

Report on key outcomes following the implementation of 20mph speed limits in the City of Edinburgh

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KEY MESSAGES

1. Average speed was reduced by 1.34mph when considering 66 streets in which the 20mph limit was implemented and data was collected.
2. The number of vehicles with average speeds that were 20mph or less increased following the rollout.
3. Our results indicate a reduction of 38% in annual road traffic collision rates (overall) and by level of severity on 20mph and 30mph streets post speed limit introduction. (It should also be noted that collisions are falling across Scotland)

Executive Summary

Background

This report is prepared by the “Is twenty plenty for health?” project team, based at the University of Edinburgh and several other Universities around the UK. The project team is conducting an evaluation of the public health impact of the 20mph speed limit policies in Edinburgh and Belfast (results not reported here). This project is funded by the NIHR and final results will not be available until after August 2020.

The aim of this interim report is to provide an overview of changes in vehicle speed and volume and road traffic collision rates resulting in personal injury before and after the implementation of the 20mph speed limits in Edinburgh. Further analyses will include the use of time series and spatio-temporal models for assessing the trend (temporal and spatial) of road traffic collisions in the City of Edinburgh.

Findings

Vehicle speed and volume

The speed and volume data used in the analysis covered sixty-six 20mph streets. These streets were 30mph before the speed limit implementation and changed to 20mph afterwards.

- There has been a statistically significant reduction in average vehicle speed of -1.34mph for all 66 streets combined.
- The largest reduction in average vehicle speed was -2.41mph and was observed in zone 1b, Rural West Edinburgh.
- A comparatively higher reduction in average speed, -2.03mph, was observed in streets where the average speed before the speed limits was greater than or equal to 24mph.
- The frequency of average speed observations which were less than or equal to 20mph was greater after the speed limit implementation.
- There was a reduction post speed limit introduction in the number of drivers exceeding 20mph at speeds over 20mph (10%), 24mph (25%) and 30mph (41%).

Road traffic related collisions

- Within the entire city of Edinburgh boundary, a reduction in collision rates has been observed on roads (with either 20mph and 30mph speed limits) after the speed limit implementation with a decrease of 371 collisions per year. Similarly, a reduction has been observed for collision rates in the following categories:
 - Collision severity levels Killed and seriously injured, and slight,
 - Pedestrians, cyclists, and motorcyclists, and
 - Young children and the elderly.

Introduction

Edinburgh is the first city in Scotland to implement a 20mph speed limit on most of its streets, a move supported by organisations such as the World Health Organisation (WHO), the National Institute for Health and Care Excellence (NICE), the Royal Society for the Prevention of Accidents (ROSPA) and Police Scotland. The WHO recently made a call for 30kmph (slightly slower than 20mph) to be the limit wherever motorised traffic mixes with pedestrians and cyclists.

Edinburgh 20mph speed limit roll out

The City of Edinburgh council (CEC) has a long standing policy of introducing 20mph speed limits, initially focussed on residential areas and around schools. In 2012 a pilot project was launched in South Edinburgh to measure changes in vehicle speeds and volumes, road traffic incidents, and the attitudes of residents to walking, cycling, and the local environment. The benefits evidenced from the pilot include lower vehicle speeds in 85% of the 28 streets that were monitored, perceived improvements in the safety of streets for children, a perception of improved conditions for walking and cycling and strong support from residents of the area for the 20mph limit.

Findings from the pilot helped shape the council's Local Transport Strategy and, in particular, its approach to setting speed limits in Edinburgh. In June 2014, a draft network of streets was finalised for public consultation. The consultation attracted nearly 3,000 responses from a wide range of individuals and organisations with a majority (60%) supporting or strongly supporting the proposals and 36% opposing or strongly opposing them.

Councillors approved a city wide 20mph speed limit network for Edinburgh at the Transport and Environment Committee in January 2015. Prior to the launch of the 20mph project in July 2016, over 50% of Edinburgh's residential streets were already in 20mph zones. The approved network extended 20mph speed limits to the city centre, main shopping streets and residential areas while retaining a network of roads at 30mph and 40mph in the city suburbs.

The extension of 20mph limits aims to:

- reduce the risk and severity of accidents by reducing speed, increasing the safety and well being of all road users. This is in line with the Council's Vision Zero philosophy, working towards the provision of a modern road network where all are safe from the risk of death or seriously injury
- create more favourable conditions for pedestrians and cyclists in the city. The extensive network of 20mph streets will help embed the QuietRoutes and the Cycle Friendly City Programme in a context that is safe and comfortable for cyclists
- create streets that are attractive, social and people friendly

The 20mph speed limit is a sign-only scheme and does not involve the introduction of any physical traffic calming measures such as speed humps.

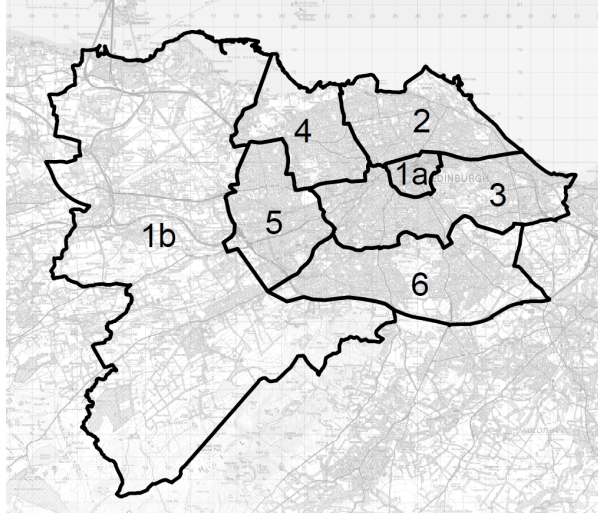


Figure 1: 20mph speed limit implementation zones in the City of Edinburgh

Implementation zones and timetable

The seven zones denote geographical areas within Edinburgh. The zones were South, West, North West, South Central/East, City Centre, rural west Edinburgh and City Centre. Implementation took place over a number of phases at different times; and the number of streets in which data on speed and volume were collected varied by zone (see Table 1). Each geographical zone was given a number and is shown in Figure 1.

Table 1: Implementation zones and timetable

Zones	Area	Implementation Phase	Operative Date	Speed Survey Sites
1a	City Centre	1	31 July 2016	7
1b	Rural West	1	31 July 2016	6
2	North	2	28 February 2017	18
3	South Central/East	2	28 February 2017	14
4	North West	3	16 August 2017	7
5	West	3	16 August 2017	9
6	South	4	5 March 2018	5

Research Questions

The following research questions are addressed in this report.

1. Was there a change in speed and volume of traffic in Edinburgh after the 20mph speed limit implementation?
2. Was there any displacement of traffic from 20mph streets to 30mph streets?
3. Was there a change in the rate of road traffic collisions (overall and by level of severity) in Edinburgh after the 20mph speed limit implementation?

Data and Methods

Data sources

The datasets analysed for this report are itemised as follows:

Speed and Volume

Monitoring data provided by the City of Edinburgh council for 66 monitored street (across the above mentioned seven geographical regions) which includes

- average speed by time of day,
- average volume per ranges of speed by time of day, and
- average volume by time of day.

Tracsis (Traffic and Data Services) were commissioned in early 2016 by the City of Edinburgh council to record speed and volume across the new 20mph network for these streets. The streets were chosen based on feedback from the Council's Local Transport & Environment Managers, feedback from the 20mph public consultation and random selection. The various categories covered in the sites chosen range from city centre, shopping, main and residential streets. The survey (survey apparatus in place for one week) records "before" data and "a year after".

Note that unless specified otherwise, the analyses for speed and volume are for streets which had speed limits changed from 30mph to 20mph after the speed limit implementation.

Road traffic related collisions

The research uses data recorded by Police Scotland (STATS19) within the City of Edinburgh Council boundary. The STATS19 database is a collection of all road traffic collisions that resulted in a personal injury and were reported to the police within 30 days of the collision. Only roads with 20mph or 30mph speed limits were included in the analyses for this dataset.

Analysis

The methods used in this report include:

- the use of descriptive statistics for vehicle speed and volume,
- the use of Student's t-tests for comparing average vehicular speed and volume in different categories, and
- the calculation of crude (basic) road traffic collision rates.

The crude (basic) road traffic collision rates are calculated by dividing the number of observed collisions by the length of the observation period in years. For all the calculations, the "before" period was of 36 months duration. The "after" period for the city wide calculations was approximately 12 months after implementation of the final phase of the network.

For the zone based rate calculations, the "after" period is taken as the time that elapsed between the date of implementation for that zone and the final date of data collection (February 28th 2019). The 20mph speed limit implementation follows a stepped wedge design.

Please note that the figures for the rate calculations were rounded off to the nearest whole number after all the calculations were done, and that the statistical significance for t-tests is taken at the 5% level.

Results

Vehicle speed

In general, we note that there has been a reduction in average vehicle speed of -1.34mph across the 66 streets surveyed. Figure 2 shows the distribution of the observed records of average vehicle speeds across the 66 streets under consideration. Data for this figure consists of 12672 observations; average speed observations for 192 timepoints for each of the 66 monitored sites.

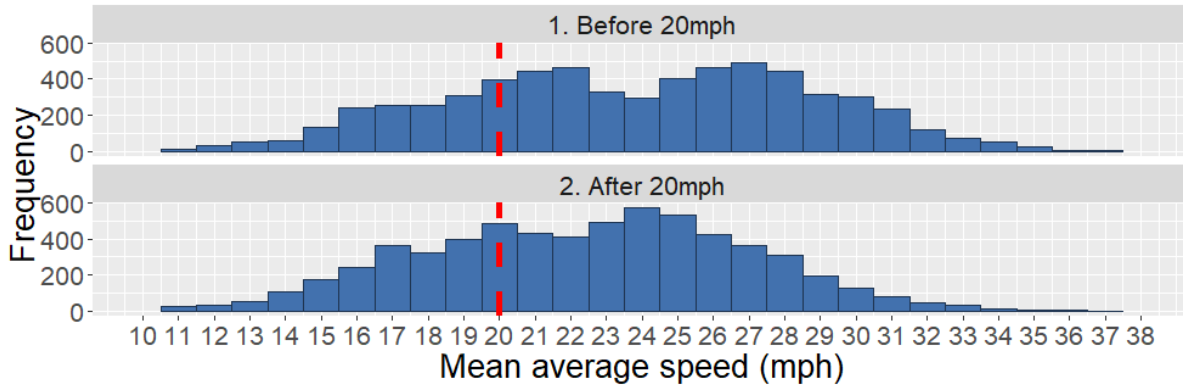


Figure 2: Histogram of average speeds on 20mph streets in the City of Edinburgh; data for this figure consists of 12672 observations; average speed observations for 192 timepoints for each of the 66 monitored sites.

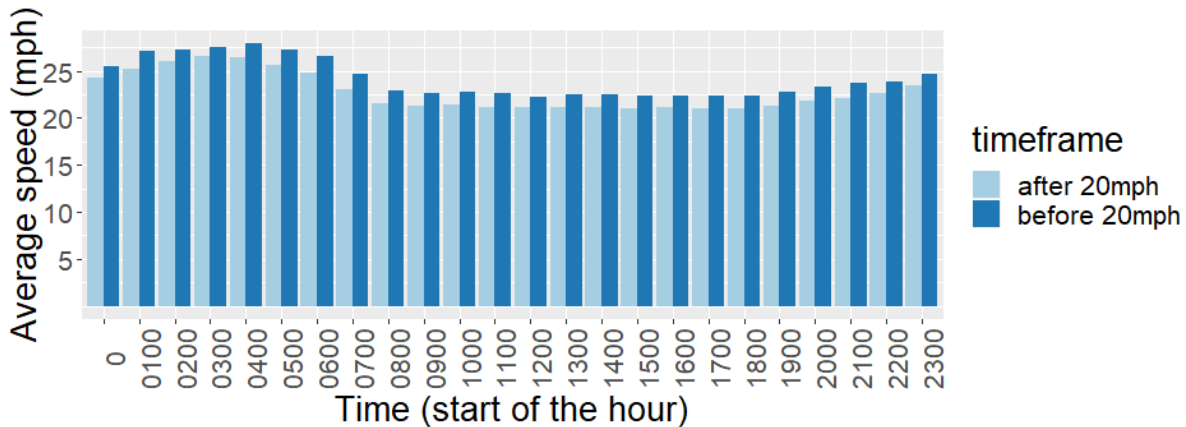


Figure 3: Average speeds on 20mph streets in Edinburgh by time of day

From Figure 2, we note that post 20mph speed limits, there is a higher frequency of speed observations less than or equal to 20.5mph and lower frequency of speed observations above 26.5mph. The red line in the figure denotes the 20mph speed marker.

A reduction in average speed has also been observed for all street categories considered, each day of the week and for streets with pre-20mph speeds greater than or equal to 24mph.

Differences in change in speed by time of day

Figure 3 shows the variation of the average vehicle speed by time of day. On visual inspection, it is noticeable that the average speed observations after the 20mph speed limits are consistently lower than that before 20mph. This is observed for each hour in the plot. Further work involves modelling the reduction of average speed controlling for variables such as time of day, and day of the week.

Differences in change in speed in streets with pre-20mph speeds greater than or equal to 24mph

Higher average speeds are associated with poorer health outcome (ie. personal injury resulting from road traffic collisions) and so it is important to know if speeds have been reduced in areas where speeds are relatively high. Streets with pre 20mph average speeds greater than or equal to 24mph were observed to

have a statistically significant reduction of average vehicle speed of -2.03mph. Streets which had pre 20mph average speed less than 24mph were observed to have a reduction of average vehicle speed of -0.72 mph (see Table 2).

Average change in speed in the different implementation zones

Table 3 provides a summary of change in average speed per implementation zone. Statistically significant reductions were observed for all zones except zones 4 and 6. This is a very crude (basic) comparison since the zones differ by

- number of streets,
- proportion of main to residential street categories,
- geographical area,
- traffic volume,
- density of road networks, and
- population sizes.

All of these will impact to some extent on average speeds and will be taken into account in other analyses we undertake at a later stage. For instance, the City Centre (zone 1a) is the smallest in size geographically but has a highly dense road network.

Overall, we note that Zone 1b (Rural West Edinburgh) has the highest difference in pre- and post-20mph average speed and Zone 6 (South) has a slight increase in average speed post-20mph. It is important to note that prior to the launch of the 20mph network in 2016, a high proportion of Zone 6 was already in 20mph speed limits and only 5 streets were surveyed in this area.

Average change in speed in the different types of streets

It has been hypothesised that the reduction in speeds may differ depending on the type of street. Streets were categorised by whether they were Main, Residential, Local shopping or City Centre streets. Statistically significant reductions in speed were observed for all the street categories considered. The highest reduction in speed, -1.59mph was noted for Main streets (see Table 4) with the lowest reduction on speed being seen in Residential Streets (-1.38mph).

Average change in speed by days of the week

It is interesting to consider whether the changes observed are for every day of the week, or differ by week days or weekends. Our results indicate that the difference in average speed was -1.34mph overall, with the lowest weekday reduction on a Monday (-1.16mph) and the highest on a Wednesday (-1.48mph). It might be of interest to policy makers that a statistically significant reduction in average speed was observed for every day of the week post 20mph speed limit implementation. See Table 2 for details.

Percentage of drivers exceeding 20mph

Finally, the percentage of drivers exceeding 20mph (observed separately for speeds over 20mph, 24mph and 30mph) post 20mph speed limits, is lower than that observed before the speed limit implementation. Speeds over 30mph showed the greatest reduction (See Table 5).

Vehicle volume

For the 20mph streets in the dataset (n=66), no statistically significant change in average vehicle volume was observed (See Table 6) after the 20mph speed limit implementation. This was observed across all time periods considered. For the 30mph streets in the dataset (n=16), no significant change in volume was observed after the speed limit implementation. For both pre and post 20mph, high levels of vehicle volume were observed (20mph streets) between 8:15 AM and 17:30 PM. For both before and after the 20mph speed limit implementation, the observed times of highest vehicle volume are similar to where the lowest average speeds were recorded.

Table 2: Summary of average speed (mph) overall

category	pre20mph	post20mph	difference	sd	95%c.i.1	95%c.i.2	p
7 Day Ave	23.63	22.29	-1.34	1.57	-1.72	-0.95	0.00
Fri	23.53	22.16	-1.38	1.70	-1.79	-0.96	0.00
Mon	23.48	22.36	-1.16	1.61	-1.55	-0.76	0.00
Sat	23.83	22.36	-1.47	1.64	-1.87	-1.06	0.00
Sun	23.91	22.58	-1.30	1.83	-1.75	-0.84	0.00
Thu	23.53	22.25	-1.23	1.81	-1.67	-0.78	0.00
Tues	23.51	22.05	-1.46	1.68	-1.87	-1.05	0.00
WD Ave	23.55	22.21	-1.34	1.59	-1.73	-0.95	0.00
Wed	23.52	22.04	-1.48	1.80	-1.92	-1.04	0.00
<24mph	20.09	19.37	-0.72	1.62	-1.28	-0.16	0.01
>=24mph	27.63	25.60	-2.03	1.19	-2.47	-1.60	0.00
All data	23.63	22.29	-1.34	1.57	-1.72	-0.95	0.00

Table 3: Summary of average speed (mph) by 20mph implementation zone

	all zones	zone 1a	zone 1b	zone 2	zone 3	zone 4	zone 5	zone 6
mean difference in speed (mph)	-1.34	-2.07	-2.41	-1.33	-1.51	-0.79	-1.18	0.41
standard deviation	1.57	1.58	1	1.57	1.32	1.15	1.39	2.4
95%c.i.1	-1.72	-3.54	-3.46	-2.11	-2.28	-1.86	-2.24	-2.57
95%c.i.2	-0.95	-0.61	-1.36	-0.55	-0.75	0.28	-0.11	3.39
P	0	0.01	0	0	0	0.12	0.03	0.72
number of streets	66	7	6	18	14	7	9	5
statistical significance*	yes	yes	yes	yes	yes	no	yes	no

* statistical significance is taken at 5% level

Despite there being no statistically significant change in volume after the 20mph speed limit implementation, there was an observed shift (on visual inspection) in the levels of vehicle volume at various speed ranges (20mph streets). As seen in Figure 4, there is an increase in vehicle volume at lower speeds and a decrease in volume at higher speeds. In particular, for the speed range 30-35 mph, there was a 41% decrease in vehicle volume, whilst for speed range 15-20mph there was an observed 26% increase in volume.

Displacement of traffic speed from 20mph to 30mph streets

Displacement of traffic from 20mph streets to 30mph streets was investigated in zone 3 only, since this was the only zone with sufficient data on both 20mph and 30mph streets.

The average difference in vehicle speed observed (pre- and post-20mph speed limit implementation) for 20mph streets was compared to that observed for 30mph streets. The difference observed (average difference in vehicle speed for 20mph streets, and average difference in vehicle speed for 30mph streets) was not found to be statistically significant.

Despite the lack of statistical significance in the difference in traffic volume in the abovementioned tests, it is worth noting that the volume in 20mph streets in zone 3 was reduced by 207 vehicles post-20mph whereas, in 30mph streets in zone 3, the reduction in volume was 39 vehicles.

Road traffic related collisions - city wide

The research uses data recorded by Police Scotland (STATS19) within The City of Edinburgh Council boundary. The STATS19 database is a collection of all road traffic collisions that resulted in a personal injury and were reported to the police within 30 days of the collision. As previously indicated, the streets considered in the analysis for this section are those which have either 20mph or 30mph speed limits.

Table 4: Summary of average speed (mph) by street category

category	pre20mph	post20mph	difference	sd	95%c.i.1	95%c.i.2	p
Main streets	24.26	22.68	-1.59	1.46	-2.02	-1.16	0
Residential streets	23.61	22.23	-1.38	1.60	-1.78	-0.98	0
Local shopping streets	24.08	22.58	-1.50	1.52	-1.96	-1.05	0
City centre streets	23.85	22.36	-1.49	1.66	-2.10	-0.88	0

Table 5: Percentage of vehicles speeding over 20mph

	vehicles>20mph	vehicles>24mph	vehicles>30mph
before	74.86	55.06	17.62
after	67.23	41.21	10.49
% reduction	10.19	25.16	40.46

Ideally, an analysis aimed at assessing the impact of a policy intervention (such as the 20mph speed limits) on road traffic collision rates would use data from multiple years pre- and post-policy intervention. For this study, due to the limited availability of post-20mph data on road collisions (and the fact that the intervention “dosage” was completed in March 2018), city wide data post-20mph was obtained over a period of approximately 12 months.

Crude (basic) collision rates were calculated for various subgroups (See Table 8) in the data. The groups considered are:

- the City of Edinburgh Council boundary,
- collision severity - slight, and killed and seriously injured, and
- vulnerable road users: children (under 16yrs), elderly (over 65 yrs), pedestrians, cyclists, and motorcyclists.

For the city wide analyses, our results indicate a reduction in the rate of road traffic collisions in each of the considered subgroups. In Table 8, the last two columns provide the difference and percentage difference in collision rates. Negative signs in these two columns indicate that there was an observed reduction in the collision rate post-20mph.

For the analysis, the before period consisted of data from ‘31-Jul-2013’ to ‘30-Jul-2016’ (approximated to 3 years) and the after period consisted of data from ‘06-Mar-2018’ to ‘28-Feb-2019’ (approximated to 1 year). The period between ‘31-Jul-2016’ and ‘05-Mar-2018’ was excluded from the analysis since the implementation of 20mph speed limits varied during that period.

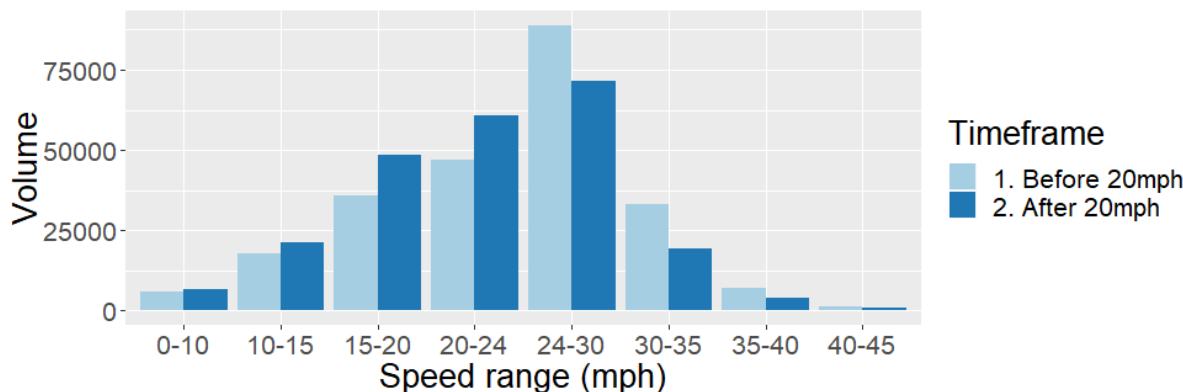


Figure 4: Average volume by speed range pre and post 20mph

Table 6: Summary of average vehicle volume

category	pre20mph	post20mph	difference	95%c.i.1	95%c.i.2	p
all zones	3641	3555	87	-112	286	0.39
zone 1a	2822	2847	-25	-145	95	0.63
zone 1b	5572	5321	250	-2396	2896	0.82
zone 2	4423	4279	144	-78	367	0.19
zone 3	4169	3962	207	-80	494	0.14
zone 4	3035	2954	82	-81	245	0.27
zone 5	2163	2415	-252	-658	154	0.19
zone 6	1690	1569	121	-109	351	0.22
main streets	5750	5512	238	-219	695	0.30
residential streets	1896	1924	-28	-142	86	0.62
shopping	7252	6647	606	-477	1688	0.23
citycentre	5843	5733	109	-941	1159	0.82

Table 7: Summary of average vehicle volume for 30mph streets in zone 3

Summary for 30mph streets in zone 3	
pre20mph	4957
post20mph	4918
difference	-39
95%c.i.1	-1215
95%c.i.2	1136
p	1

The results reveal a preliminary indication of the effect of the 20mph speed limits, but do not provide conclusive evidence of the effect of 20mph on road traffic related collisions. It is important to account for the already decreasing trend in collisions in the City of Edinburgh in further analyses.

Road traffic related collisions for the different 20mph implementation zones

In Table 9 we note that the crude (basic) collision rates observed after the 20mph speed limit implementation are lower than that observed before. As mentioned earlier, the “before” period for the calculation consists of 36 months whilst the “after” period is taken as the time interval between the speed limit in a given zone and the final date of data collection, February 28th 2019.

Since the speed limit implementation followed a stepped wedge design, the “after” period varies between zone, and the reductions in collision rates documented in this report are based on a shorter “after” time period. Table 9 provides details on the length of the “before” and “after” periods associated with the calculations for each zone (in months).

As in Table 8, the last two columns provide the difference and percentage difference in collision rates. Negative signs in these two columns indicate that there was an observed reduction in the collision rate post-20mph.

Important considerations in further analyses would include consideration of key factors such as:

- the population size for each zone,
- the proportion of streets in each zone which are residential,
- the index of deprivation associated with each zone,
- the number of streets sampled in each zone and
- the proportion of streets for which the speed limit was switched to 20mph.

The zone with the greatest reduction in collision rates is Zone 3 (South Central/East) and the zone with the greatest percentage reduction in collision rates is Zone 6 (South).

Table 8: Crude annual road traffic collision rates - city wide, severity, vulnerable groups; columns 2 and 3 provide the number of collisions observed pre and post 20mph respectively.

	collisions pre-20mph	collisions post-20mph	rate pre-20mph	rate post-20mph	diff in rates	perc.diff.rates
City wide						
city wide	2949	612	983	612	-371	-38
Collision severity						
Slight	678	134	226	134	-92	-41
Killed and seriously injured	187	48	62	48	-14	-23
Vulnerable ages						
children	304	62	101	62	-39	-39
elderly	395	104	132	104	-28	-21
Cyclists/motorcyclists						
cyclist	672	155	224	155	-69	-31
motorcyclist	266	42	89	42	-47	-53
pedestrians	865	182	288	182	-106	-37

Note:

before period: 36 months, after period: approximately 12 months

Table 9: Crude annual collision rates (per 20mph implementation zone) ; columns 2-3 provide the number of collisions observed pre and post 20mph respectively

zone	collisions pre-20mph	collisions post-20mph	rate pre-20mph	rate post-20mph	diff in rates	perc.diff.rates
zone 1a City Centre	480	330	160	132	-28	-18
zone 1b Rural West	98	66	33	26	-6	-19
zone 2 North	675	302	225	151	-74	-33
Zone 3 South Central/East	878	421	293	210	-82	-28
zone 4 North	194	83	65	55	-9	-14
zone 5 West	301	94	100	63	-38	-38
zone 6 South	219	38	73	41	-32	-43

Note:

before period: 36 months (all zones), after period: 30 months (zones 1a, & 1b), 24 months (zones 2 & 3), 18 months (zones 4 & 5), 12 months (zone 6)

From Table 9 it is clear that the rate of collisions is lower than that observed before.

Conclusions

The topic of 20mph speed limits is of national interest across the UK. A recent report (Bornioli, 2019) indicates that the impact of the 20mph speed limits in Bristol was accompanied with reduction of not only speed, but road traffic collision rates. Our report is supportive of these conclusions.

Answering the research questions

The following research questions were asked in this report:

- Was there a change in speed and volume of traffic in Edinburgh after the 20mph speed limit implementation?
- Was there any displacement of traffic from 20mph streets to 30mph streets?
- Was there a change in the rate of road traffic collisions (overall and by level of severity) in Edinburgh after the 20mph speed limit implementation?

Was there a change in speed of traffic in Edinburgh after the 20mph speed limit implementation?

Yes. The results in this report point to a statistically significant reduction in average vehicle speed, with the highest reduction observed for zone 1b, Rural West Edinburgh of -2.41mph. Additionally, we note a relatively larger reduction in average speeds on streets with higher speeds before the speed limit implementation.

Was there a change in volume of traffic in Edinburgh after the 20mph speed limit implementation?

No. There was no evidence of a change in the average volume of traffic after the 20mph speed limit implementation.

Was there any displacement of traffic from 20mph streets to 30mph streets?

No evidence of this for zone 3. In terms of whether there was any displacement of traffic from 20mph streets to 30mph streets, the results for zone 3 (South Central/East) provide a preliminary indication that there was none. Comparisons for the other implementation zones were not done due to lack of data on 30mph streets in these zones.

Was there a change in the rate of road traffic collisions (overall and by level of severity) in Edinburgh after the 20mph speed limit implementation?

Yes. This was observed for the city wide analysis. Our preliminary models (Popov et al, not reported here) indicate that the decrease in road traffic collisions resulting in personal injury across the City of Edinburgh council boundary after the speed limit implementation is greater after the speed limit implementation. These models are based on data from 1996 to 2017.

Future work involves incorporating 2018 data in the abovementioned models and quantifying the impact of the 20mph speed limit on vehicle speed and on road traffic collision rates. These will be conducted in the framework of a natural experiment evaluation (Craig et.al, 2012).

References

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