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Promoting walking and cycling as an alternative to using cars: systematic review

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Abstract

Objectives
To assess what interventions are effective in promoting a population shift from using cars towards walking and cycling, and to assess the health and distributional effects of such interventions.

Data sources
Published and unpublished reports in any language identified from electronic databases, bibliographies, websites and reference lists.

Review methods
Systematic search and appraisal to identify experimental or observational studies with a prospective or controlled retrospective design that evaluated any intervention applied to an urban population or area by measuring outcomes in members of the local population.

Results
22 studies met the inclusion criteria. We found some evidence that targeted behaviour change programmes can change the behaviour of motivated subgroups, resulting (in the largest study) in a modal shift of around 5% of all trips at a population level. Single studies of commuter subsidies and a new railway station have also shown modest effects. The balance of best available evidence about publicity campaigns, engineering measures and other interventions suggests that they have not been effective. Participants in trials of active commuting experienced short-term improvements in certain health and fitness measures, but we found no good evidence about the health effects of any effective population-level intervention.

Conclusions
The best available evidence of effectiveness is for targeted behaviour change programmes, but the social distribution of their effects is unclear and some other types of intervention remain to be rigorously evaluated. We need a stronger evidence base for the health impacts of transport policies, preferably based on properly conducted prospective studies.

What this paper adds

What is already known on this subject?

- Transport policies increasingly seek to reduce traffic congestion by discouraging car use and encouraging the use of alternative modes of transport

- Walking and cycling offer opportunities for physical activity, which may improve individuals' health, and do not give rise to the air pollution, injuries and other adverse effects of using motor vehicles

- We lack good evidence either of what interventions are likely to be effective in promoting a modal shift from using cars towards walking and cycling, or of the actual effects of such interventions on population health

What does this study add?

- The best available evidence suggests that targeted behaviour change programmes can be effective in changing the transport choices of motivated subgroups, but the social distribution of their effects and their effects on the health of local populations are unclear

- Evidence that other, apparently sensible types of intervention (such as agents of change, publicity campaigns, cycle routes, traffic restraint, financial incentives, and offering alternative services such as car sharing, telecommuting or improved public transport) have been effective is inconsistent, of low validity, based on single highly contextual studies, or non-existent

- We need to build a stronger evidence base for the health impacts of transport policies, preferably based on properly conducted prospective studies

Introduction

Driving cars contributes to traffic congestion, air pollution and the risk of injury and death to road users, whereas walking and cycling pose little risk to others and provide opportunities for physical activity. [1 2] Increasing population physical activity has been described as the "best buy" for improving public health, [1] but we have tended to promote physical activity as leisure and through individual behaviour change. [3] Could we also achieve this through changes in the transport environment?

Shifting people's mode of transport is now a common objective of transport policies, whose overall aims may include managing congestion and improving air quality, road safety and access to services. Various interventions have been advocated or implemented, but evidence of the actual effects of proposed measures is rarely cited, and we cannot assume that apparently sensible measures will be effective or free from harmful effects. [4-8] To date, systematic reviews in this field have tended to concentrate on relatively narrow questions about safety. [9] We carried out a systematic review of the best available evidence on the effects of population-level interventions to promote a modal shift from using cars towards walking and cycling.

Methods (see bmj.com for more details)

We searched electronic databases and websites, bibliographies, reference lists and our own archives for published and unpublished documents in any language, combining groups of search terms representing cars, walking or cycling, and a change in mode of transport. We then invited experts to contribute additional references.

We included controlled or uncontrolled prospective studies, and controlled retrospective studies, of urban population- or area-level interventions whose outcome measures had included changes in the distribution of transport mode choice among local people. We also sought evidence of health effects and about the distribution of effects between social groups. We assessed studies against ten common validity criteria based on existing checklists. [10-12] (Table W1).

The interventions, study designs and outcome metrics used were very heterogeneous (Table W2). Formal statistical synthesis was not possible, but for some studies we were able to summarise effects using a common metric: the absolute percentage share of all trips that were shifted from cars to walking and cycling combined (box).

Calculation of a common primary outcome metric

We found that studies had used a variety of metrics for expressing data relevant to our primary outcome measure. We could not identify a single common metric with which to synthesise the results of all relevant studies, but where possible we did summarise effects on the overall modal distribution of transport choices as follows.

We calculated the absolute change in the percentage share of all trips that were made by walking and cycling combined and compared this with the absolute change in the percentage share of all trips that were made by car. If the two changes were in opposite directions, we took the smaller of the two changes and used this to summarise the absolute modal shift from the car to the physically active modes. For example, if the percentage share of car trips decreased from 50% to 40% of all trips, and the percentage share of walking and cycling trips combined increased from 20% to 25%, we summarised this as a positive modal shift of 5% of all trips from a baseline share of 20%. If the two changes were in the same direction (if, for example, the public transport share of all trips increased at the expense of car, walking and cycling trips), we summarised this as a modal shift of zero.

Results

We screened 5606 references and assessed the full text of 399 documents in seven languages (Figure W1). Twenty-two studies met our inclusion criteria: three randomised controlled trials, seven non-randomised controlled prospective studies, eleven uncontrolled prospective studies and one controlled retrospective study.

We categorised studies according to the main focus of the intervention assessed. Within each intervention category, we have reported interventions in decreasing order of overall study validity, citing results of statistical tests if authors reported them or if we could estimate confidence intervals from reported data (table; Table W3 for additional data).

Effects on choice of transport mode

Targeted behaviour change programmes (six studies of four interventions)

These interventions aimed to change people's travel behaviour by offering an intervention only to a motivated subgroup of the population and/or by offering information and advice tailored to people's particular requirements.

In Glasgow, the Walk In to Work Out self-help package was evaluated in a randomised controlled trial in commuters identified as contemplating or actively preparing to change their behaviour. After six months, the intervention group reported an increase in mean time spent walking to work each week 1.93 (95% CI 1.06 to 3.52) times greater than controls. [W1-2]

In the TravelSmart programme, households interested in changing their behaviour were given a tailored selection of resources such as leaflets, timetables, maps and free trial bus tickets. A controlled repeated cross-sectional study of a sample of *all* households in Perth (Australia) found a positive modal shift of 5.5% of all trips ($p<0.01$) in the intervention area after six months compared with a 2% shift towards the car in a neighbouring control area. [W3-9] Subsequent controlled pilots in Frome [W10] and Gloucester [W11] (England) have also found net positive modal shifts (3.6% and 4.4% respectively).

In Århus (Denmark), volunteer suburban car commuters were given a free bike and bus pass for a year in the Bikebusters programme. In an uncontrolled study, participants reported a positive modal shift of 25% of all weekday trips after 11 months. [W12-14]

In the Travel Blending programme, households in two Living Neighbourhood areas in Adelaide were given tailored feedback on personal travel diaries, supported with information such as timetables or maps. In an uncontrolled panel study, households reported small increases (+1.0% and +2.0% respectively) in walking trips and inconsistent changes in cycling trips after one month. [W15-18]

Agents of change and publicity campaigns (four studies)

These interventions were applied to whole groups of people undifferentiated by motivation or personal travel circumstances.

In a cluster randomised controlled trial in primary schools in Camden & Islington (London), pupils in ten intervention schools that received one year's input from a school travel co-ordinator were no less likely to travel to school by car than those in control schools (odds ratio 0.98, 95% CI 0.61 to 1.59). [W19]

In Maidstone (England), a controlled repeated cross-sectional study of households on trunk route corridors showed that two years after a publicity campaign on sustainable transport, the only statistically significant change was a decrease in cycling trips in the intervention area ($p<0.05$). [W20]

In Phoenix (Arizona), drivers responding to an uncontrolled repeated cross-sectional telephone survey reported a positive modal shift of 1% of commuting journeys seven months after the Clean Air Force campaign to promote not driving to work one day a week. [W21]

In the Curb Your Car campaign, transport fairs and co-ordinators and free bus passes were offered at state workplaces in Eugene (Oregon). An uncontrolled repeated cross-sectional study found no evidence of a shift in employees' usual mode of travel to work after nine months. [W22]

Engineering measures (six studies)

The effects of improving and extending cycle route networks were evaluated in repeated cross-sectional household studies in Delft (Netherlands; controlled study) and Detmold and Rosenheim (Germany; uncontrolled study). In Delft, households in the intervention suburb reported a 3% increase in the cycling mode share of all trips after three years, with no change in the mode shares for walking or for the car; in the control area, the frequency of car trips increased and the frequency of bike trips did not change. A nested panel study found a positive modal shift of 0.6% of all trips. [W23-30] In Detmold and Rosenheim, households reported a negative modal shift of 5% of all trips (Detmold) and zero modal shift (Rosenheim) after five years. [W31-33]

In an uncontrolled repeated cross-sectional study, secondary school pupils in Stockton (England) reported a negative modal shift of 2% in their usual mode of travel to school 17 months after a new cycle route was opened in the town. [W34]

Also in England, traffic restraint schemes were evaluated in uncontrolled studies of 20 mph (30 km/h) zones in six urban neighbourhoods and of the Bypass Demonstration Project in six small towns. There was no evidence of a change in travel patterns in a panel study of residents of the 20 mph zones, [W35] and a repeated cross-sectional survey of residents of the bypassed towns found a negative modal shift of 3% in their main mode of travel to the town centre. [W36-37]

In an uncontrolled repeated cross-sectional study in Boston, office workers reported a positive modal shift of less than 1% of commuting journeys after the introduction of the downtown Auto Restricted Zone. [W38-40]

Financial incentives (two studies)

In California, a directive to "cash out" the cost of subsidising workplace parking (by offering at least equivalent subsidies to staff who commute by other modes) was evaluated in a controlled repeated cross-sectional study. Employees at eight intervention workplaces reported a positive modal shift of 1% of commuting journeys after one to three years ($p<0.01$), compared with no statistically significant change in one control workplace. [W41-42]

In Trondheim (Norway), a toll ring was introduced for motor vehicles around the city centre. An uncontrolled household panel study found a negative modal shift of 2.6% of all trips after one year. [W43-44]

Providing alternative services (three studies)

In San Francisco, a controlled repeated cross-sectional study of the City CarShare club found that members were no more likely to report a positive modal shift after nine months than aspiring members still waiting to join. Members' car mode share increased by a greater proportion than did their combined walking and cycling mode share (+17.0% and +3.7% respectively). [W45-47]

In Voorhout (a commuter town in the Netherlands), an uncontrolled household panel study found a positive modal shift of 5.0% of all trips ($p<0.001$) one year after the first railway station was opened in the town. [W48]

A controlled retrospective study of commuters registered with neighbourhood telecommuting centres in California found a negative modal shift of 0.2% on telecommuting days compared with normal commuting days, with a 24% decrease in reported distance travelled on foot or by bike. [W49]

Health effects (six studies, Table W4)

We found robust evidence of health effects only in two randomised controlled trials of the effects of active commuting in selected volunteers. The Walk in to Work Out trial in Glasgow showed statistically significant net increases in sample mean scores on the mental health, vitality and general health subscales of the SF-36 after six months. [W1] A smaller trial in Tampere showed statistically significant net improvements in maximum aerobic power, maximum treadmill time, and heart rate and blood lactate at submaximal standard work load after ten weeks. [W50-51]

We also found data on road traffic accidents and other aspects of community health, but only from small studies of relatively low validity of interventions not shown to be effective in promoting a modal shift. [W34-37]

Social distribution of effects (11 studies, Table W5)

Findings were generally reported very briefly and/or without providing the data on which statements were based. The data were insufficient to permit any meaningful synthesis.

Table. Summary of evidence of effectiveness of interventions to promote modal shift

Study	Validity score	Nature of comparison	Evidence for a modal shift from using cars towards walking and cycling				
			Statistically significant positive effect	Positive effect of uncertain statistical significance	Inconclusive or no effect	Negative effect of uncertain statistical significance	Statistically significant negative effect
Targeted behaviour change programmes							
Glasgow [W1-2]	9	Controlled	•				
Perth (TravelSmart) [W3-9]	7	Controlled	•				
Frome (TravelSmart pilot) [W10]	9	Controlled		•			
Gloucester (TravelSmart pilot) [W11]	9	Controlled		•			
Århus [W12-14]	7	Uncontrolled		•			
Adelaide [W15-18]	4	Uncontrolled			•		
Publicity campaigns and agents of change							
Camden-Islington [W19]	8	Controlled			•		
Maidstone [W20]	7	Controlled			•		
Phoenix [W21]	5	Uncontrolled		•			
Eugene [W22]	4	Uncontrolled			•		
Engineering measures							
Delft [W23-30]	7	Controlled		•			
Detmold-Rosenheim [W31-33]	6	Uncontrolled				•	
Stockton [W34]	5	Uncontrolled				•	
England (20 mph zones) [W35]	5	Uncontrolled			•		
Boston [W38-40]	4	Uncontrolled		•			
England (bypasses) [W36-37]	3	Uncontrolled				•	
Financial incentives							
California (cashing out) [W41-42]	8	Controlled	•				
Trondheim [W43-44]	7	Uncontrolled				•	
Providing alternative services							
San Francisco [W45-47]	7	Controlled			•		
Voorhout [W48]	7	Uncontrolled	•				
California (telecommuting) [W49]	4	Controlled				•	

Discussion

Principal findings

We found evidence from a few relatively well conducted studies that targeted behaviour change programmes can change the behaviour of motivated subgroups. [W1-14] At a population level (in the main TravelSmart study) this resulted in around 5% of all household trips being shifted from cars to walking or cycling. Volunteers participating in trials have experienced short-term improvements in certain measures of health or fitness after taking up active commuting. [W1-2 W50-51] Single studies of commuter subsidies [W41-2] and a new railway station [W48] have also shown positive modal shifts of 1% and 5% of trips respectively.

The balance of best available evidence about agents of change, publicity campaigns, engineering measures and road user charging suggests that they have not been effective in our terms. [W19-40 W43-44] We also found evidence from single controlled studies that car share clubs [W45-47] and telecommuting [W49] were not effective; if anything, participation in these interventions was associated with negative effects.

Strengths and weaknesses of the review

We sought population-level evidence to answer a public health question. We therefore searched for a wide range of evidence from diverse sources, making no assumptions about what types of intervention or study design would be relevant, and explicitly considering external validity or transferability (such as the choice of study population) in selecting studies for inclusion. [13] We may still have missed some relevant evidence because of poor indexing in some databases. A common objective of evidence synthesis is to pool results and derive generalisable estimates of effect size, but we could not do this because the interventions and studies we found were very heterogeneous.

Few systematic reviews of interventions to improve health have explicitly sought evidence of the social distribution of effects. We did seek such evidence, but found that it was very limited and often not supported by the citation of actual data.

Strengths and weaknesses of the available evidence

In general, the most robust evidence of effectiveness is concentrated around interventions targeted on motivated groups of volunteers. Neither these interventions nor their observed effects are necessarily applicable to larger, less selected populations. Many of the other studies were of demonstrably low rigour or were poorly reported. We found little evidence about the social distribution of intervention effects, and no good evidence of how an effective population-level intervention had influenced any aspect of population health.

We chose to specify a modal shift between cars and walking and cycling as the key outcome measure for this review, but relatively few primary studies have reported data about this outcome. Some interventions were not primarily intended to achieve this. Others may have been ineffective in our terms but successful in other terms — by promoting public transport at the expense of other modes, or by promoting cycling at the expense of walking. Our difficulty in finding relevant evidence may reflect hitherto different priorities in the transport and health policy and research communities. Walking and cycling have long been marginalised in transport planning, and recognition of their potential wider social benefits remains limited. [14] Emerging findings from contemporary interventions such as the London congestion charge or the National Cycle Network suggest that these may be encouraging walking or cycling, [15 16] but evaluation studies are often not designed to assess effects on important population health determinants such as physical activity.

Implications and unanswered questions

It is difficult to change long-standing and complex patterns of behaviour, so the evidence that some in-depth, targeted interventions have achieved any measurable modal shift is encouraging. Our findings are consistent with a view that interventions which engage people in a participative process and address factors of personal salience may be more effective than those which simply aim to raise awareness or impose changes in the physical and economic environments. However, some types of intervention in the latter group remain to be rigorously evaluated, so this view reflects absence of evidence as much as it reflects evidence of absence of effectiveness. [17]

The authors of two studies stated that observed increases in cycling were largely attributable to existing cyclists making more trips. [W3-9 W23-30] Together with the finding that the best evidence of effectiveness is for targeted behaviour change interventions, this raises the possibility that an apparently “successful” intervention could conceal increasing disparities in physical activity levels between social groups. This requires further research.

Ecological comparisons show that walking and cycling mode shares can vary between populations, both between and within countries, by an order of magnitude greater than the population effect size of any intervention included in this review. [18-21] It may be unrealistic to expect interventions to produce substantial effects in relatively inactive populations without addressing the other, potentially complex reasons for such variations, such as attitudes towards cars and bicycles. Combining interventions in a genuinely integrated urban transport policy might be more effective, but we currently lack evidence from intervention studies to support this assertion.

Our findings echo Wanless’ more general observation that we know relatively little about the likely health impact of interventions to influence the wider determinants of population health. [22] Many transport policy interventions constitute natural experiments whose effects on population health could and should be evaluated using well designed prospective (and, where appropriate, controlled) studies. These studies should use pluralistic methods of evaluation to provide multiple perspectives on the putative causal relation between a complex contextual intervention and its alleged effects. They should assess changes in physical activity and wellbeing, as well as adverse effects such as injuries and the potential for widening social inequalities in health and health determinants.

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Contributorship

DO and MP had the original idea. DO designed the review with input from MP, carried out study selection, data extraction and critical appraisal, and wrote the paper. All authors contributed to the design of the study and to the writing of the paper. In addition, VH and DO executed the literature search and ME and MP contributed to study selection, data extraction and critical appraisal.

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References to the primary studies included in the systematic review can be found on bmj.com.

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Additional material for bmj.com

Methods for search, selection and assessment of primary studies

Electronic sources searched

We searched the following electronic databases from their start dates to the end of 2002:

- ASSIA
- CINAHL
- Cochrane Library (CDSR and CCTR)
- Dissertation Abstracts
- Embase
- Geobase
- HMIC
- HELMIS
- IBSS
- Index to Theses
- Medline and PreMedline
- PapersFirst
- PsycInfo
- Regard
- Web of Science (SCI and SSCI)
- Sociological Abstracts
- SportDiscus
- Transport

Through quality-assured internet gateways in medicine (www.omni.ac.uk), social sciences (www.sosig.ac.uk) and engineering (www.eevl.ac.uk), we also identified and searched a purposive sample of sixteen transport-related websites that contained bibliographies or searchable databases of documents and represented a range of types of organisation, countries of origin and language of publication:

- US National Transportation Library (ntl.bts.gov)
- French Centre for the Study of Urban Planning Transportation and Public Facilities (www.certu.fr)
- European Local Transport Information Service (www.eltis.org/en/index.htm)
- Energie-Cités association of European local authorities (www.energie-cites.org)
- European Platform on Mobility Management (www.epommweb.org)
- International Bicycle Fund (www.ibike.org/bibliography/bike-policy.htm)
- US Transportation Research Board (www.nas.edu/trb)
- Nottingham School of the Built Environment (www.nottingham.ac.uk/sbe/planbiblios/index_A-D.html)
- Scottish Executive (www.scotland.gov.uk)
- Sustrans (www.sustrans.org)
- Norwegian Institute for Transport Economics (www.toi.no)
- UK Transport Research Laboratory (www.trl.co.uk)
- Swedish Road and Transport Research Institute (www.transguide.org)
- Danish Ministry of Transport (www.trm.dk and www.vd.dk)
- Centre for Transport Studies, University College London (www.ucl.ac.uk/transport-studies)
- Victoria Transport Policy Institute (www.vtpi.org/tdm)

Search strategy for electronic databases

1. Use of cars

(automobile* OR auto use* OR car OR cars OR commut* OR congested OR congestion OR driver* OR mechanised transport* OR mechanized transport* OR motoring OR motorist OR motor* transport OR personal transport OR road use* OR traffic OR vehic*)

In Medline we added the MeSH headings transportation/ and motor vehicles/

AND

2. Use of physically active modes of transport

(active commut* OR active transport* OR bicycl* OR bike* OR biking OR cycle hire OR cycling OR cyclist* OR ecological commut* OR ecological transport* OR green* commut* OR green* transport* OR green travel* OR non-auto* OR non-motorised OR non-motorized OR pedestrian* OR physical* activ* OR walk*)

*In non-biomedical databases we added the term cycle**

AND

3. Change in mode of transport

(((modal OR mode) AND (analys* OR analyz* OR choice* OR distribution OR effect* OR selection* OR shift* OR split* OR substitut* OR switch* OR transfer* OR transport* OR use*))

OR

((transport* OR travel) AND (behavio(u)r OR chang* OR demand* OR habit* OR impact* OR pattern* OR shift* OR substitut*))

OR

(decreas* OR discourag* OR disincentiv* OR encourag* OR incentiv* OR increas* OR intermodal distribution OR mode of transport OR promot* OR reduc* OR restrain* OR restrict*))

Study selection and assessment

We included experimental or observational evaluation studies, with a controlled or uncontrolled prospective design or a controlled retrospective design, of the effects of any policy, programme or project applied to an identifiable urban population or area in an OECD member state by measuring outcomes in a sample of local households, residents, commuters, drivers or school pupils.

Because we sought population-level evidence, we excluded studies of interventions for individuals in clinical settings, studies of travel plans at single workplaces or schools, and studies based solely on people or vehicles visiting or passing through study locations.

We sought evidence of the following outcomes: changes in the distribution of transport mode choice between cars and walking and cycling; effects on any measure of human health, fitness, health-related behaviour or wellbeing; and the distribution of effects between social groups.

After obviously irrelevant titles had been sifted out by the lead reviewer, at least two reviewers independently screened all identified titles and abstracts. All references identified by any reviewer as relevant were retrieved in full text and assessed again against the inclusion criteria.

We drew on existing checklists [10-12] to formulate ten common validity criteria that could be applied to all the study designs included. These reflected the main potential biases in epidemiological studies in general and some specific potential biases in assessing changes in transport behaviour.

The lead reviewer carried out detailed data extraction and critical appraisal, seeking clarification from authors or reporting agencies where necessary. Each study was checked by one other reviewer and any disagreements were resolved by discussion and re-examination of the documents.

References to primary studies included in the review

Glasgow

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Frome

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Figure W1
Study flow

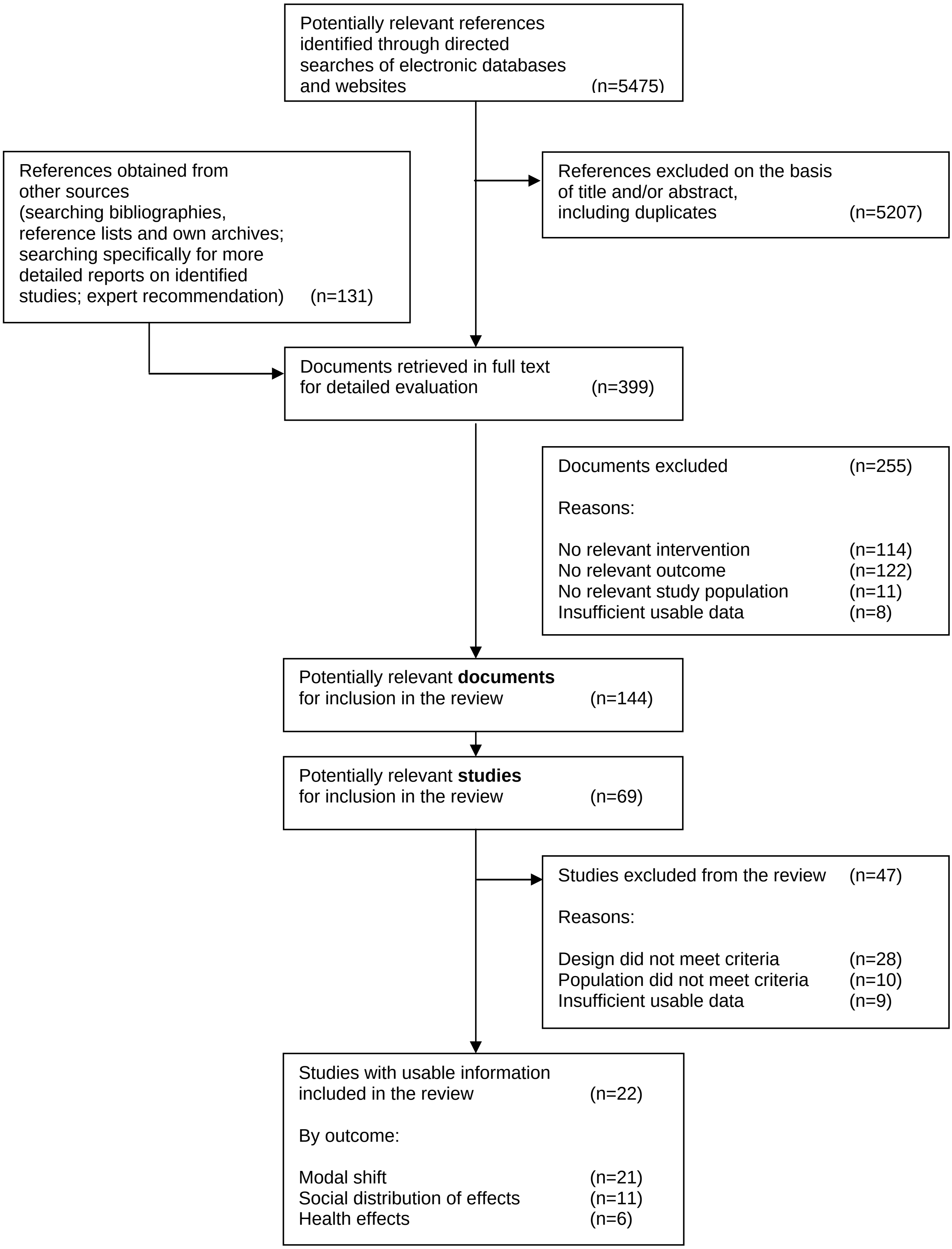

Table W1
Summary of validity assessment for included studies

Criterion	Adelaide [W15-18]	Boston [W38-40]	California (cashing out) [W41-42]	California (telecommuting) [W49]	Camden-Islington [W19]	Delft [W23-30]	Detmold-Rosenheim [W31-33]	England (bypasses) [W36-37]	England (20 mph zones) [W35]	Eugene [W22]	Gloucester [W11]	Frome [W10]	Glasgow [W1-2]	Maidstone [W20]	Perth [W3-9]	Phoenix [W21]	San Francisco [W45-47]	Stockton [W34]	Tampere [40]	Trondheim [W43-44]	Voorhout [W48]	Århus [W12-14]
Were “before” and “after” data obtained from the same, or comparable, groups or areas?	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Were outcomes compared with an appropriate control group or area, and if so, were control data collected in a comparable way?			✓	✓	✓	✓					✓	✓	✓	✓	✓		✓		✓			
Were participants, groups or areas randomly allocated to receive the intervention or the control?					✓								✓						✓			
Was the study sample randomly recruited from the study population with a response rate of at least 40%, or otherwise shown to be representative of the study population?			✓		✓	✓	✓				✓	✓	✓		✓			✓		✓	✓	✓
Were the results based on a minimum sample size of at least 100 people in each group or wave?	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Were outcomes studied in a cohort or panel of respondents with an attrition rate of less than 30%?											✓	✓							✓			✓
Were confidence intervals or the results of significance tests reported?			✓		✓						✓	✓	✓	✓	✓		✓		✓	✓	✓	
Did the assessment of transport behaviour consider more than one type of trip, or trips made over a period longer than one day or a “typical” day?	✓		✓	✓		✓	✓		✓		✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
Were the effects of the intervention assessed at least three months after the start of the intervention?		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Were “before” and “after” data collected at seasonally comparable times of the year, or if not, was the study a controlled study?	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of criteria met	4	4	8	4	8	7	6	3	5	4	9	9	9	7	7	5	7	5	6	7	7	7

Table W2
Characteristics of included studies

Study	Year	Intervention	Study population	Study design	Primary outcome
Adelaide [W15-18]	1998	Tailored feedback on travel diaries with suggestions on changing travel patterns, supported with customised information (Travel Blending)	Households living, working or visiting in two neighbourhoods of Adelaide	Uncontrolled prospective panel study	Reported frequency of, and time spent on, all trips in a seven-day travel diary by mode
Boston [W38-40]	1978	Car restriction, subsidised bus services and pedestrianisation in central business district	Employees in city centre office buildings in Boston	Uncontrolled repeated cross-sectional study	Reported mode of journey to work on day before survey
California (cashing out) [W41-42]	1992	State legislation requiring employers with at least 50 staff to "cash-out" the cost of rented parking spaces	Employees at workplaces in urban South California	Controlled repeated cross-sectional study	Reported mode of all journeys to work over five consecutive days
California (telecommuting) [W49]	1993	Voluntary use of neighbourhood telecommuting centres as an alternative to commuting to their usual workplace	Registered users of telecommuting centres in California	Retrospective study using participants as their own controls	Reported mode of all trips recorded over two periods of three consecutive days
Camden-Islington [W19]	NR	Site-specific advice to participating schools from a school travel coordinator	Pupils in primary schools in two London boroughs	Cluster randomised controlled trial	Reported mode of journeys to school on one day
Delft [W23-30]	1982	Upgrading and increased connectivity (+3.3 km) of cycle route network	Households in suburbs of Delft	Controlled repeated cross-sectional study with nested panel study of a subset of respondents to both survey waves	Reported mode of all trips of residents aged 10 and over on one of a number of specified days covering all the days of the week
Detmold-Rosenheim [W31-33]	1981	Bicycle-friendly demonstration project in two towns, mainly consisting of planning and building improvements to cycle route network (+31 km, +13 km respectively)	Households in both towns	Controlled repeated cross-sectional study	Reported mode of all trips of residents aged 10 and over on one of a number of specified days covering all the days of the week

Table W2 continued

Study	Year	Intervention	Study population	Study design	Primary outcome
England (bypasses) [W36-37]	1992	Construction of bypasses, followed by a variety of traffic calming measures and enhanced walking or cycling facilities in each town centre	Residents of six small towns in England	Uncontrolled repeated cross-sectional study	Reported main mode of residents' journeys to town centres
England (20 mph zones) [W35]	1996	Construction of 20 mph (30 km/h) zones, enforced using a range of engineering measures	Residents of neighbourhoods in six towns in northern England	Uncontrolled repeated cross-sectional study	Stated change in travel patterns
Eugene [W22]	1994	Promotion of alternative transport modes through workplace transport fairs, transport coordinators, free bus passes, and rewards for staff using alternative modes	State employees in Oregon	Uncontrolled repeated cross-sectional study	Reported most commonly used mode for commuting
Frome [W10]	2001	Individualised marketing of alternative modes of transport to households showing an interest in using them (TravelSmart: see Perth)	Households in Frome	Controlled prospective panel study with common baseline dataset	Reported main mode of all household trips, expressed in terms of estimated trips per person per year by mode
Glasgow [W1-2]	1998	Self-help pack to promote active commuting (Walk In to Work Out) containing written interactive materials based on the transtheoretical model of behaviour change, e.g. advice on choosing routes, personal safety, safe cycle storage, activity diary, map	Employees at three public sector organisations in Glasgow	Randomised controlled trial with intention-to-treat analysis	Reported time spent walking to work in seven-day recall physical activity diary, progression to higher stage of change, and prevalence of cycling
Gloucester [W11]	2001	Individualised marketing of alternative modes of transport to households showing an interest in using them (TravelSmart: see Perth)	Households in a suburb of Gloucester	Controlled prospective panel study with common baseline dataset	Reported main mode of all household trips, expressed in terms of estimated trips per person per year by mode

Table W2 continued

Study	Year	Intervention	Study population	Study design	Primary outcome
Maidstone [W20]	1994	Campaign using mass media and community activities to raise awareness of alternative modes of transport	Households on trunk route corridors approaching Maidstone and Tunbridge Wells	Controlled repeated cross-sectional study	Reported frequency of all household trips in a typical week by mode
Perth [W3-9]	2000	Individualised marketing of alternative modes of transport to households showing an interest in using them (TravelSmart), using a tailored combination of e.g. public transport information, cycle route map, walking information booklet with motivational challenge chart, sometimes followed up with home visits	Households in South Perth and Victoria Park	Controlled repeated cross-sectional study of households using a mixture of survey sources to compile the baseline dataset, a combination of random and quota sampling for follow-up, and analysing outcomes in a sample representative of all local households irrespective of their interest or participation in the intervention	Reported main mode of all household trips, expressed in terms of estimated trips per person per year by mode
Phoenix [W21]	1988	Campaign using mass media and community activities to promote voluntary no-drive day	Drivers living in Maricopa County and commuting to work	Uncontrolled repeated cross-sectional study	Reported mode of all commuting journeys
San Francisco [W45-47]	NR	Neighbourhood-based car-sharing cooperative	Members and aspiring members in San Francisco	Controlled repeated cross-sectional study	Reported mode of all trips on any two days selected by the respondent
Stockton [W34]	1985	New shared pedestrian and cycle route (4 km)	Secondary school pupils in Stockton	Partially-controlled repeated cross-sectional study	Reported usual mode of journey to school
Tampere [40]	NR	Participation in a trial of the effects of walking and cycling to work on physical fitness and blood lipids	Car or bus commuters in Tampere	Randomised controlled trial [no actual intervention to promote modal shift except for participation in trial]	None [included for health effects only]

Table W2 continued

Study	Year	Intervention	Study population	Study design	Primary outcome
Trondheim [W43-44]	1991	Toll ring for motor vehicles inbound towards the city centre, Monday to Friday between 0600 and 1700	Households in Trondheim	Uncontrolled prospective panel study	Reported mode of all trips, and of inbound trips across the cordon, of residents aged over 13 recorded in a one-day travel diary
Voorhout [W48]	1997	Opening of a railway station in a commuter town for the first time	Households in Voorhout	Uncontrolled prospective panel study	Reported mode of (a) all activities and (b) work and school activities of residents aged over 12 on two consecutive days selected by the respondent
Århus [W12-14]	1995	"Inveterate motorists" invited to try to use bike and bus as much as possible in exchange for free bike, free bus pass and other accessories and information for one year (Bikebusters)	Car commuters in Århus	Uncontrolled prospective panel study	Reported mode of all weekday trips over one week

NR: not reported

Table W3
Descriptive and primary outcome data for each study

Validity score	Study, primary reference and secondary reference(s) if relevant	Sample size [a]	Response rate [b]	Follow-up rate [c]	Follow-up (months) [d]	Outcome measure	Findings [e]
Targeted behaviour change programmes							
9	Glasgow [W1-2]	102 commuters	89%	66%	6	Reported time spent walking to work in seven-day recall physical activity diary	Among those who had not walked to work at the start of the study, those in the intervention group (n=14) reported spending a significantly greater mean time per week walking to work than controls (n=12) (125 mins vs 61 mins) There was also a significant increase in the reported mean time spent walking to work per week, in favour of the intervention group, among those who already walked to work (intervention group (n=61): 52 min to 79 min, control group (n=43) 50 min to 60 min) Analysis of covariance (using logarithms) resulted in an estimated average relative increase in the time spent walking to work at six months, for someone given the intervention, of 1.93 (95% CI 1.06 to 3.52) times any increase in walking time for a corresponding control who walked the same amount at baseline

Table W3 continued

Validity score	Study, primary reference and secondary reference(s) if relevant	Sample size [a]	Response rate [b]	Follow-up rate [c]	Follow-up (months) [d]	Outcome measure	Findings [e]
	Glasgow continued					Reported time spent cycling	There was no difference in the reported average weekly minutes spent cycling between cyclists in the intervention group (n=9) and control group (n=9)
						Progression to higher stage of change	A significantly larger percentage of the intervention group (49%) had progressed to a higher stage of active commuting behaviour change compared with the control group (31%: difference 18% (95% CI 5% to 32%). At 12 months, 25% of the intervention group had progressed to the "action" or "maintenance" stages (95% CI 17% to 32%)

Table W3 continued

Validity score	Study, primary reference and secondary reference(s) if relevant	Sample size [a]	Response rate [b]	Follow-up rate [c]	Follow-up (months) [d]	Outcome measure	Findings [e]
7	Perth (TravelSmart) [W3-9]	706 households	75%	NA	6	Reported main mode of all household trips, expressed in terms of estimated trips per person per year by mode extrapolated from a one-day travel survey	**Intervention group**: estimated absolute modal shift of +5.5% from a baseline of 13.9%. Changes in all mode shares were statistically significant whether using trips or persons as the denominator (walking: p<0.01 in either case; cycling: p<0.01 on trips, p<0.10 on persons; car driver: p<0.01 in either case; car passenger: p<0.01 on trips, p<0.10 on persons). Changes sustained at 18-month follow-up (but comparable control group data not shown)
						Reported time spent walking and cycling	Estimated mean time spent walking increased from 10 to 13 minutes per person per day. Estimated mean time spent cycling increased from two to three minutes per person per day
							Control group: estimated absolute modal shift of –2%. Based on reported proportions, the change in car share is likely to be significant (estimated 95% CI: 0% to +6%) and the changes in walking and cycling shares are not [f]

Table W3 continued

Validity score	Study, primary reference and secondary reference(s) if relevant	Sample size [a]	Response rate [b]	Follow-up rate [c]	Follow-up (months) [d]	Outcome measure	Findings [e]
9	Frome [W10]	749 households [g]	74%	80%	3	Reported main mode of all household trips, expressed in terms of estimated trips per person per year by mode extrapolated from a one-day travel survey	Estimated absolute modal shift of +3.6% from a baseline of 31.1% after adjustment for changes in control group. Decrease in car driver share of all trips was statistically significant ($p<0.05$)
9	Gloucester [W11]	624 households [g]	66%	76%	3	Reported main mode of all household trips, expressed in terms of estimated trips per person per year by mode extrapolated from a one-day travel survey	Estimated absolute modal shift of +4.4% from a baseline of 28.7% after adjustment for changes in control group. Decrease in car driver share of all trips was statistically significant ($p<0.05$)
7	Århus [W12-14]	150 commuters	NR [h]	88%	11	Reported mode of all weekday trips over one week	Estimated absolute modal shift of +25.3% from a baseline of 18.4%. Insufficient data to judge statistical precision of results
6	Tampere [W50-51]	35 commuters	NR	96%	2.5	None [included for health effects only]	

Table W3 continued

Validity score	Study, primary reference and secondary reference(s) if relevant	Sample size [a]	Response rate [b]	Follow-up rate [c]	Follow-up (months) [d]	Outcome measure	Findings [e]
4	Adelaide [W15-18]	403 households	NR [h]	35-50%	1	Reported frequency of, and time spent on, all trips in a seven-day travel diary by mode	Among households that participated in the intervention, there was an overall reduction in all trips of 8% and 11% in Dulwich and Christies Beach respectively. Car driver trips decreased by 10.2% and 14.6% respectively, and car passenger trips decreased by 9.4% and 8.6% respectively. Walking trips increased by 1.0% in Dulwich and decreased by 2.0% in Christies Beach. Time spent walking increased by 8.2% in Dulwich. Cycling trips decreased by 11.0% in Dulwich and increased by 20.9% in Christies Beach. Insufficient data to judge statistical precision of results

Table W3 continued

Validity score	Study, primary reference and secondary reference(s) if relevant	Sample size [a]	Response rate [b]	Follow-up rate [c]	Follow-up (months) [d]	Outcome measure	Findings [e]
Publicity campaigns and agents of change							
8	Camden-Islington [W19]	714 school pupils	85%	NA	14	Reported mode of journeys to school on one day	Pupils in intervention schools were more likely to travel to school by car (24.1% vs 22.5%) and less likely to walk to school (69.9% vs 71.0%) than pupils in control schools. There was no significant difference in the odds of a pupil travelling to school on foot, by bike or on public transport between intervention and control schools (odds ratios and 95% CIs: unadjusted 0.98 (0.54, 1.76); adjusted for baseline characteristics 1.20 (0.81, 1.82); adjusted for baseline and other covariates 0.98 (0.61, 1.59)
7	Maidstone [W20]	761 households	20%	NA	24	Reported frequency of all household trips in a typical week by mode	**Intervention area:** average number of weekly journeys by car increased (12.74 to 12.82, NS), on foot decreased (5.02 to 4.95, NS), and by bike decreased (0.75 to 0.45, p<0.05) **Control area**: average number of weekly journeys by car decreased (12.83 to 12.10, NS), on foot increased (6.72 to 6.85, NS), and by bike decreased (1.03 to 0.56, p<0.10)

Table W3 continued

Validity score	Study, primary reference and secondary reference(s) if relevant	Sample size [a]	Response rate [b]	Follow-up rate [c]	Follow-up (months) [d]	Outcome measure	Findings [e]
5	Phoenix [W21]	701 drivers	NR	NA	7	Reported mode of all commuting journeys	Estimated absolute shift of +1% following the current year's intervention from a baseline of 5% (+3.5% from a baseline of <2.5% when compared to the previous year's baseline survey; a proportion of this shift occurred between the waves of the intervention). Based on reported proportions, the changes over the two year period for all modes are likely to be significant (estimated 95% CIs: car –2% to –6%, walking +2% to +4%, cycling 0% to +2%), but for the current study year only the change in walking share is likely to be significant (estimated 95% CI 0% to +2%) [f]
4	Eugene [W22]	263 commuters	NR	NA	9	Reported most commonly used mode for commuting	Estimated absolute shift of 0 from a baseline of 2-6% depending on area of residence. Insufficient data to judge statistical precision of results

Table W3 continued

Validity score	Study, primary reference and secondary reference(s) if relevant	Sample size [a]	Response rate [b]	Follow-up rate [c]	Follow-up (months) [d]	Outcome measure	Findings [e]
Engineering measures							
7	Delft [W23-30]	1937 households	Before: 68% After: NR	NA	36	Reported mode of all trips of residents aged 10 and over on one of a number of specified days covering all the days of the week	In the main intervention area, cycling share increased from 40% to 43% of all trips, the frequency of bike trips increased by 4% and the frequency of car trips did not change. A comparison of similar trips made by a sub-panel of respondents in the intervention area who participated in both survey waves (a sample described by authors as “biased”, sample size not reported) found a positive modal shift of 0.6% of all trips from a baseline of 66.2%; 8.8% of cycling trips after the intervention had been shifted from other modes, of which 4.4% came from walking and 3.3% came from the car. In a secondary intervention area which received only improvements to the bike route to the city centre, cycling mode share increased from 38% to 39%. In the control area, the frequency of car trips increased by 15% and the frequency of bike trips did not change. Insufficient data to judge statistical precision of results.

Table W3 continued

Valid-ity score	Study, primary reference and secondary reference(s) if relevant	Sample size [a]	Response rate [b]	Follow-up rate [c]	Follow-up (months) [d]	Outcome measure	Findings [e]
6	Detmold-Rosenheim [W31-33]	Detmold: 583 households Rosenheim: 598 households	Detmold: 53% Rosen-heim: 62%	NA	60	Reported mode of all trips of residents aged 10 and over on one of a number of specified days covering all the days of the week	**Detmold:** Estimated absolute shift of -7% (unadjusted) or –5% (adjusted for changes in age structure and car ownership) from a baseline of 41%. Insufficient data to judge statistical precision of results **Rosenheim:** Estimated absolute shift of 0 (unadjusted and adjusted) from a baseline of 49%**.** Insufficient data to judge statistical precision of results
5	Stockton [W34]	2946 school pupils	73%	NA	17	Reported usual mode of journey to school	Estimated absolute shift of –2% from a baseline of 81%. Based on reported proportions, the changes in car and cycling shares are likely to be significant (car: estimated 95% CI +1% to +3%; bike: estimated 95% CI –1% to –3%) and the change in walk share is not [f] "Despite the overall decline in the numbers cycling to school, the schools within the 'catchment area' had cyclist percentages 2-6 times higher than those for the 'control' schools outside the catchment area (4 to 6% compared with 1-2%". The authors did not report a before-and-after comparison of cycling mode share in the notional intervention and control areas

Table W3 continued

Valid-ity score	Study, primary reference and secondary reference(s) if relevant	Sample size [a]	Response rate [b]	Follow-up rate [c]	Follow-up (months) [d]	Outcome measure	Findings [e]
5	England (20 mph zones) [W35]	200-350 residents in each of six zones	NR [h]	NR	12	Stated change in travel patterns	In three of the zones a "significant proportion" (27%, 11% and 9% respectively) of respondents in the 12-month follow-up survey said that the intervention had made them more likely to walk. However, after comparing the reported frequencies of actual journeys by purpose and mode before and after the intervention, the authors concluded that the introduction of the 20 mph zones did not appear to have influenced the frequency or purpose of walking or car trips. Respondents did not indicate any increase in cycle use following zone implementation
4	Boston [W38-40]	5449 commuters	31%	NA	24	Reported mode of journey to work on day before survey	Estimated absolute shift of +0.3% to +0.9% from a baseline of 6.0%. [i] Based on reported proportions, the change in car share is likely to be significant (estimated 95% CI –4% to –7%) and the change in walking share is not. [f]
3	England (bypasses) [W36-37]	1446 residents	NR	NA	12-28	Reported main mode of residents' journeys to town centres	Estimated absolute shift of –3% from a baseline of 55%. Based on reported proportions, the change in walking share is likely to be significant (estimated 95% CI 0% to –8%) and the changes in car and cycling shares are not [f]

Table W3 continued

Validity score	Study, primary reference and secondary reference(s) if relevant	Sample size [a]	Response rate [b]	Follow-up rate [c]	Follow-up (months) [d]	Outcome measure	Findings [e]
Financial incentives							
8	California (cashing out) [W41-42]	1694 commuters	>90%	NA	12-36	Reported mode of all journeys to work over five consecutive days	**Intervention workplaces**: estimated absolute shift of +1% from a baseline of 2.8%. Overall change in distribution between all modes was significant at each workplace separately ($p<0.01$) **Control workplace:** estimated absolute shift of –1%. Overall change in distribution between all modes not significant ($p>0.10$)

Table W3 continued

Valid-ity score	Study, primary reference and secondary reference(s) if relevant	Sample size [a]	Response rate [b]	Follow-up rate [c]	Follow-up (months) [d]	Outcome measure	Findings [e]
7	Trondheim [W43-44]	1900 households	77%	62%	12	Reported mode of all trips, and of inbound trips across the cordon, of residents aged over 13 recorded in a one-day travel diary	Estimated absolute shift of –2.6% for all trips from a baseline of 35.9%. Insufficient data to judge statistical precision of this result The mean number of reported daily trips per traveller decreased from 4.46 to 3.92 (-12.2%; p<0.05). Within this overall decrease, the percentage decreases in walking and cycling trips were greater than the decreases in car trips as driver and as passenger (-28.1%, -14.9%, -5.6% and –14.3% respectively). All decreases were statistically significant at p<0.01 except for that for car trips as driver, which was significant at p<0.05 The proportions of respondents who reported any walking or cycling trips decreased (walking –6.6%, p<0.01; cycling –2.6%, p<0.10)

Table W3 continued

Validity score	Study, primary reference and secondary reference(s) if relevant	Sample size [a]	Response rate [b]	Follow-up rate [c]	Follow-up (months) [d]	Outcome measure	Findings [e]
Providing alternative services							
7	San Francisco [W45-47]	247 car share club members	22%	NA	9	Reported mode of all trips on any two days selected by the respondent	Estimated absolute shift of 0 from a baseline of 48.4%. Based on reported proportions, the difference in combined walking and cycling shares between intervention and control groups is likely to be significant (estimated 95% CI –4% to -13%) and the difference in car share is not [f] Car and combined walking and cycling shares in both intervention and control groups increased between the "before" and "after" surveys: car share increased from a pooled baseline of 5.2% to 22.2% (intervention) and 22.8% (control), and the combined walking and cycling share increased from a pooled baseline of 36.1% to 39.8% (intervention) and 48.4% (control). Author's analysis of journeys excluding journeys in car share club vehicles found that the differences in changes in private car, walking, and cycling shares between the intervention and control groups were not significant (p>0.10)

Table W3 continued

Valid-ity score	Study, primary reference and secondary reference(s) if relevant	Sample size [a]	Response rate [b]	Follow-up rate [c]	Follow-up (months) [d]	Outcome measure	Findings [e]
7	Voorhout [W48]	197 households	56%	59%	12	Reported mode of (a) all activities and (b) work and school activities of residents aged over 12 on two consecutive days selected by the respondent	Estimated absolute shift of +5.0% for all activities (from a baseline of 42.1%) and +1.9% for work and school activities (from a baseline of 29.0%). Changes in overall distribution of mode choice for both activity categories were significant ($p<0.001$) [j]
4	California (telecommuting) [W49]	72 commuters	35%	NA	NA	Reported mode and distance of all trips recorded over two periods of three consecutive days	Estimated absolute shift of –0.2% from a baseline of 6.1% (statistical tests not reported). Absolute distance travelled by walking and cycling on telecommuting days was 24% lower than on control days [k]

Table W3 continued

NA: not applicable; NR: not reported; NS: reported as “not statistically significant”

[a] Sample size refers (in a controlled study) to the number followed up in the intervention group, or (in an uncontrolled study) to the number responding to the “before” or “after” survey wave, whichever was the smaller

[b] Response rate refers (in a panel study) to the response rate to the “before” wave of a survey, or (in a repeated cross-sectional study) to the response rate for the “before” or “after” survey wave, whichever was the smaller

[c] Follow-up rate refers to the proportion of participants in an experimental or panel study who completed the follow-up survey wave

[d] Follow-up period refers to the interval between the start of the intervention (or the “before” survey wave, if this was not reported) and the follow-up survey wave chosen for data extraction (the last wave, the most seasonally-appropriate wave or the wave at which the most relevant outcome data were collected)

[e] Where a baseline is cited for a modal shift, this is the combined mode share for walking and cycling before the start of the intervention

[f] Estimated 95% confidence intervals for difference between independent proportions based on published results

[g] Includes control group

[h] Incalculable due to complex and/or non-random method of recruitment

[i] Cycling share included “miscellaneous”, therefore estimated effect size depends on assumptions made about this category

[j] Author confirms that any other modes included in his “slow mode” category are marginal

[k] Car share included vanpooling

Table W4
Health effects of interventions

Category	Study	Effect sought	Findings
Targeted	Glasgow [W1-2]	SF-36	The sample mean scores on three subscales of the SF-36 increased significantly ($p<0.05$) in the intervention group compared with the control group: mental health (from 72 to 76), vitality (from 57 to 64) and general health (from 71 to 76). There was no significant change in the sample mean scores on the other five subscales
		Accidents	"There were no adverse effects noted from this intervention such as traffic accidents"
Targeted	Tampere [W50-51]	Fitness	Mean walking speed for commuting journeys increased from 5.8 km/h to 6.2 km/h and the mean cycling speed increased from 17.6 km/h to 20 km/h
			Net changes in intervention group compared with control group: maximal aerobic power and maximum treadmill time increased significantly (+4.5%, $p=0.02$ and +10.3%, $p<0.001$ respectively). Heart rate and blood lactate at submaximal standard work load decreased significantly ($p=0.04$ and $p=0.002$ respectively)
		Blood lipids	HDL cholesterol increased (+5%, $p=0.06$); no significant change in total cholesterol or triglyceride concentrations
		Weight	No changes in either group
Targeted	Århus [W12-14]	Blood pressure	Prevalence of "normal blood pressure" increased from 87% to 90%, prevalence of "high and slightly high blood pressure" decreased from 13% to 10%
		Weight	No change in average weight overall (79 kg), but men lost an average of 200 g and women gained an average of 1 kg
		Cholesterol	Prevalence of "normal" cholesterol level decreased from 66% to 61%; prevalence of "grey zone" cholesterol level increased from 18% to 23%; prevalence of "high" cholesterol level increased from 15% to 16%
		Fitness	Prevalence of "poor" or "low" self-rated fitness decreased from 65% to 51%; prevalence of "average" self-rated fitness increased from 19% to 32%; prevalence of "good" or "high" self-rated fitness increased from 16% to 17%
		Smoking	No change in smoking prevalence ("one third")
			Health measures were assessed before and after the end of the project. No details of methods, participation rates or tests of statistical significance were reported
Engineering	Stockton [W34]	Accidents	The absolute number of accidents to cyclists increased in both a notional catchment area for the cycle route and in a control area elsewhere in the town (catchment area: from 23 to 26; control area: from 34 to 46). No tests of statistical significance were reported. The authors reported a "statistically significant" shift in the distribution of all accidents from the catchment area to the control area

Table W4 continued

Category	Study	Effect sought	Findings
Engineering	England (20 mph zones) [W35]	Community severance Noise Accidents	"There is anecdotal evidence from discussions held with groups of residents in the two largest zones that it was easier to cross the main roads after the speed limits had been reduced to 20 mph… No increase in adult or child street activity has so far been apparent… the numbers [reporting that they talked to neighbours and friends in the street] did not change significantly" "The majority of respondents felt that noise levels had stayed the same as a result of the introduction of the 20 mph zone. In the Warrington zone, where the most stringent measures have been introduced, almost three-quarters of those questioned three months after implementation felt that noise levels had been reduced" The mean annual number of accidents decreased in all zones by between 32% and 100%. The overall decrease was described as "significant" in the summary of results but no tests of statistical significance were reported
Engineering	England (bypasses) [W36-37]	Disturbance Accidents	The proportion of respondents who rated vibration, fumes and noise as "big problems" decreased from 8%, 13% and 9% (respectively) before the intervention to 4%, 5% and 4% after the intervention. No tests of statistical significance were reported The mean annual number of accidents decreased in all six towns. The annual number of accidents to pedestrians and cyclists decreased in five towns and increased in one town. No tests of statistical significance were reported

Table W5
Social distribution of intervention effects

Category	Study	Reported findings	Evidence suggests positive effects greater among
Targeted	Glasgow [W1-2]	"There were no gender, age or distance to work effects… However, more women than men responded to the opportunity to be involved"	Females
Targeted	Perth [W3-9]	"There was a minor increase in the number of cyclists" [meaning that the increase in cycling trips was mostly the result of a larger number of bicycle trips per cyclist per day]. The intervention had no effect in the "not interested" group. The car share decreased in all age/sex groups studied, but particularly among women of working age (under 20: absolute decrease of 1% from a baseline share of 5%; males 20-60: absolute decrease of 3% from a baseline share of 38%; females 20-60: absolute decrease of 8% from a baseline share of 43%; over 60: absolute decrease of 2% from a baseline share of 14%)	Existing cyclists Females of working age
Targeted	Frome [W10]	The car share decreased in all age/sex groups studied (under 20: absolute decrease of 1% from a baseline share of 11%; males 20-60: absolute decrease of 2% from a baseline share of 25%; females 20-60: absolute decrease of 2% from a baseline share of 34%; over 60: absolute decrease of 2% from a baseline share of 30%)	
Targeted	Gloucester [W11]	The car share decreased by in all age/sex groups studied (under 20: absolute decrease of 1% from a baseline share of 16%; males 20-60: absolute decrease of 3% from a baseline share of 39%; females 20-60: absolute decrease of 3% from a baseline share of 30%; over 60: absolute decrease of 1% from a baseline share of 15%)	Adults of working age
Targeted	Århus [W12-14]	There was a higher cycling mode share (and combined walking and cycling mode share) for men than for women at follow-up (combined shares approximately 53% and 49% respectively, estimated from graphs). Participants from households with more than one car had a lower cycling mode share (and combined walking and cycling mode share) than those from households with only one car (combined shares approximately 48% and 53% respectively, estimated from graphs). The authors also reported that "use of the bicycle increases with age; use of the bicycle is independent of income; use of the bicycle drops the larger the number of adults in the household" [data not reported]. The authors also reported a small negative modal shift in trips made by participants' spouses, who now had greater access to the family car (estimated absolute shift of –4% from a baseline of 35%)	Males Households with only one car Older adults Smaller households

Table W5 continued

Category	Study	Reported findings	Evidence suggests positive effects greater among
Targeted	Adelaide [W15-18]	In stepwise logistic regression, household composition was shown to have a minor influence on the estimated reductions in vehicle emissions resulting from the intervention. The higher the proportion of retired persons in the household and the older the mean age for adults, the less the estimated reduction	Households without older adults
Engineering	Delft [W23-30]	"The increase of bicycle mobility cannot be ascribed to a larger number of people using the bicycle, but is the result of a larger number of bicycle trips per cyclist per day. This finding is consistent with the findings… that many non-cyclists are captive users of their modes… and do not have freedom of choice. Bicycle use by men increased more than that by women"	Existing cyclists Males
Engineering	Detmold-Rosenheim [W31-33]	Modal shifts were stratified by age, sex, occupational group and bike and car ownership in both towns (in this analysis, the car mode share included motorised two-wheelers). In both towns, the modal shift was more positive (or less negative) among males, non-bike owners and car owners than among females, bike owners and non-car owners respectively. In Rosenheim, the modal shift was more negative among those aged over 65 compared with those in younger age groups, and among pensioners compared with those in other occupational groups.	Males Non-bike owners Car owners People below retirement age
Engineering	Stockton [W34]	Boys were more likely than girls to cycle to school, both before and after the intervention	Males
Engineering	England (bypasses) [W36-37]	The decrease in walking mode share was seen in both males and females (absolute decreases of 2% and 5% respectively), in adults both under and over the age of 60 (4% and 6% respectively), and in people with access to no car, one car, and more than one car (2%, 1% and 6% respectively)	
Financial	California (cashing out) [W41-42]	The policy was said to have had a redistributive effect on income: some firms had previously offered higher parking subsidies to higher-paid employees, but after the intervention the benefits were offered at a flat rate to all employees	