Developing and implementing 20-mph speed limits in Edinburgh and Belfast: mixed-methods study

Ruth Jepson,[1*] Graham Baker,[2] Claire Cleland,[3] Andy Cope,[4] Neil Craig,[5] Charlie Foster,[6] Ruth Hunter,[3] Frank Kee,[3] Michael P Kelly,[7] Paul Kelly,[2] Karen Milton,[8] Glenna Nightingale,[1] Kieran Turner,[1,2] Andrew James Williams[9] and James Woodcock[10]

[1]Scottish Collaboration for Public Health Research and Policy, University of Edinburgh, Edinburgh, UK
[2]Physical Activity for Health Research Centre, University of Edinburgh, Edinburgh, UK
[3]School of Medicine, Dentistry and Biomedical Sciences, Queen's University Belfast, Belfast, UK
[4]Sustrans, Bristol, UK
[5]Public Health Scotland, Edinburgh, UK
[6]Centre for Exercise, Nutrition and Health Sciences, University of Bristol, Bristol, UK
[7]Department of Public Health and Primary Care, University of Cambridge, Cambridge, UK
[8]Norwich Medical School, University of East Anglia, Norwich, UK
[9]School of Medicine, University of St Andrews, St Andrews, UK
[10]Centre for Diet and Activity Research, University of Cambridge, Cambridge, UK

*Corresponding author ruth.jepson@ed.ac.uk

Declared competing interests of authors: Ruth Hunter is a member of the Public Health Research (PHR) Funding Board. Frank Kee is a co-investigator on the Game of Stones trial (PHR 14/185/09 and NIHR129703), the Supporting MumS trial (NIHR131509), the Global Health LINKS Research Group (NIHR 16/137/85) and Improving the Oral Health of Older People in Care Homes: a Feasibility Study (TOPIC) (NIHR 17/03/11). He is a principal investigator of the MECHANISMS study (MR/RO11176/1) and the Healthy Urban Living and Ageing in Place (HULAP) study (GCRF-GIAA18-19). Furthermore, he is a member of the following panels: Medical Research Council (MRC) Public Health Intervention Development (PHIND) Funding Panel (2013–18); MRC Better Methods, Better Research Panel (2020–present); MRC Non-clinical Fellowship Panel (2020–present); UK Research and Innovation Future Leaders Fellowship Panel (2020–present); Agile COVID Panel (2020–21); Policy Research Unit Commissioning Panel (2016 and 2018); Long COVID Panel (2021); ADD ('Our Future Health' study) Advisory Board (2020–present); School of Public Health Advisory Board (2018–present); MRC Longitudinal Studies Funding Panel; and Methods Advisory Group. He was also a member of the PHR Funding Board (2009–13; chairperson 2014–19). Michael P Kelly received grants from the Wellcome Trust, The Dunhill Medical Trust, the National Institute for Health and Care Research (NIHR), the Arts and Humanities Research Council (AHRC) and Marie Curie, and received NIHR and AHRC consultancy fees. He is a member of the Scientific Advisory Board Systems Science In Public Health Economic

Research (SIPHER), University of Sheffield. Andrew James Williams received a grant from Sustrans/ Transport for Scotland for £15,255 to conduct a systematic review into the association between modes of travel and loneliness/social isolation (McHale C, Williams A, Cormie V. Systematic review of research investigating the relationship between social disconnection and transportation activities. PROSPERO 2021 CRD42021232445 URL: www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021232445) (5 months from November 2020).

Disclaimer: This report contains transcripts of interviews conducted in the course of the research and contains language that may offend some readers.

Published September 2022
DOI: 10.3310/XAZI9445

Scientific summary

Edinburgh and Belfast 20-mph speed limits

Public Health Research 2022; Vol. 10: No. 9
DOI: 10.3310/XAZI9445

NIHR Journals Library www.journalslibrary.nihr.ac.uk

Scientific summary

Background

Transport initiatives, such as a reduction of speed limits to 20 mph, are expected to result in lower traffic speeds and fewer casualties, leading to an improvement in the perception of safety and a subsequent increase in cycling and walking.

Objectives

Objective 1

Objective 1 was to explore the decision-making processes that made 20-mph speed limits possible in Edinburgh and Belfast.

Objective 1 research questions:

- What factors led to the rise of 20-mph limits on the local political and policy agendas?
- What processes hindered and enabled agreement to implement the 20-mph policy?
- What are the likely facilitators of and barriers to long-term successful implementation of the 20-mph policy in these cities?

Objective 2

Objective 2 was to describe and understand the 'how' and 'what' of implementation (i.e. the implementation processes) of the two 20-mph speed limit interventions.

Objective 2 research questions:

- How was the 20-mph speed limit intervention implemented in each city?
- To what extent was the intervention delivered as intended in each city, and what adaptations were made to how the interventions were delivered?
- What were the barriers to and enablers of implementation in the two cities?

Objective 3

Objective 3 was to assess the impact of introducing 20-mph speed limits (primarily signage) on a range of health outcomes.

Objective 3 research questions:

- Does introducing 20-mph speed limits result in reductions in the speed of motorised vehicles?
- What is the impact on the number and type of road collisions and casualties?
- What is the impact on population perceptions of the safety and pleasantness of their home and work environments?
- What is the impact on the number of people (journeys) cycling or walking to work or study?

Objective 4

Objective 4 was to investigate people's experiences of, and interactions with, the multiple intervention activities, examining how and why behaviour change occurred or did not occur.

Objective 4 research questions:

- How are the effects (or lack of effects) experienced by various population subgroups?
- Do the qualitative and quantitative data support the hypothesised causal pathways and mechanisms?
- Are there any unintended/unexpected pathways and consequences?

Objective 5

Objective 5 was to carry out an economic evaluation of the 20-mph speed limit policies.

Objective 5 research questions:

- How do the public health benefits compare with the costs (potentially including opportunity costs) of implementation?
- What additional benefits or consequences are there that would make implementing 20-mph speed limits more or less cost-effective?

Objective 6

Objective 6 was to assess the transferability of 20-mph speed limit networks to other cities, towns or districts in the UK.

Objective 6 research question:

- What is the potential for implementing the 20-mph speed limit in other parts of the UK?

Methods

Design

This was a mixed-methods study that comprised an outcome, process, policy and economic evaluation of two natural experiments. The number and variety of individuals, groups and systems likely to be affected by the 20-mph limits, and the importance of their behaviour and the interactions between them, required an evaluation appropriate for the complexity of the intervention. Therefore, guided by a programme theory, we undertook a pragmatic, theory-based, mixed-methods evaluation comprising several studies that, between them, aimed to gather comprehensive data on the 20-mph intervention. The evaluation combined routinely and locally collected quantitative data, and primary quantitative and qualitative data. No single study, or methodological approach, could provide answers to all the research questions related to the overall and differential impacts of the intervention.

The outcome evaluation comprised before-and-after (controlled when possible) studies in Edinburgh and Belfast. Matched (geographic) controls were derived from the routinely collected data. Natural experimental approaches are specifically advocated when '[i]t is possible to obtain the relevant data from an appropriate study population, comprising groups with different levels of exposure to the intervention' (Craig P, Cooper C, Gunnell D, Haw S, Lawson K, Macintyre S, *et al.* Using natural experiments to evaluate population health interventions: new Medical Research Council guidance. *J Epidemiol Community Health* 2012;**66**:1182–6). In Belfast and Edinburgh, a number of stakeholders were already collecting data; it is more efficient to make use of available data, supplementing when necessary, than to replicate costly data collection. We explored and accounted for biases that are known to affect observational methods and, particularly, before-and-after studies. Specifically, the implementation of the interventions and the data that were collected was decided on and controlled by the local jurisdictions; the difficulties (ethical and logistical) of maintaining a robust evaluation design across urban areas meant that observational and natural experimental methods were employed. Outcomes included speed; total number of road collisions and casualties; public perceptions of safety, mode of travel, driver behaviour and attitudes; and liveability.

A substantial part of this study was a process evaluation to provide lessons and recommendations that could be applied to other urban areas wishing to implement new speed limits for motorised vehicles. This included interviews with key stakeholders and focus groups with members of the general population in Edinburgh and Belfast. To understand the context and transferability, we used key informant interviews, documentary analysis and media analysis.

For the economic evaluation, we planned to undertake a cost–utility analysis informed by data on changes in physical activity associated with any changes in active travel, supplemented with a partial cost–benefit analysis based on data on changes in collisions and casualties and cost–consequences analyses based on data on liveability, including perceptions of safety.

Results (research findings)

Pre implementation and process of adopting the 20-mph limits

Speed limits of 20 mph were deliberated in government discussions in both Scotland and Northern Ireland for many years before the schemes became a reality. In both cities the main policy goal was to reduce roads traffic collisions and casualties by slowing down traffic, although it was also intended to use the policy to achieve wider health and environmental objectives.

Strong leadership was key, and in both cities there were politicians who were important in moving the 20-mph speed restrictions forward. In both cities, small-scale restrictions were implemented around schools and these served as pilot schemes for the larger scale-up.

In Edinburgh, an area-wide pilot in the south of the city was also implemented. The main opposition to the 20-mph limits came from bus operators and taxi drivers in Edinburgh, owing to concerns about increased journey times, and the Federation of Small Businesses in Belfast, which was concerned that the public would be deterred from coming into the city, thereby causing a reduction in footfall for local businesses.

Implementation

The intervention activities were viewed as being broadly implemented as intended in both cities, with signage being one example; this is likely, in part, to be because of the rigid parameters afforded by the legislation, with only minor amendments being made. Enforcement activities, specific to the 20-mph limits, were limited by finite resources and competing priorities in both cities, and over time became 'daily business'. Public experiences of these activities varied, but an important finding was the disconnect between agents (e.g. police services) and the public in terms of how the interventions should be enforced. The processes associated with rolling out such a large scheme in Edinburgh were identified as challenging; a dedicated '20-mph team' within the local authority was created to address this. The creation of a dedicated official, and strong partnership and joined-up working, were identified as key facilitators of broad implementation and the delivery of a tailored education and awareness-raising campaign in Edinburgh. In Belfast, the government organisational structure was seen as a potential barrier to formal awareness-raising activities. This latter point may help to explain the different levels of awareness of the 20-mph speed limits that were evident between participants from the two cities.

Impact

Outcomes

In Edinburgh, the overall percentage reduction in casualty rates was 39% (the overall reduction in collision rates was 40%). The percentage reduction for each level of severity was 23% for fatal casualties, 33% for serious casualties and 37% for minor casualties. Mean and median speeds reduced by 1.34 mph and 0.47 mph, respectively, at 12 months. There was an increase in two factors related to perceptions: support for 20 mph and rule-following after implementation, which was supported by the qualitative data.

There were increases in several domains of the Microscale Audit of Pedestrian Streetscapes (MAPS) for Edinburgh (assessing liveability).

In Belfast, there was a reduction of 2% in collisions and a small but statistically significant increase in several domains of the MAPS. There was no statistical change in speed. Active travel outcomes could not be assessed owing to the lack of robust data. The qualitative data supported the findings of the quantitative data. There was evidence that the intervention had increased people's awareness of their own driving behaviour, and also the driving behaviour of others. In relation to perceptions of other drivers' behaviour, there was a consistent, but not conclusive, view from participants that other drivers were adhering to the limits, particularly in certain areas such as residential streets. Again consistently, it was perceived that driving at precisely 20 mph was being done by only a minority, but what the intervention had succeeding in doing was reducing the overall traffic speed within the city by a smaller extent, often from a speed that had been in excess of the previous limit. Insufficient data were available to determine the impact of the schemes on walking and cycling levels.

Economic evaluation

A full economic evaluation was not possible because of the absence of data on active travel and because of changes in the role of one of the economic evaluation leads, as a result of the COVID-19 pandemic. However, interim analyses to inform the progression decision suggested that it was plausible that the benefits of the scheme in Edinburgh, associated with the reduction in collisions and casualties, would exceed the costs. The observed increases in liveability strengthen this conclusion.

Conclusions

Speed limit interventions that use signs and lines (plus education and promotions) instead of traffic-calming infrastructure can reduce casualties, and have significant public support and compliance once implemented. To be most effective, they may need to be implemented at a citywide level, or in areas where speeds are high, and be combined with significant education and awareness-raising. Large-scale implementation may mean that there is a differential effect depending on factors such as time of day and volume of traffic (e.g. a driver would still be restricted to driving at 20 mph at 02.00 on an empty street and the impact on casualties and other health outcomes would be negligible).

The findings of this research suggest that 20-mph limits can lead to similar public health outcomes to 20-mph zones, and have the advantage of being less costly and less intrusive. We have not been able to undertake a full economic evaluation; however, the data suggest that it is likely that the benefits of the 20-mph limits in Edinburgh exceed the costs, and further work has been identified that could make these conclusions more robust and more generalisable to other contexts.

Implications for policy and practice

A speed reduction intervention such as 20-mph limits can be implemented at various scales, from around schools to cities and even countries. Although small-scale changes that have a direct impact on vulnerable road users are generally welcomed, any large-scale change, such as a citywide implementation of 20-mph speed limits, needs careful planning and consultation. Evidence of effectiveness is an important first step to getting the key stakeholders, such as the police, public transport authorities and local councillors, on board. This needs to be followed by addressing local concerns and potentially undertaking pilot studies. Linking with other policy agendas (such as climate considerations, health and tourism) can increase traction. Once implemented, education and promotion are key to getting the public to respond positively. The value of enforcement is complex: although the public in favour of the intervention want more visible enforcement, it may be considered as heavy-handed by others. In addition, police resources are scarce

and need to be considered pre implementation. The impact of these interventions can be primarily demonstrated through the reduction in collisions and in the number and severity of casualties. It was not possible to demonstrate the effectiveness of the 20-mph speed limits on other outcomes such as active travel (walking and cycling). However, although changes in casualties can be achieved through altering the speed limit, changes in active travel depend on changes in perceptions of safety related to speed. This consideration needs to be factored in to any roll-out of this intervention if seeking to increase active travel.

Recommendations for research (numbered in priority order)

1. Develop a statistical approach to public health interventions that incorporates variables from multiple outcomes. In our study we analysed each outcome independently of each other. Further research could incorporate prior knowledge such as estimates from Elvik's models (Elvik R. *The Power Model of the Relationship Between Speed and Road Safety. Update and New Analyses*. Oslo: Norwegian Centre for Transport Research; 2009) and from relevant systematic reviews within a Bayesian framework to allow for a broader modelling approach to the evaluation of the impact of 20-mph speed limits on the rate of road traffic collisions.
2. Develop population measures of active travel that can be administered simply, inexpensively and at scale. The audit of the active travel data sources has raised some important points about the difference between routinely and non-routinely collected data in terms of timing, frequency and location, and the impact that this can have on the evaluation of natural experiments. Of course, such monitoring has to be low burden and low cost for all stakeholders. The required quality of these data combined with the more distal (not directly affecting the outcome of interest) pathway from intervention (compared with, for example, proximal outcomes such as speed or collisions) raises crucial methodological challenges for future evaluation work.
3. Undertake further work on perceptions to establish (1) whether or not there are sustained changes in support for the intervention over time and (2) the relationship between perceptions around safety and support, and change in speed and other outcomes.
4. Further research is needed to assess the differential effectiveness of changes to speed, and effects on different socioeconomic groups and communities. There are many suggestions in the extant literature of differential risk, but it remains an important question as to what happens in different groups following the introduction of speed restrictions.
5. Further research is needed on the effects on noise and air pollution following the introduction of lower speed restrictions. This should be linked to the differential effects in different communities in the previous point.
6. Further research using direct observation of walking and cycling following the introduction of speed restrictions is needed. Direct observation, rather than relying on reported behaviour, will provide much more objective evidence to inform future planning and decision-making.
7. There remain some important broader methodological questions raised by this project. The Medical Research Council guidance on complex interventions was helpful up to a point, but we encountered a situation in which the intervention was not a single thing, but rather multiple things going on in different places at different times, in ways over which the researchers had no control. This was truly a complex intervention in a complex environment, occurring in real time. We learned a great deal, but we think that there is future scope for the complexity guidelines to be revisited to elaborate on some of the problems we encountered.
8. Undertake a full economic evaluation of 20-mph speed limit interventions.

Study registration

This study is registered as ISRCTN10200526.

Funding

This project was funded by the National Institute for Health and Care Research (NIHR) Public Health Research programme and will be published in full in *Public Health Research*; Vol. 10, No. 9. See the NIHR Journals Library website for further project information.

Public Health Research

ISSN 2050-4381 (Print)

ISSN 2050-439X (Online)

Public Health Research (PHR) was launched in 2013 and is indexed by Europe PMC, NCBI Bookshelf, DOAJ, INAHTA and Ulrichsweb™ (ProQuest LLC, Ann Arbor, MI, USA).

This journal is a member of and subscribes to the principles of the Committee on Publication Ethics (COPE) (www.publicationethics.org/).

Editorial contact: journals.library@nihr.ac.uk

The full PHR archive is freely available to view online at www.journalslibrary.nihr.ac.uk/phr.

Criteria for inclusion in the *Public Health Research* journal

Reports are published in *Public Health Research* (PHR) if (1) they have resulted from work for the PHR programme, and (2) they are of a sufficiently high scientific quality as assessed by the reviewers and editors.

Reviews in *Public Health Research* are termed 'systematic' when the account of the search appraisal and synthesis methods (to minimise biases and random errors) would, in theory, permit the replication of the review by others.

PHR programme

The Public Health Research (PHR) programme, part of the National Institute for Health and Care Research (NIHR), is the leading UK funder of public health research, evaluating public health interventions, providing new knowledge on the benefits, costs, acceptability and wider impacts of non-NHS interventions intended to improve the health of the public and reduce inequalities in health. The scope of the programme is multi-disciplinary and broad, covering a range of interventions that improve public health.

For more information about the PHR programme please visit the website: https://www.nihr.ac.uk/explore-nihr/funding-programmes/public-health-research.htm

This report

The research reported in this issue of the journal was funded by the PHR programme as project number 15/82/12. The contractual start date was in March 2017. The final report began editorial review in March 2021 and was accepted for publication in February 2022. The authors have been wholly responsible for all data collection, analysis and interpretation, and for writing up their work. The PHR editors and production house have tried to ensure the accuracy of the authors' report and would like to thank the reviewers for their constructive comments on the final report document. However, they do not accept liability for damages or losses arising from material published in this report.

Published by the NIHR Journals Library (www.journalslibrary.nihr.ac.uk), produced by Prepress Projects Ltd, Perth, Scotland (www.prepress-projects.co.uk).