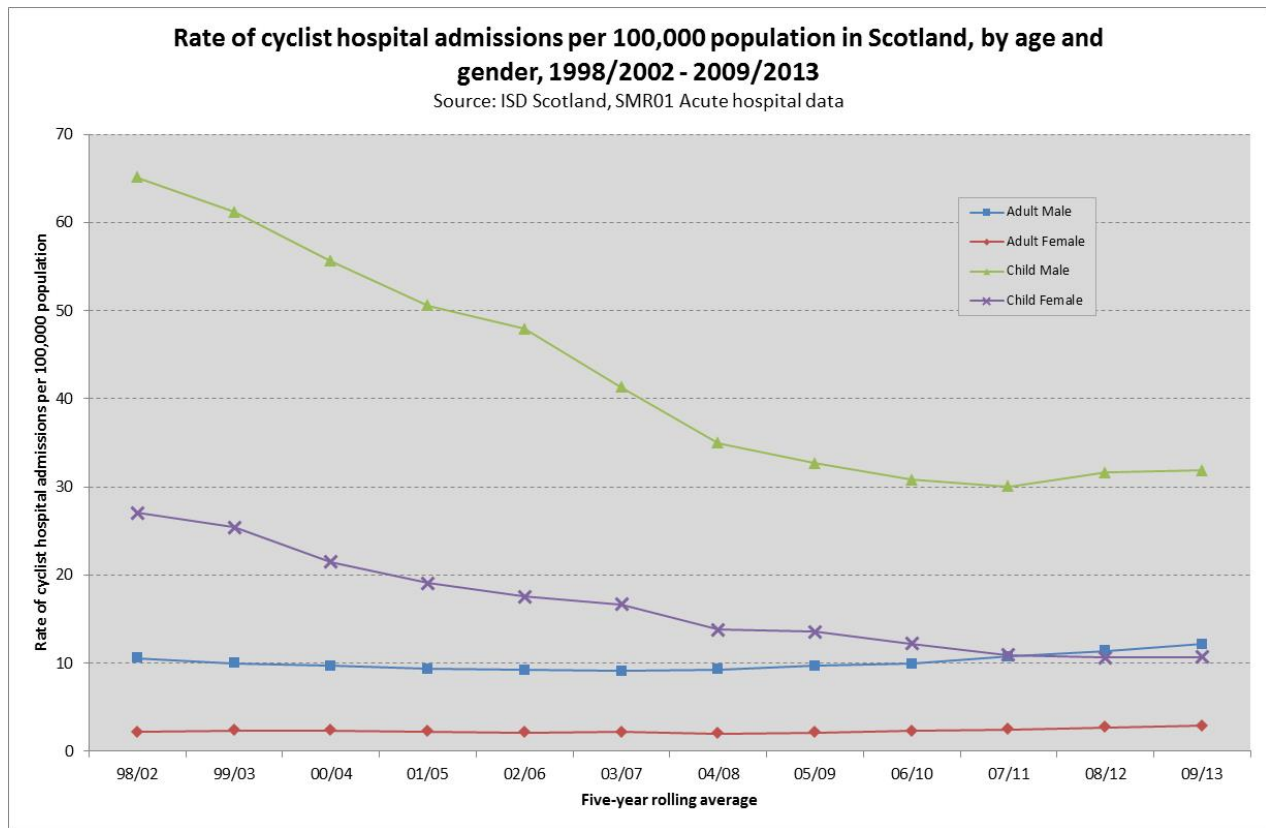


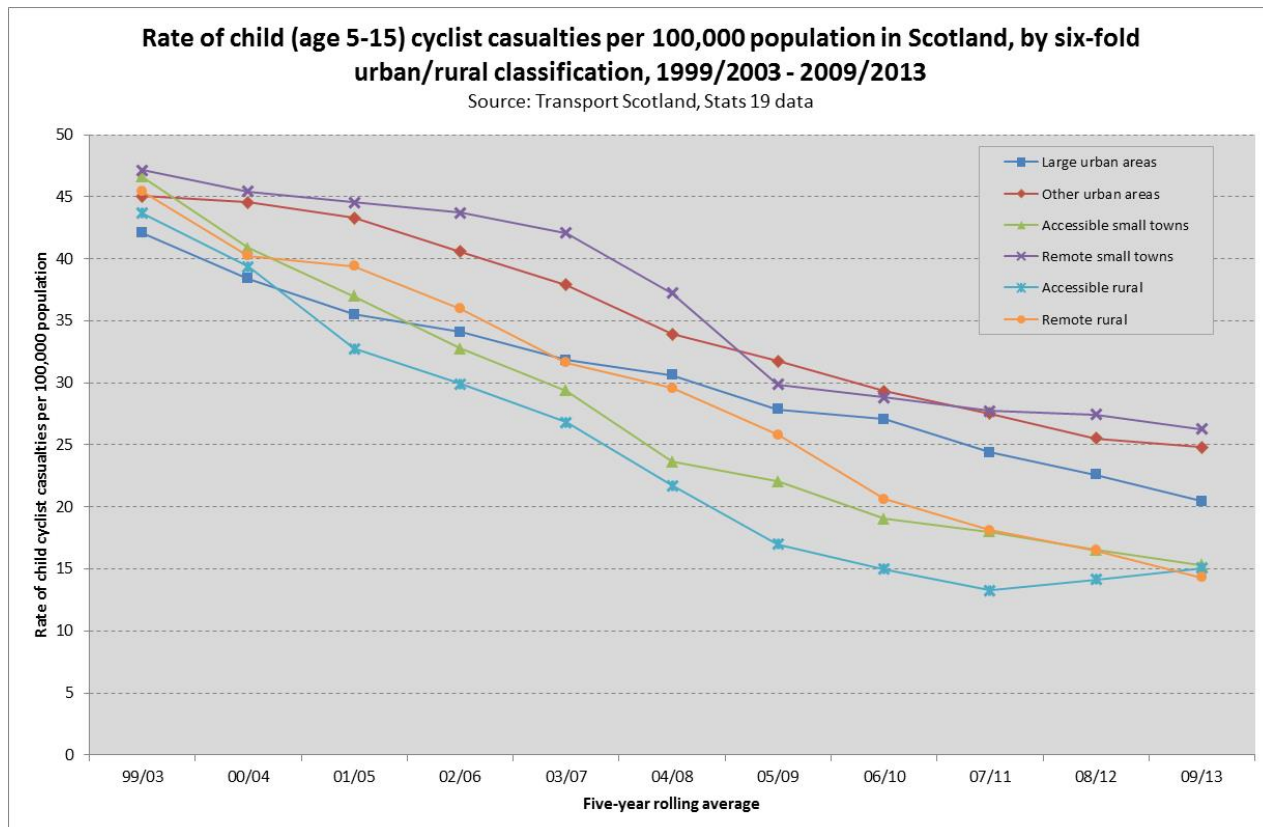
Figure 27 shows that, similarly to pedestrians, there are higher rates of cyclist casualties admitted to hospital among children of both genders in Scotland than among adults. The rate of adult male cyclist casualties admitted to hospital reduced until 2003/2007 but has risen since by 34% in the period 2003/2007 - 2009/2013. The rate of adult female cyclist casualties admitted to hospital also increased in the period 2004/2008 - 2009/2013 by 45%, albeit the female casualty rate is much lower. Overall, adult cyclist hospital admission rates increased from 5.5 per 100,000 in 2003/2007 to 7.4 per 100,000 in 2009/2013 (an increase of 34%). These rises are likely to reflect the increased prevalence of cycling and that there are more male cyclists. There was also a small rise in male child cyclist casualties from 2008/2012 onwards.

In the 2009/2013 period, the rate of child cyclist casualty hospital admissions for boys was three times that for girls. The gap was even greater among adults with men being approximately four times more likely to be a cyclist casualty requiring hospital admission than women.

5.3.4 Cyclist casualties by urban/rural classification

Figure 28 shows child cyclist casualties by urban/rural classification.

Figure 28: Rate of child (age 5-15) cyclist casualties per 100,000 population in Scotland, by six-fold urban/rural classification, 1999/2003 - 2009/2013.

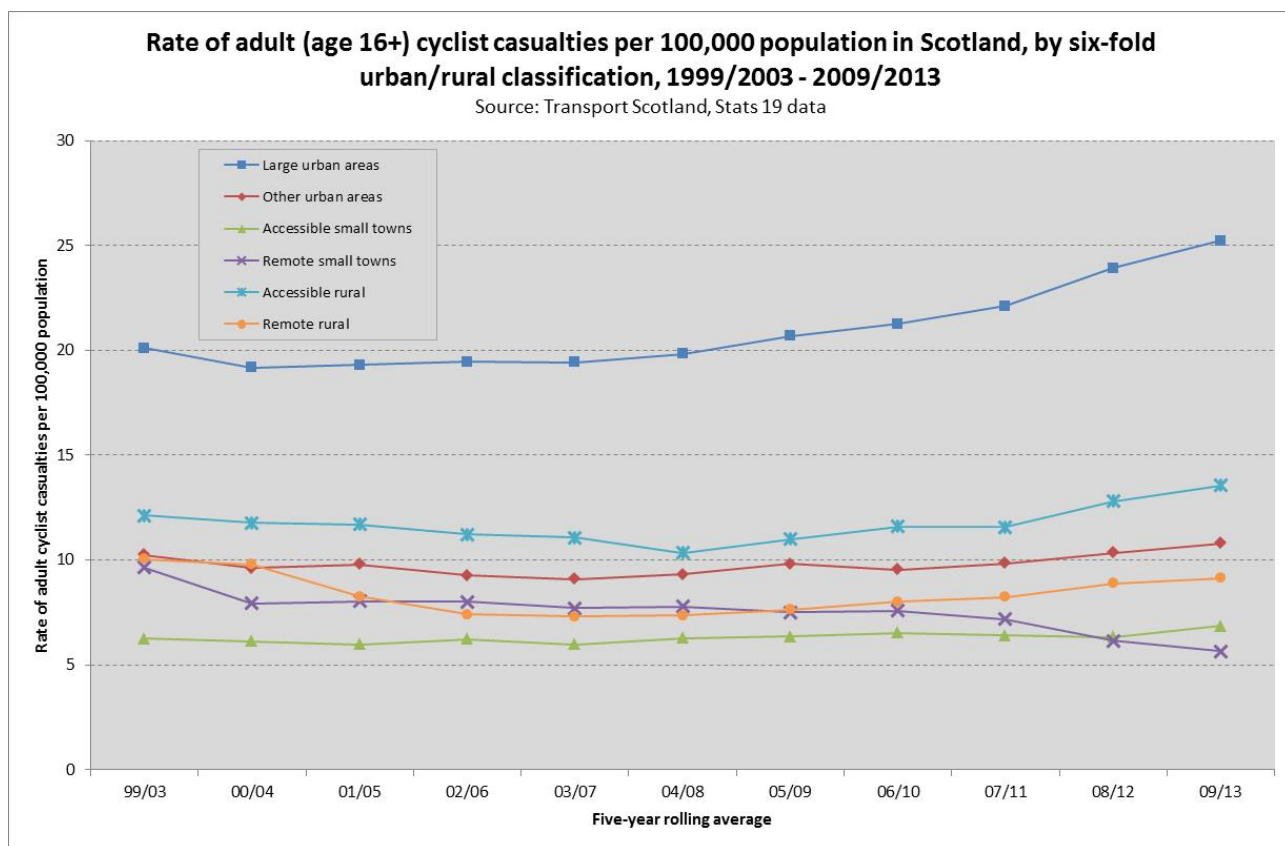


A decrease in the rate of child cyclist casualties based on police recording is noticeable in all urban/rural classifications between 1999/2003 and 2009/2013. The ordering of the categories is different from the order observed for pedestrian casualties. The highest child cyclist casualty rates are observed in the remote small towns category, with large urban areas having the third highest rate of child cyclist casualties in the most recent period (2009/2013).

Child cyclist hospital admissions – not shown – also appear to generally decrease. The highest hospital admission rate for child cyclists in 2009/2013 was for children residing in remote small towns.

Figure 29 shows adult cyclist casualty rates by urban/rural classification.

Figure 29: Rate of adult (age 16+) cyclist casualties per 100,000 population in Scotland, by six-fold urban/rural classification, 1999/2003 - 2009/2013.



Adult cyclist casualty rates rose in most urban/rural categories between the 2004/2008 and 2009/2013 periods, most noticeably in large urban areas, where the casualty rate rose by 27% over this period. The adult cyclist casualty rate in large urban areas was more than double the rate in any other category of area; in 2009/2013, there were over four times as many adult cyclist casualties per 100,000 population in large urban areas compared with remote small towns.

Rates of adult cyclist casualties admitted to hospital (not shown) rose in all the urban/rural categories from approximately 2004/2008 onwards, but there is no clear urban/rural patterning.

5.3.5 Cyclist casualties in selected Scottish cities

Figure 30 shows cyclist casualty rates from Stats19 data for four Scottish cities. At a city level cyclist casualty rates can be based on a small number of casualties occurring each year and are therefore liable to fluctuate.

Figure 30: Rate of child (age 5-15) cyclist casualties per 100,000 population in selected Scottish cities, 1999/2003 - 2009/2013.

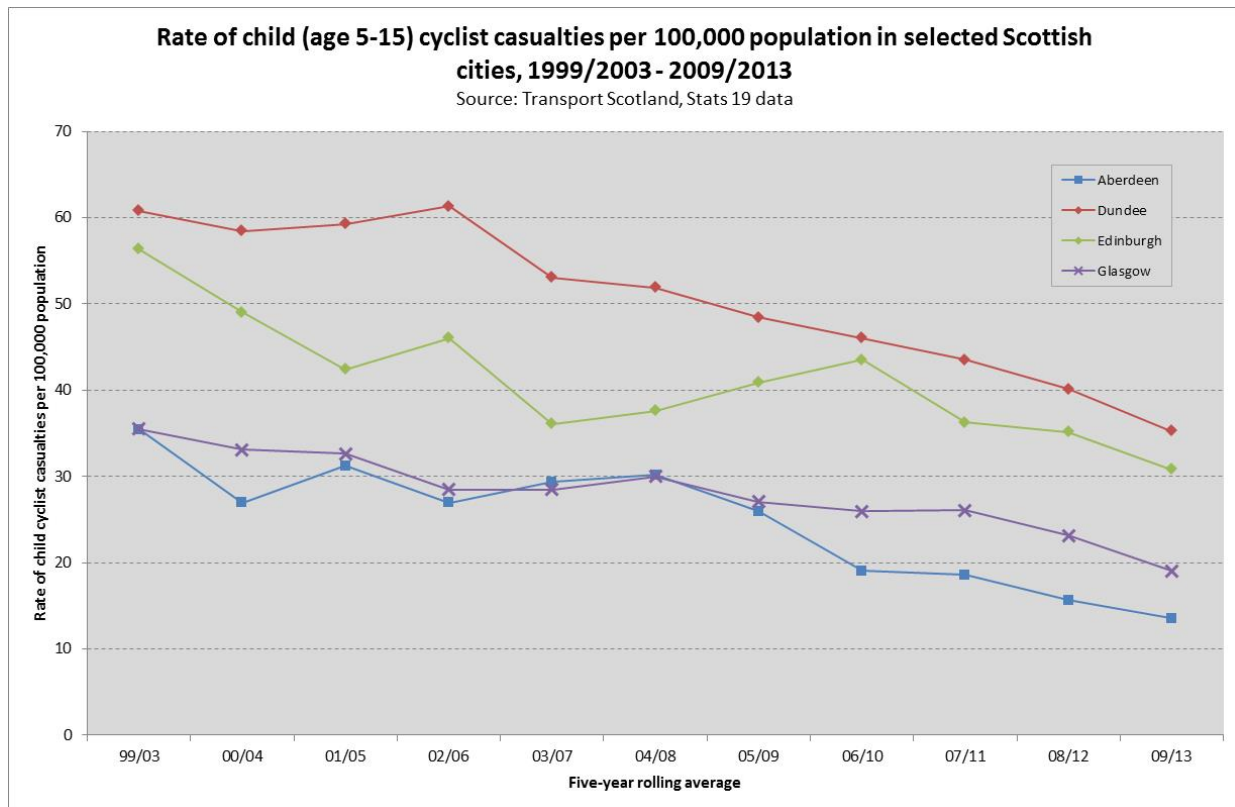


Figure 30 shows that Dundee consistently had the highest rate of child cyclist casualties across the four selected cities over the time period 1999/2003 - 2009/2013. Each of the cities shown shows a decrease in child cyclist casualty rates of between 40% and 50%, apart from Aberdeen, where the rate fell by 62%. In 2009/13, the rate of child cyclist casualties in Edinburgh and Dundee remained more than double that in Aberdeen.

Figure 31 shows hospital admission rates for child cyclist casualties, as sourced from the SMR01 dataset.

Figure 31: Rate of child (age 5-15) cyclist hospital admissions per 100,000 population in selected Scottish cities, 1998/2002 - 2009/2013.

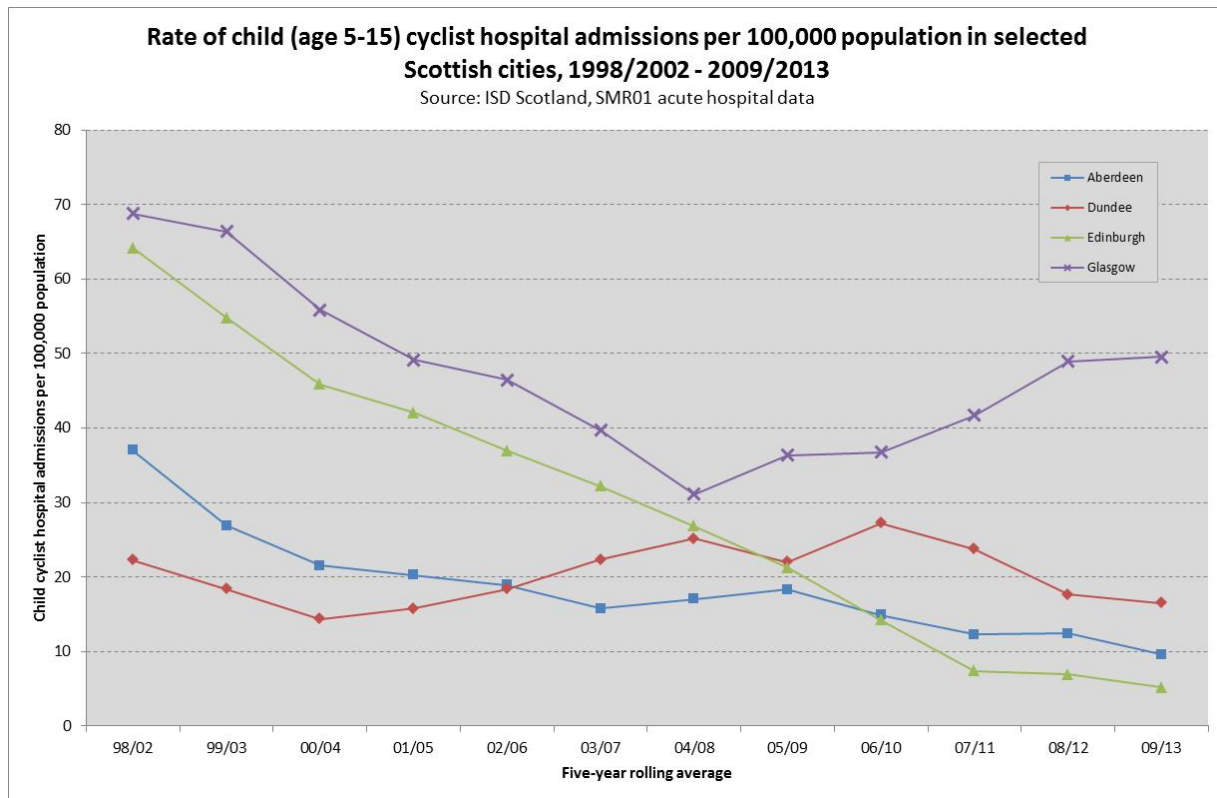


Figure 31 shows a potentially interesting relationship between child cyclist hospital admission rates in Glasgow and Edinburgh.

Between 1998/2002 and 2004/08, the child cyclist hospital admission rates decreased for both cities, by 58% in Edinburgh and 55% in Glasgow. However at this point the trends diverge. From 2004/2008 to 2009/2013, the child cyclist casualty admission rate in Edinburgh decreased by 81%, while in Glasgow the rate increased by 59%. As a result, over the whole period, 1998/2002 - 2009/2013, Edinburgh's child cyclist admission rate decreased by 92%, while the rate of child cyclist hospital admissions in Glasgow decreased by only 28%. By the end of the time period, 2009/2013, Edinburgh had the lowest rate of child cyclist admissions (5.2 per 100,000 population), while Glasgow had the highest rate (49.5 per 100,000 population), which was more than double the next highest city.

Clearly, the city casualty trends based on hospital admissions differ substantially from those based on police reporting, emphasising the need for caution in interpreting the data. The trends shown may be skewed by differences in the way that hospital admissions are recorded between hospitals and between health board areas. Additionally these trends at a city level are based on relatively small numbers of casualties, particularly in relation to child cyclist hospital admissions.

Figure 32 looks at adult cyclist casualty rates in the same four cities, as reported in Stats19 data.

Figure 32: Rate of adult (age 16+) cyclist casualties per 100,000 population in selected Scottish cities, 1999/2003 - 2009/2013.

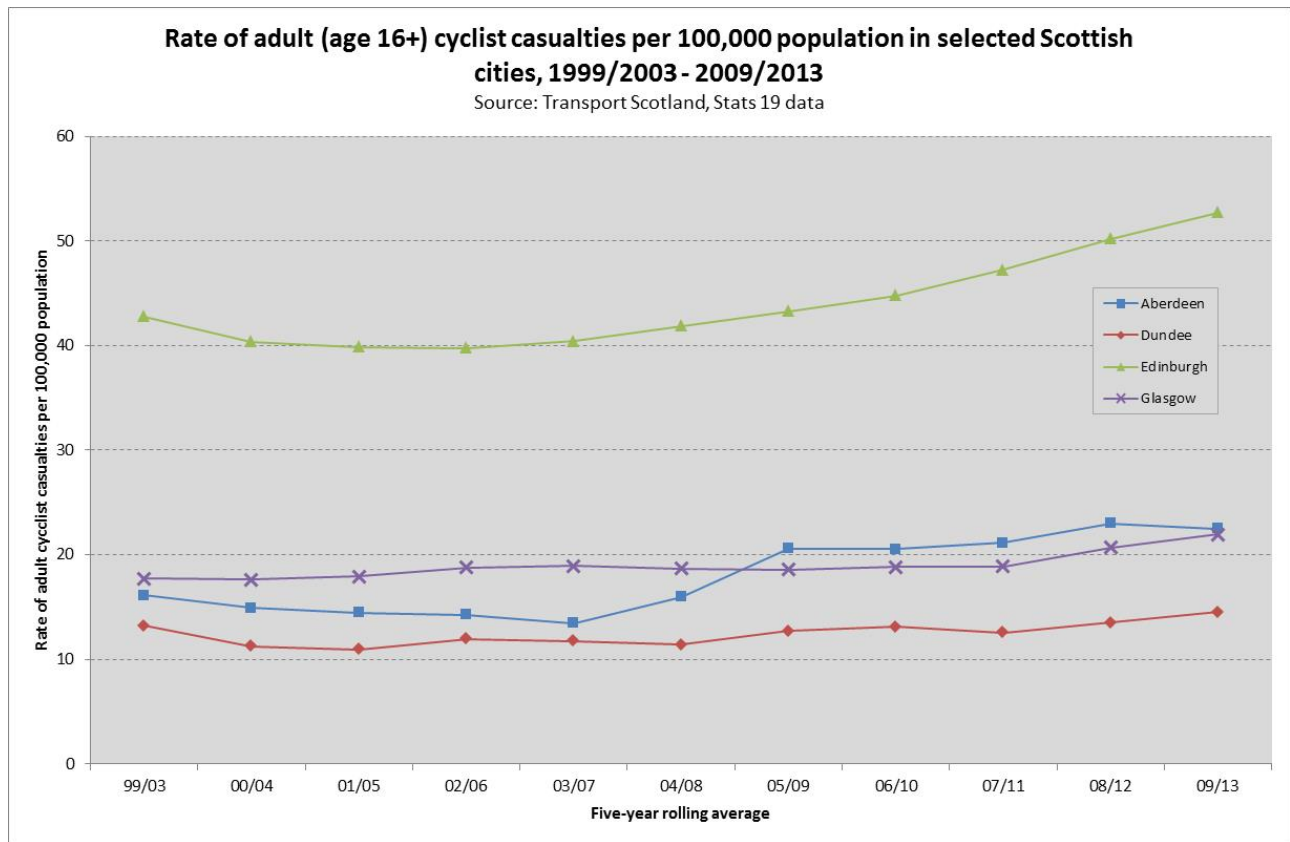


Figure 32 shows that among adult cyclists, casualty rates have increased in each city. The highest rate of casualties was in Edinburgh, which consistently had more than double the rate of adult cyclist casualties observed in any of the other three cities. Section 4 of this report shows that Edinburgh has a higher prevalence of cycling than the other cities which may help to explain such a stark difference.

Figure 33 compares adult cyclist hospital admission rates between the four cities.

Figure 33: Rate of adult (age 16+) cyclist hospital admissions per 100,000 population in selected Scottish cities, 1998/2002 - 2009/2013.

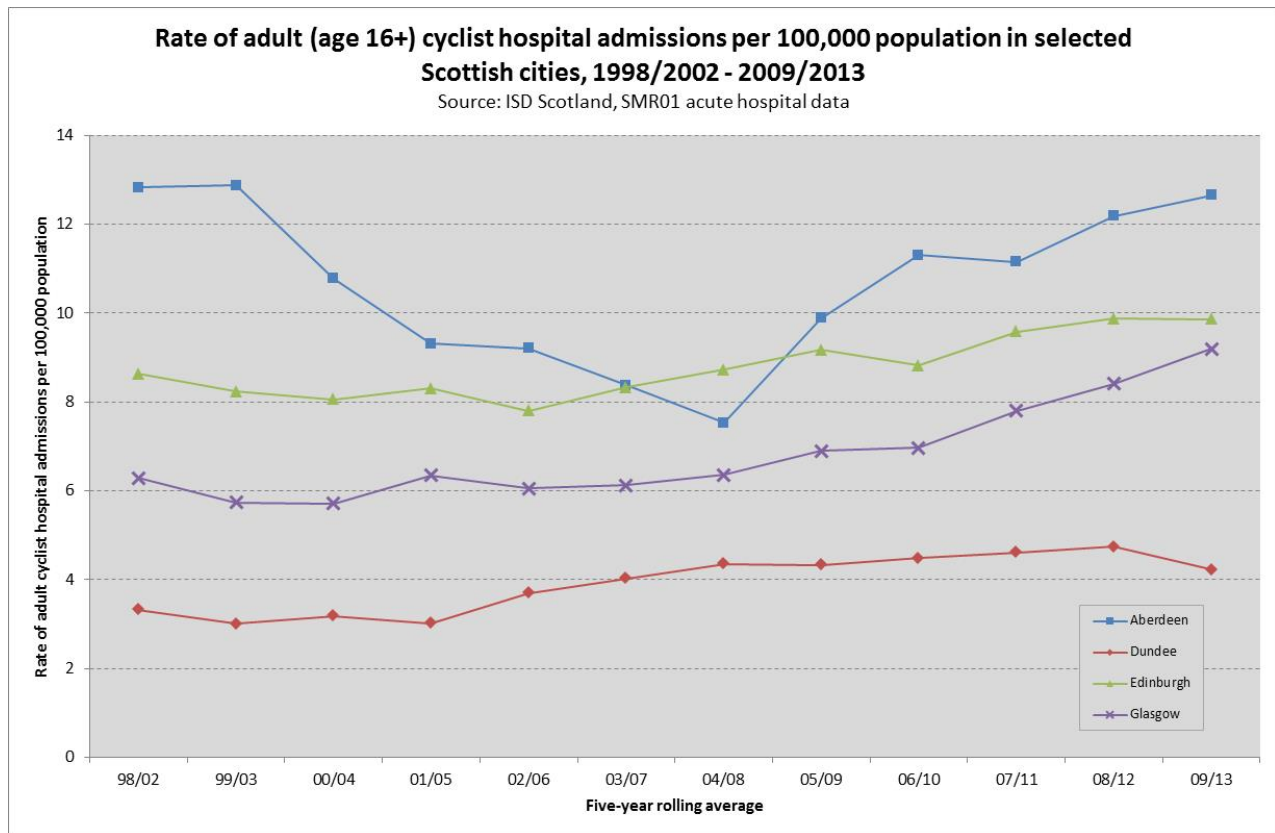


Figure 33 shows that in Dundee, Edinburgh and Glasgow, the rates of adult cyclist casualties admitted to hospital have increased gradually over the period 1998/2002 - 2009/2013. The rate in Aberdeen fluctuated, showing a steep decrease up until 2004/2008, after which the rate increased again to close to the rate at the beginning of the time period.

In 2009/2013, Dundee had the lowest rate of adult cyclist hospital admissions, with the rate of adult cyclist casualties admitted to hospital in Aberdeen being over three times higher than the rate in Dundee.

As emphasised before, there are differences in the casualty trends based on police reported and hospital reported data, and these will be influenced by different recording practices between the schemes and at a local level. Nevertheless, both recording schemes suggest that there has been an increase in adult cyclist casualties in Scotland’s largest cities in the last decade.

5.3.6 Cyclist casualties by deprivation

Figure 34 shows child cyclist casualty rates collected by Police Scotland in Stats19 data.

Figure 34: Rate of child (age 5-15) cyclist casualties per 100,000 population in Scotland, by 2012 Scottish SIMD quintiles, 1999/2003 - 2009/2013.

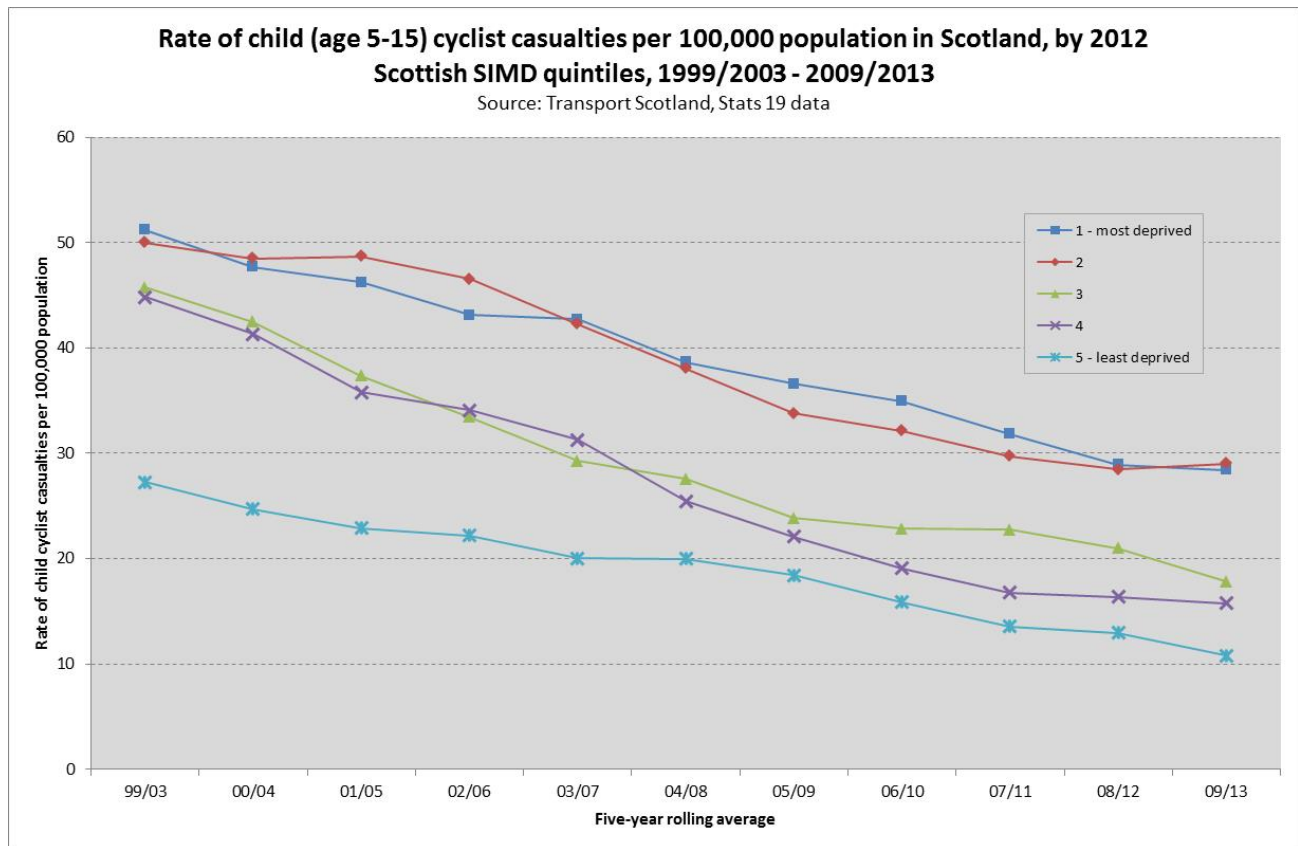


Figure 34 shows that the rates of child cyclist casualties reported by the police have reduced across all deprivation categories in the last decade. However, the decrease was larger in the 60% least deprived areas (categories 3, 4 and 5) where casualty rates dropped by 60-65%, compared with the 40% most deprived areas (categories 1 and 2) where the rates reduced by 40-45%. In the most recent period, 2009/2013, the rate of child cyclist casualties occurring in the most deprived quintile was two-and-a-half times that in the least deprived quintile.

Child cyclist hospital admissions (not shown) also fell over this time period, with rates being consistently highest for those residing in the most deprived areas.

We observed earlier that there has been a rise in adult cyclist casualties, in contrast with the general downward trend for other types of casualty. Figure 35 shows adult cyclist casualties by deprivation category.

Figure 35: Rate of adult (age 16+) cyclist casualties per 100,000 population in Scotland, by 2012 Scottish SIMD quintiles, 1999/2003 - 2009/2013.

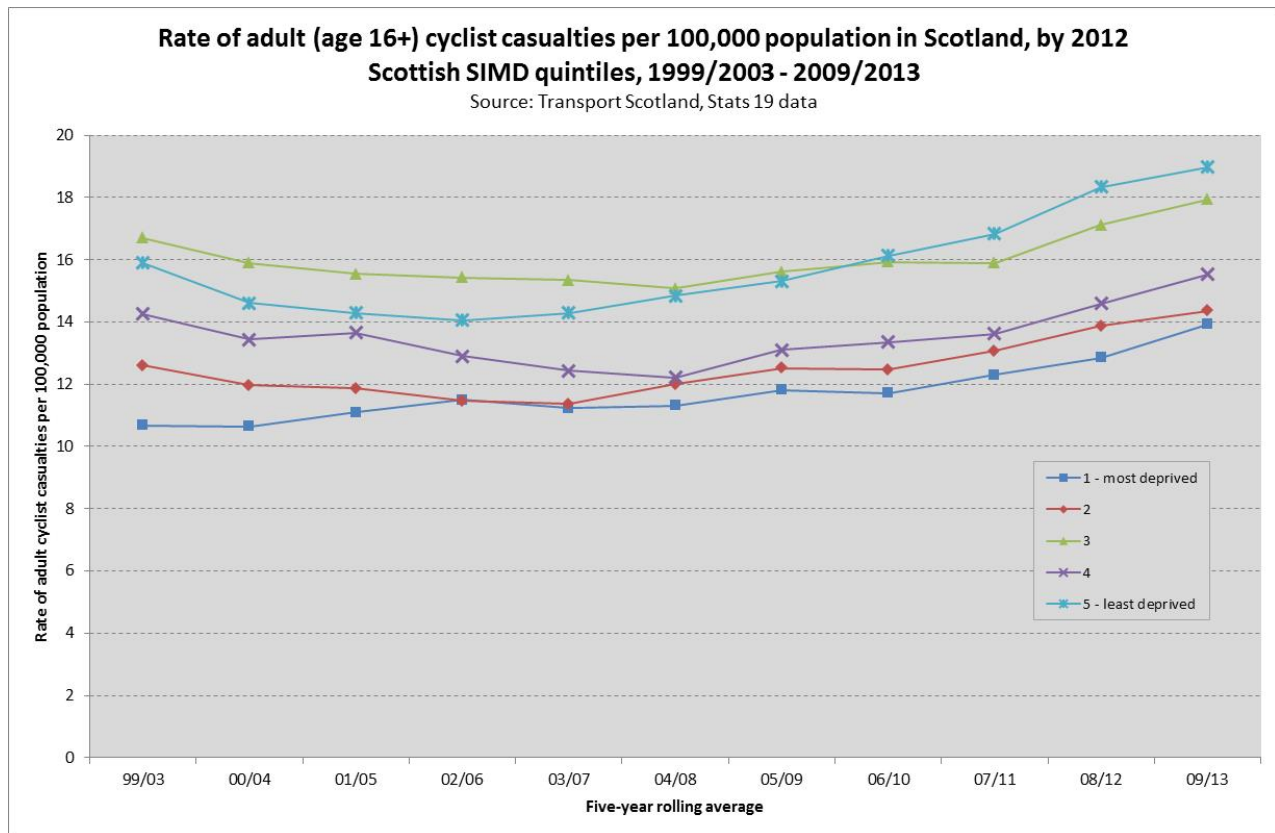


Figure 35 shows that from approximately midway through the 2000s to the end of the period (2009/2013), there was an increase in adult cyclist casualty rates across all deprivation categories. The size of the increase was largest in the most deprived quintile, where from 1999/2003 - 2009/2013 there was an increase of 30%; in contrast the casualty rates in the least deprived quintile increased by 20% over the same period.

The deprivation gradient in adult cyclist casualties is distinctly different from the deprivation gradient for adult pedestrian casualties. The lowest casualty rates occur in the most deprived two quintiles and the highest adult cyclist casualty rates occur in the least deprived three quintiles. In 2009/2013, there were 1.4 times as many casualties per 100,000 population in the least deprived quintile compared with the most deprived quintile.

Adult cyclist hospital admission rates (not shown) were relatively static until the 2004/2008 period, when the rates begin to increase across all deprivation categories, most noticeably the least deprived category, which has consistently had the highest casualty rates.

It is likely that a rise in the prevalence of cycling has contributed to an increase in the adult cyclist casualty rate, but it is also possible that it has become more dangerous to cycle over the time period shown with increases in traffic volume.

5.3.7 Cyclist casualties by date

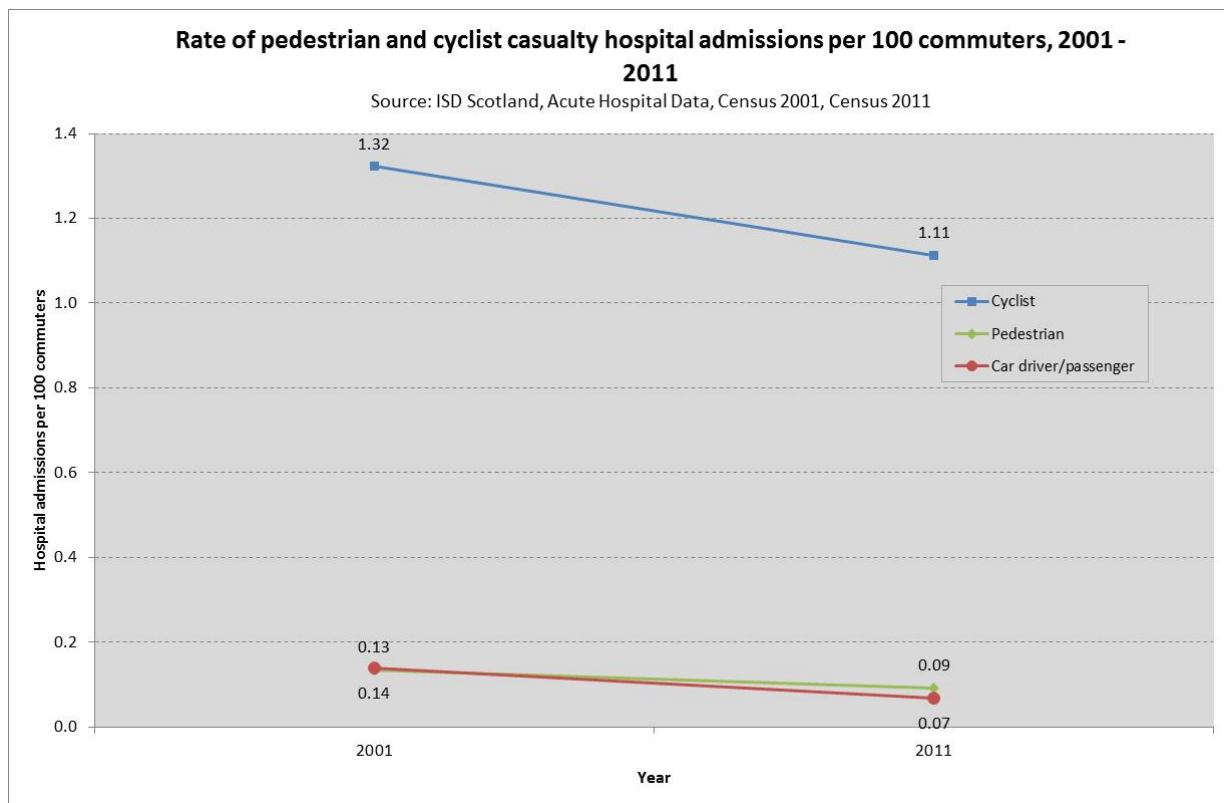
Both the hospital admissions records (SMR01) and the police reported road casualty data (Stats19) include dates and so it was possible to combine data from both sources to explore whether rates of cyclist casualties were associated with particular dates, for instance, when there might have been a cycling event. This analysis was undertaken comparing corresponding casualty and hospital admission figures by date and looking for 'spikes' in the data series – where the number of casualties rose sharply. Analysis was based on comparing casualty numbers aggregated as three day averages to account for potential delays in hospital admissions. Very few spikes in the data were detected, with specific examples potentially being related to the same accident, but there was no clear evidence of an association with a larger event.

5.4 Alternative denominators

The casualty rates calculated in Section 5 have used a population-based denominator. In calculating casualty rates this helps to account for the size of the population and changes in population, but fails to take account of the modal share for different modes of transport and changes in modal share. In theory, if a measure of travel prevalence by mode of travel could be used as the denominator, then a better measure of casualty rates, more closely aligned with exposure to risk, could be developed.

We have attempted to do this using census data. The censuses in 2001 and 2011 recorded information on people's commute to work or study, which we used as a proxy for transport prevalence – see Figure 36.

Figure 36: Rate of pedestrian and cyclist casualty hospital admissions per 100 commuters, 2001 - 2011.



Using commuters as the denominator for hospital casualty rates, the trends in casualties are downward for all three modes shown: car casualties reduced by approximately 50% between 2001 and 2011, pedestrian casualties by 30% and cyclist casualties by around 15%. This suggests that, although cyclist hospital admissions per head of population were rising, this may be accounted for by a rise in the prevalence of cycling as a method of commuting to work or study.

However, there are caveats to note about the data used for this analysis, which affect the accuracy of the casualty rate that has been created. The census data used in the denominator underestimates the number of people using a particular mode of transport because:

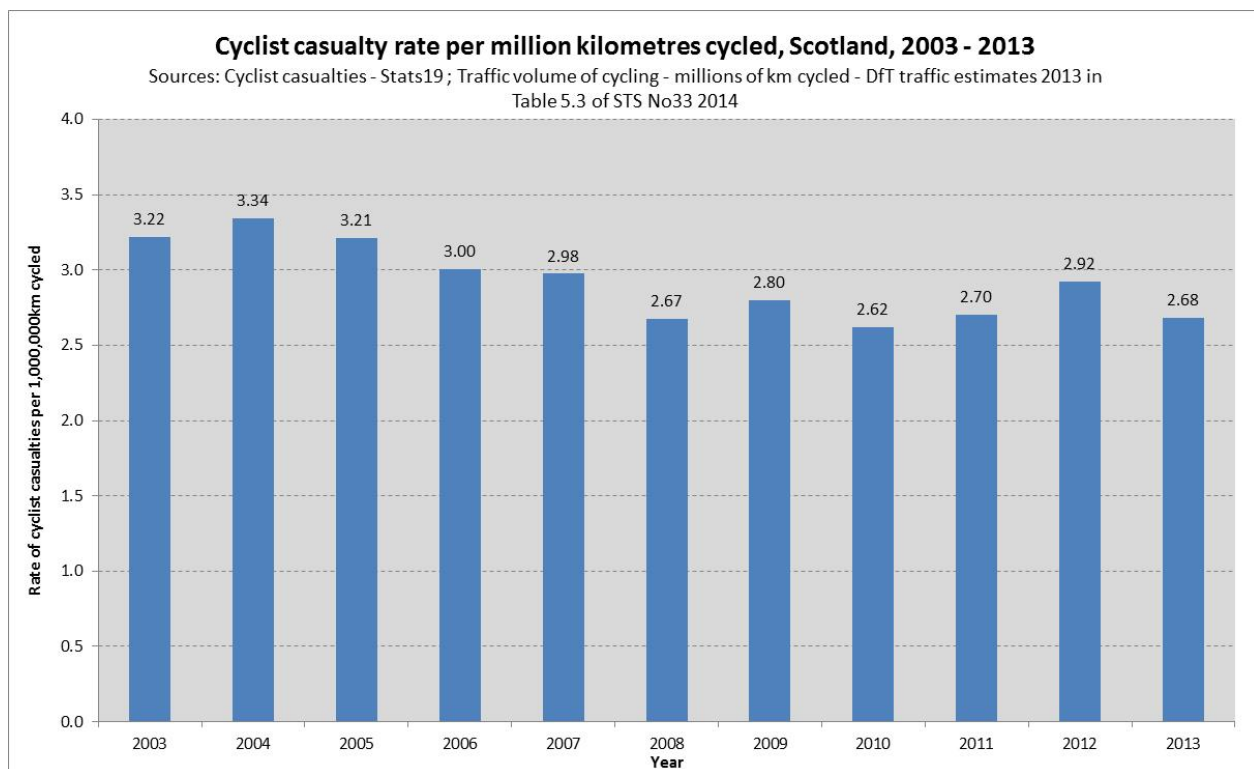
- the census results only account for people's commute to work or study; uses of transport for other journeys (e.g. leisure) will not be recorded
- commutes are recorded under the method of transport which accounts for the most number of miles travelled, people who use more than one method will only be counted under one method
- people who did not work or study during the week before completing the census will not be counted under any method of transport.

In contrast, the hospital data from SMR01 account for all known (i.e. recorded) road traffic casualties irrespective of journey type and their employment status.

However, the greatest limitation of these rates is that the denominator data for each mode do not take account of the distances travelled by each mode. Although census data accounting for the distance commuted by each mode could in theory be provided, it was not possible to access data in this format within the timescale of the project.

Cycling Scotland have published³³ an estimate of cyclist casualty rates based on police recorded cyclist casualties using a denominator based on estimate of the distance cycled on Scottish roads. This graph is reproduced here as Figure 37.

Figure 37: Cyclist casualty rate per million kilometres cycled, Scotland, 2003 – 2013.



While, based on this measure, the cyclist casualty rate has reduced since 2003, it is also notable that there has been no appreciable change in casualty rates since 2008.

5.5 Strengths and weaknesses of the study

As with all studies there are limitations to point out, which in this case relate mainly to the data sources applied in the study.

The census data used to describe transport modal share are only collected every ten years and 2011 data are already nearly four years out of date. Additionally, these data only relate to one type of journey, to work or study, and do not take into account multi-modal journeys. Census respondents are asked to state their usual mode of travel to work or study for the main part of the journey. By definition, journeys made by unemployed adults are excluded. Nevertheless, the census is a crucial source of data on personal travel, principally because of its population-wide coverage, the strength of quality assurance that is carried out on the data collected, and because it allows long-term trends (over decades) to be tracked.

Two types of road accident casualty data were analysed. Casualties injured in road traffic accidents recorded by the police (Stats19) are reported across the country, but not all accidents occurring on roads will be notified to or recorded by the police. Additionally, casualties injured off-road – for example, falling off a bicycle on a cycle path – will not be recorded. Therefore this source is likely to underestimate the true level of casualties from all modes of transport. Nonetheless, Stats19 data are collected by the police across the country and figures can be compared on a year-to-year or more frequent basis.

The second source of casualty data used was hospital admissions (SMR01). Casualties recorded as hospital admissions represent a sample of road casualties who have suffered more serious injuries. Clearly casualties who have suffered relatively minor injuries not requiring overnight hospital treatment will not be recorded and so the casualty rates produced significantly underestimate 'real' casualty levels. However, these data, as is the case with police recorded casualties, are collected across the country and are subject to quality assurance checks; and, additionally, provide information on the type of injury suffered.

It is notable from our analysis of casualty trends at a city level that there may be differences in recording practices which may affect the casualty trends that have been calculated at a city level. Thus, it is worth reiterating that all the casualty trends, and in particular the city level trends, should be interpreted with caution.

The most significant weakness of our analysis of casualty rates has been the lack of a denominator that can adequately take account of risk exposure by mode. We have discussed this and experimented with using census-based data. Realistically, in the absence of more frequent and accurate recording of journeys and distances travelled by different modes, a population denominator for casualty rates will have to be used but with all the caveats we have outlined.

Finally, this has been an ecological study limited to analysis of aggregated, population level trends. Detailed investigation of the circumstances of individual accidents and casualties – i.e. road conditions, time of day, weather, type of road/junction – was beyond the scope of the study, although this type of case study approach has been undertaken by others at a local authority level³⁴. A more forensic study would almost certainly identify more specific factors relating to road injury accidents and, thus, potentially could reveal further issues that could be addressed to improve road safety. Additionally, reported accidents represent the tip of an iceberg, as many accidents do not involve injury and/or do not get reported. There is a need to document and understand the impact of road incidents which do not involve injury, so-called 'near misses'. Recently published evidence on cycling suggests that not only is fear of injury a barrier to cycling but that experiencing non-injury incidents (near misses) may contribute to this and that UK cyclists experience very high rates of non-injury incidents, by comparison with reported injury rates³⁵.

6 Discussion

6.1 Trends in walking, cycling and other travel modes

Before discussing the casualty trends, it is worth reiterating the main Scottish trends in modes of transport used for personal travel. It should be noted that these are based on census data and are limited to travel to work or study.

The long-term national trends in travel to work over the last 45 years (since 1966) are clear: car commuting has risen steadily from 21% in 1966 to 69% in 2011; commuting on foot and by bus has more than halved dropping to an 11% share for each mode in 2011; train use (including the underground) has risen slightly to 4.5% of commuters in 2011; the proportion of commuters who cycle to work has been low and relatively static but did rise very marginally from 1.5% in 2001 to 1.6% in 2011.

Journey to work or study trends at a local authority level are generally consistent with national trends, although some local authorities stand out as following distinctly different trajectories. The proportions of 'active commuters' – those walking or cycling – increased in only four local authorities: Aberdeen; Dundee; Edinburgh; and East Renfrewshire.

Edinburgh, in particular, is unique in terms of its modal share trends for journeys to work or study; between 2001 and 2011 train and bus use rose, car driving and being a passenger declined, cycling increased from a high base (3% to 4.3%) and walking increased marginally, to 28.6%. Edinburgh now has a higher proportion of people who walk, cycle and take the bus to work than anywhere else in Scotland and the number of people with access to a car has also reduced between 2001 and 2011³⁶. These changes predate Edinburgh City Council's commitment to spend 5% of its transport budgets (capital and revenue) for 2012/13 to encourage cycling; this proportion was planned to increase by 1% annually, rising to 8% in 2015/16³⁷.

It is also worth noting the socioeconomic characteristics of cyclist and pedestrian commuters travelling to work and study, as measured by area deprivation. Data from the 2011 Census suggested that commuters walking to work or study are as likely to walk if they come from the most deprived (25%) or the least deprived decile (24%). However, data reported from the Scottish Household Survey Travel Diary in 2013 showed a higher proportion of people walking to work from the most deprived quintile than from any other deprivation quintile³⁸.

In contrast, while bicycle commuting prevalence is much lower, there is a clear and consistent social gradient in those who cycle: based on the 2011 Census, the proportion of adults who cycled to work or study in the least deprived decile (2.7%) was 2.7 times higher than the proportion who did so from the most deprived decile (1%). Figures from the Scottish Household Survey Travel Diary support this – in 2013, in the most deprived quintile 1.3% of employed adults commuted to work by bicycle compared with 4.5% in the least deprived quintile.

6.2 Casualties

There has been significant reduction in road casualties over nearly half a century: the number of recorded road casualties in Scotland has come down from a peak in 1966 of

32,280 to 11,498 in 2013, a reduction of 64%³⁹. Nevertheless, when examining pedestrian and cyclist casualties, there are important and distinct trends and patterns to note.

6.2.1 Pedestrian casualty trends

Rates of pedestrian casualties admitted to hospital reduced significantly between 1998/2002 and 2009/2013, by 38% for adults and 57% for children (see Tables 21a & 22a in Appendix B). Looking at police recorded road casualty data from the last decade (1999/2003 - 2009/2013), child pedestrian casualty rates have fallen by over 50% in each severity category (slight, serious and fatal), while adult pedestrian casualty rates have fallen by at least a third in each severity category over the same period. Despite these reductions, child pedestrian casualty rates recorded by the police are still at 2.6 times higher than adult pedestrian casualty rates.

Among pedestrian casualties who are admitted to hospital, injury data show that *leg, ankle and foot injuries* are slightly more common than *head and neck* and *torso, arm and hand injuries*.

Pedestrian casualty rates have fallen for males and females, but rates of casualties remain higher for both men and boys. In the period 2009/2013, child pedestrian casualties among boys were 1.7 times more common than for girls, while adult male pedestrian casualties were 1.8 times higher than for women.

Child and adult pedestrian casualty trends have fallen across both urban and rural areas, but remain higher in urban areas. The rates of child casualties in large urban areas are four times higher than in remote rural areas and, similarly, adult pedestrian casualty rates are 3.6 times higher in large urban areas compared with remote rural areas (in 2009/13, based on Police road traffic accident reports).

Analysis of urban area data by city, revealed downward casualty trends in each of the four cities examined. However, differences between the casualty trends recorded via police and hospital reporting systems were observed. These differences are likely to be affected by the different severities of injury recorded on each system, by different recording procedures, both between systems and in each city, and by fluctuations relating to the relatively small numbers of casualties.

There is a consistent deprivation-related gradient in pedestrian casualty rates. Child and adult pedestrians are more likely to be casualties in the most deprived areas (shown by police accident location reports) and if they are from deprived areas (shown by hospital data). Based on police reporting of road traffic accidents, child pedestrian casualties were 3.2 times higher in the most deprived quintile compared with the rate in the least deprived quintile in the period 2009/13; among adults the equivalent pedestrian casualty rates were 2.4 times higher in the most deprived quintile compared with the least deprived quintile.

6.2.2 Cyclist casualty trends

The most prominent cyclist casualty trend to note is that, since the mid 2000s, adult cyclist casualties have risen, both in terms of hospital admissions and police road accident casualties.

Child cyclist casualty rates have fallen by over 50% in the slight and seriously injured categories in the last decade based on police reporting; child cyclist fatalities have been relatively low over the last decade, ranging from 0 to 5 per year. More worryingly, adult cycling casualties classified as slightly or seriously injured have increased between 2004/2008 and 2009/2013.

Among children, cycling injuries to the upper body and head have been at a consistently higher rate than injuries to legs, ankles and feet. While upper body and head injury rates for child cyclists have decreased in the last decade, in recent years the rates have levelled out and there have been no further reductions. In contrast, the rate of adult cyclists admitted to hospital involving injuries to all areas of the body began to rise from 2004/2008 onwards. This is particularly noticeable for injuries to the *torso, arm and hand*, which account for the highest rates in hospital admissions, and increased by 37% between 2004/2008 and 2009/2013.

Child cyclist casualties of both genders have higher rates of hospital admission than adults, although rates have reduced in the last decade. The rate of adult male cyclist casualties admitted to hospital reduced until 2003/07 but has risen since by 34% in the period 2003/2007 - 2009/2013; the equivalent rate for adult females rose by 45% from 2004/2008 to 2009/2013, albeit the female casualty rate is much lower. Overall, adult cyclist hospital admission rates increased from 5.5 per 100,000 in 2003/2007 to 7.4 per 100,000 in 2009/2013 (an increase of 34%). These rises are likely to be related to rises in levels of cycling.

It is notable also that the cyclist casualty admission rate for boys was three times the rate for girls, while among adults, the rate of male cyclist casualties admitted to hospital was four times that for women. These differentials are likely in part to be related to higher levels of cycling among males.

A decrease in the rate of child cyclist casualties reported to the police was observed across all urban/rural classifications in the period 1999/2003 - 2009/2013. Large urban areas have the highest level of adult cyclist casualties reported via police recording – at least double the rate of other urban/rural classes – and the rise in cyclist casualties is most noticeable in this urban/rural category.

There are different trends in child cyclist casualties at a city level for police reported casualties compared with casualties admitted to hospital. These differences highlight that the two recording systems do not necessarily capture the same sample of casualties; hospital admissions clearly relate to those seriously injured, while it is likely that cyclist casualties who are injured but not badly will be missing from the police recording systems, particularly if their accident occurs off-road. Differences in what is recorded by each system are exacerbated at a city level, where numbers of casualties are lower and reported trends are liable to be influenced by different local recording practices.

Among adult cyclists, the highest rate of casualties reported to the police among Scotland's four largest cities is in Edinburgh, which consistently has had more than double the rate of casualties observed in any of the other three cities. In terms of hospital admissions, there have been increases in adult cyclist casualty rates in each of Scotland's four largest cities in recent years.

Trends by deprivation in child cyclist casualty rates indicate a general downward trend but the rate in the most deprived quintile in 2009/2013 was 2.6 times higher than in the least deprived quintile, and this gap has widened since 1999/2003 when the rate in the most deprived quintile was 1.9 times that in the least deprived quintile. Among adults there is a quite different pattern; there has been an upward trend in cycling casualties across all deprivation quintiles with casualty rates being higher in the least deprived quintiles.

Finally, it worth noting that analysing cycling casualties by date did not reveal any particular spikes or peaks in casualties, suggesting that cycling casualties were not associated with particular days or specific cycling events.

6.2.3 Casualty rates in relation to exposure to risk

As has been commented on already, the population denominator used to present casualty rates does not properly reflect exposure to risk. A better measure would be to express casualties as a rate with a denominator based on the number of people using a particular mode of travel and the distance they travelled using that mode in a year. This is an unavoidable weakness of the current analysis – as we do not have accurate estimates of those who travel by different modes and how far they travel – and this particularly affects the cycling casualty rates given the relatively low prevalence of cycling and the social gradient in cycling prevalence. This issue of not being able to take account of exposure to risk is exacerbated in places which have experienced significant changes in cycling prevalence. For example, rates of cycling commuting in Glasgow and Edinburgh increased by 69% and 46%, respectively, between 2001 and 2011.

To address this weakness, we tested alternative approaches to calculating casualty rates: i) using data on peoples' mode of travel to work or study from 2001 and 2011 Censuses as a proxy denominator to account for transport prevalence; and, ii) we reproduced a cyclist casualty rate trend based on a denominator that took account of the volume of kilometres travelled by bicycle on Scottish roads. There are limitations to both these approaches and a better denominator based on distance travelled, mode and type of journey is needed to allow more accurate casualty rate trends to be estimated. Nevertheless, using each approach, the trend in the cyclist casualty rate appeared to be reducing or at least the rate was not rising, suggesting that the rise in cyclist casualties is associated with the rise in the prevalence of cycling.

However, it is still of great concern that population-based rates of cycling casualties and actual casualties are rising as cycling prevalence increases. Motor vehicle casualties have dropped consistently as car use has risen, reflecting the success of efforts to make cars and roads safer. We should not expect or accept that cyclist casualties increase as cycling prevalence increases.

6.3 Policy context

This study has been conducted to explore pedestrian and cyclist casualty trends in some depth, looking at geography, area deprivation, age, gender, severity and type of injury. These casualty trends reflect the safety of active travel for different people and places. Safety is a key issue to address if the greater levels of active travel (and physical activity) which are aspired to in Scotland are to be achieved.

Scotland has a growing range of policies, strategies and plans that support active travel and that indeed aim to increase levels of walking and cycling. The extent to which this is achieved will depend on many factors, but safety is critical. Developing safe and well-maintained infrastructure, restricting road speed, road safety campaigns, including road user training, and increasing levels of investment – substantially – will all be important, if increasing levels of walking and cycling are to be achieved.

6.4 Infrastructure development and maintenance

Scotland, and Scottish cities, have much to learn from elsewhere. Support for investment in infrastructure, committed leadership and sustained effort as exemplified in a range of cities across Europe⁴⁰ are some of the key ingredients in making progress in relation to active travel. There are examples from Scotland⁴¹ and other parts of the UK⁴² that show that the development of traffic-free infrastructure has led to increased levels of cycling and walking. In delivering new infrastructure, safety is a key factor. The evidence from a small mixed methods study of users of the Anderston-Kelvingrove cycling and walking route in Glasgow points to safety being the main reason for users choosing to travel on the route; additionally, cyclist and pedestrian commuters were willing to travel on a longer journey if the route was perceived to be safer, more pleasant and less stressful⁴³.

Proper maintenance and repair of infrastructure is another important, if often neglected, issue. Poor road condition, deteriorating road markings, damaged pavements and potholes are common issues and the perception is that Scotland has more of these problems than other parts of the UK⁴⁴. These problems contribute to pedestrian, cyclist and motorist accidents and can cost councils money. Scottish councils are paying significant amounts of compensation for accidents caused by poorly maintained roads and paths; over a recent five-year period, Scottish councils spent around £5 million on compensation payments relating to over 7,000 claims⁴⁵, while compensation for pedestrian trips on pavements amounts to £1 million every year⁴⁶. Better-maintained pavements, paths and roads will reduce the likelihood of accidents and create an environment which is safer and therefore more conducive to active travel. There is a need also to ensure that pavements and dedicated paths/routes are gritted and kept useable, if people are not to be forced into their cars during cold spells.

6.5 Road speed

More concerted action to reduce vehicle speeds will reduce the prevalence of road accidents and their severity and will encourage more people to cycle and walk. Analysis of the role of vehicle speed in pedestrian fatalities in Great Britain found that 85% of pedestrians, who were killed when struck by cars or car-derived vans, died in a collision that occurred at impact speeds below 40mph, 45% at less than 30mph and 5% at speeds below 20mph⁴⁷. Many studies have shown that pedestrians are more likely to be severely or fatally injured when hit by cars at higher speeds, and particularly when the car is travelling more than 30mph⁴⁸.

Therefore, 20mph zones^{xiii} have the potential to be part of the solution to bringing down casualty rates particularly among vulnerable road users. In one review of accident data

^{xiii} Areas where the speed limit has been set at 20mph and traffic calming measures have been put in place to encourage drivers to stay within the 20mph limit.

within 72 20mph zones showed reductions in all accidents in the zones by 62% and significantly for the most vulnerable road users – all pedestrian accidents reduced by 63%, all cyclist accidents reduced by 29%; child pedestrian accidents dropped by 70% and child cyclist accidents reduced by 48%⁴⁹. A Transport for London review, carried out in over 100 20mph zones in London, found similar evidence that the zones were effective in reducing accidents and particularly road injuries to children⁵⁰.

A more recent approach is the use of 20mph limits within a city or town^{xiv}. Portsmouth City Council was the first local authority in England to implement an extensive area-wide 20mph speed limit scheme (without traffic calming) over most (94%) of its residential roads which previously had a 30mph speed limit. Early analysis of the impact of this scheme provided mixed findings: there was a 21% drop in casualties reported to the police in the two years after the introduction of the scheme compared with the three years prior to introduction. However, the number of casualties 'killed or seriously injured' (KSIs) rose slightly over the same period, although the low numbers meant this was not a statistically significant rise. Currently there is more limited evidence that 20mph limits, as opposed to 20mph zones, achieve the desired effect of reducing accidents and casualties.

In Glasgow, there have been proposals from the Council to introduce mandatory 20mph zones – one of the recommendations of the city's Health Commission⁵¹ was for mandatory 20mph zones in residential areas – although progress has been slow. More recently (in January 2015), Edinburgh Councillors approved a new road speed limit network after three years of research and public consultation, with residential roads, shopping streets and the city centre included as 20mph roads⁵². New guidance on 20mph speed restrictions has also been issued by Transport Scotland in recognition that these types of measure can make roads safer for the most vulnerable road users such as cyclists and pedestrians⁵³. Integrating cycling and pedestrian path development with the introduction of effective speed control initiatives will help create safer, more integrated transport infrastructure on Scotland's streets.

6.6 Road users

Efforts to improve the awareness and skills of all road users should help to improve safety on our roads. Cycle proficiency courses, such as those run by Bikeability Scotland⁵⁴, help improve cyclists' confidence, ability and awareness on road and in traffic. Similarly Sustrans' I Bike scheme⁵⁵ provides training and advice for schools, with the aim of increasing levels of cycling to school. Some, but by no means all, bus companies provide driver training that aims to increase awareness of cyclists, pedestrians and other vulnerable road users. Behaviour change media campaigns, such as the Give Me Cycle Space⁵⁶ campaign which aims to boost the numbers of children cycling to school by encouraging drivers to drive more carefully around schools, also have their place. However, the reach of these campaigns and schemes is limited with their focus mainly on cyclist safety. More needs to be done to improve the safety of all vulnerable road users, particularly pedestrians.

^{xiv} 20mph limits are similar to the 20mph zones, but without the traffic calming measures. Road signs and markings, and education and publicity are used to encourage drivers to stay within the limit.

6.7 Legislative measures

As well as speed restrictions, there are many legislative measures that have been brought in to improve road safety. The most recent Scottish example is the legislation to reduce the legal drink-drive limit in Scotland from 80mg alcohol to 50mg alcohol in every 100ml of blood which was introduced in December 2014. The impact of this measure will need to be evaluated, but one might expect that this type of measure might reduce the number of accidents across all casualty groups.

Another legislative approach is put forward by Road Share⁵⁷, a campaign group who are trying to change the law of liability in Scotland relation to collisions involving motorists and cyclists or pedestrians to one of presumed liability^{xv}. Road Share argue that international data – though far from complete – show an association between countries with low casualty rates and with high levels of walking and cycling, and having presumed liability legislation in place⁵⁸. The strength of evidence of this association is debatable, as is the cause and effect relationship, and, as the group make clear, presumed liability legislation would be but one of a range of actions that might lead to more people walking and cycling.

6.8 Home Zones and congestion charging

The Home Zone concept, pioneered in the 1970s in the Netherlands, is seen as a way of reclaiming local streets from car domination. This approach is built on the physical alteration of local streets and roads aimed at forcing motorists to drive with greater care and at lower speeds. The UK government has supported Home Zone schemes across England and Wales, while in 1999 the Scottish Executive invited councils to submit Home Zone projects, some of which were subsequently evaluated. The findings suggested that there were comparatively minor changes in vehicle speeds or volumes, but that this was partly a reflection of the location of the Home Zone pilots⁵⁹. However, perhaps the initiative to create a Place Standard for Scotland⁶⁰ – which includes an aim ‘to support consistency in the delivery of high quality, sustainable places that promote wellbeing, low-carbon behaviour and positive environmental impacts’ – offers an opportunity to think about Home Zones afresh.

Congestion charging, is another potential intervention that could impact on traffic volume and road safety. Pre-released study findings – to be presented at the Royal Economic Society’s 2015 annual conference – reportedly show that traffic accidents have fallen in Central London by 40% since the introduction of the congestion charge in 2003 and accidents involving cyclists have also fallen⁶¹. It is notable that congestion charging was rejected by the citizens of Edinburgh in 2005 and is a measure that does not appear likely to find favour with authorities in Scotland at present.

6.9 Measurement and reporting

This study has highlighted the difficulty in accessing accurate, up-to-date and comprehensive estimates of cycling and walking across Scotland, within different localities

^{xv} Under a system of presumed liability, following a collision between a motorist and a cyclist or pedestrian, the motorist (via their insurer) would be presumed liable to compensate a cyclist or pedestrian for loss, injury or damage unless liability can be established otherwise. Presumed Liability is different from the current fault-based system as it shifts the burden of proof to those who bring the most danger to the collision, rather than the more vulnerable road user needing to prove that the less vulnerable road user was at fault⁵⁸.

and population groups and for different journey types. While information on pedestrian and cyclist casualties is more comprehensive, the data recorded by hospitals and by the police also have their limitations, as has been discussed. In order to monitor casualties rates more accurately, and to understand trends in active travel, better estimates of distances travelled by different travel modes and for different journey types are also required.

To bring an increased focus on active travel perhaps now is the time to emulate the Danish approach to making cycling intelligence accessible through Copenhagen's Bicycle Account⁶² and via the Cycling Embassy of Denmark⁶³. These publications gather and present an impressive array of statistics relating to cycling, including: levels of cycling; cycling's modal share; distances cycled; cyclist's feeling of safety; actual safety; and other cycling-related factors.

An equivalent Scottish web publication covering both walking and cycling at a national and city level could help provide a focus for efforts to promote active modes of travel. It would potentially help to give walking – which more people do on a daily basis but which tends to be overshadowed by cycling – a higher profile and level of importance.

An accessible resource of this type would undoubtedly take time to develop but its key strength would be as an evidence-base to present statistics, trends and research on key issues relating to active travel. Such a resource would undoubtedly stimulate debate and could act as a catalyst by identifying problems and priorities for change.

7 Conclusions

The long-term trends in how people travel to work in Scotland over the last 45 years reveal clearly the increasing predominance of car use. While taking the bus and walking to work has more than halved, car use has trebled, train use has risen slightly and bicycle commuting has risen very marginally, but remains low – with a modal share of 1.6% in 2011. Nonetheless, more recent data provide some evidence of a shift toward higher levels of active travel.

In relation to pedestrian and cyclist casualties our study highlights a number of important trends in a Scottish context: a rise in adult cyclist casualties, a consistently higher rate of pedestrian casualties in more deprived communities, a higher rate of child pedestrian and cyclist casualties in comparison with adults and, generally, higher levels of pedestrian and cyclist casualties in large urban areas.

It seems plausible that the increase in cyclist casualties is directly associated with an increase in cycling prevalence, although cycling has not increased in all local authority areas. Similarly, it is plausible that the higher adult cyclist casualty rates in the least deprived areas are associated with a greater proportion of regular cyclists coming from these areas. The continuing rise in licensed vehicles and traffic volume may be another contributing factor to the rise in cyclist casualties.

There are methodological gaps to be filled. To assess risk, particularly for vulnerable road users, better data on prevalence and distances travelled by different modes are required. This would enable more accurate estimates of cyclist and pedestrian casualties in relation to exposure to risk.

Limitations in available data, and the disparate sources of data on active travel, highlight a need for an accessible active travel web resource that brings together statistics and research on walking and cycling trends, casualties, new infrastructure and related initiatives. Such a resource would provide an evidence base for debate and could help inform how further progress can be made to both increase levels of walking and cycling and how to reduce pedestrian and cyclist casualties.

To increase levels of active travel and to address the real safety concerns that exist multiple and concurrent approaches are needed. Investment in safer, integrated infrastructure and area speed restrictions would be effective in reducing the real and perceived risks of accidents for pedestrians and cyclists. Better road maintenance, training programmes for cyclists, bus drivers and other road users and behaviour change campaigns also have a part to play. Investment in such initiatives, particularly those focused on safer infrastructure and reducing road speed, is likely to have the added benefit of encouraging more people to walk and cycle.

In a generally favourable policy context, the challenge is to increase investment in active travel sufficiently to enable significant modal shifts towards walking and cycling to be achieved. It is worth reiterating that population level increases in everyday walking and cycling are likely to provide multiple benefits, with increased physical activity leading to better physical and mental health, improved air quality and reduced carbon emissions.

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