Assessing the health and economic benefits of cycling in Glasgow

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1 Introduction

It is widely accepted that regular, moderate physical activity is very good for health. National policy and strategy places increasing emphasis on its importance, particularly given the inadequate levels of physical activity and increasing prevalence of obesity evident amongst Scottish children and adults[1,2,3]. Current physical activity guidelines for children (aged five to 18 years) are that they should engage in moderate to vigorous intensity physical activity for at least 60 minutes, and up to several hours every day, and that 'vigorous intensity activities', including those that strengthen muscle and bone, should be incorporated at least three days a week. For adults (aged 19 to 64 years), the guideline is that over the course of a week, activity should add up to at least 150 minutes (2.5 hours) of moderate intensity activity in bouts of ten minutes or more, for example, 30 minutes on at least five days a week. Alternatively, comparable benefits can be achieved through 75 minutes of vigorous intensity activity spread across the week, or combinations of moderate and vigorous intensity activity. Adults should also undertake physical activity to improve muscle strength on at least two days a week.

Cycling is classified as a higher intensity physical activity that benefits individual health as well as contributing to other public health goals such as reduced car travel and associated carbon emissions[4]. As far back as 1992, the British Medical Association believed that the public health benefits of cycling outweighed the risks[5]. It is widely agreed that cycling can make a contribution to population health and sustainability as a component of active travel, and there have been a number of estimations regarding the type and extent of health benefits that can be attained through investments in policies and initiatives which promote more cycling[6]. Many UK and European cities have invested in measures to encourage and promote walking and cycling and have experienced visible increases in levels of both walking and cycling[7,8]. Increased levels of cycling can also stimulate economic growth and vibrancy in urban areas through enhanced connectivity and safer, more attractive public spaces which are not dominated by vehicular traffic[8].

2 Background to this paper

2.1 Methods applied to assessing the health benefits of cycling

In an attempt to quantify the economic impacts of cycling, the World Health Organisation (WHO) has developed a health economic assessment tool (HEAT) for cycling, which can be used to estimate the health benefits of cycling in an area[9]. The tool produces an estimate of the *mean annual benefit* due to reduced mortality as a result of cycling. It is thought that this tool is likely to underestimate benefits as it only considers reduced mortality and not reduced morbidity gained through regular physical activity. In addition, other monetary benefits such as reduced employee absenteeism are not included. Nonetheless, the tool provides a useful starting point for economic assessment of the health benefits of cycling. Applying the HEAT tool to Scottish Government travel data, Transform Scotland estimated that if 40% of Scottish car commuter journeys of less than five miles in length were switched to cycling, the annual economic benefit (accruing after five years) would be £2 billion per annum[10]. At a UK level, the Department for Transport has adopted HEAT for cycling as part of its comprehensive online guidance on the appraisal of transport projects and wider advice on scoping and carrying out transport studies[11].

The Cycling Action Plan for Scotland (CAPS) was published by the Scottish Government in June 2010. This plan, which aims to get more people cycling more often, has the vision that by 2020, 10% of all journeys taken in Scotland will be by bicycle[12]. Glasgow City Council has also published a 'strategic plan for cycling'[13] which includes the vision that 'cycling will be the biggest participation activity in the city by 2020'. However, information about levels of cycling, and who cycles is often difficult to assess.

2.2 Quantifying trends in local cycling levels

In order to obtain a more accurate picture of walking and cycling levels locally, Glasgow City Council has commissioned counts of pedestrians and cyclists entering and leaving the city over several years. Figure 1 shows the cordon recording sites around Glasgow city centre.

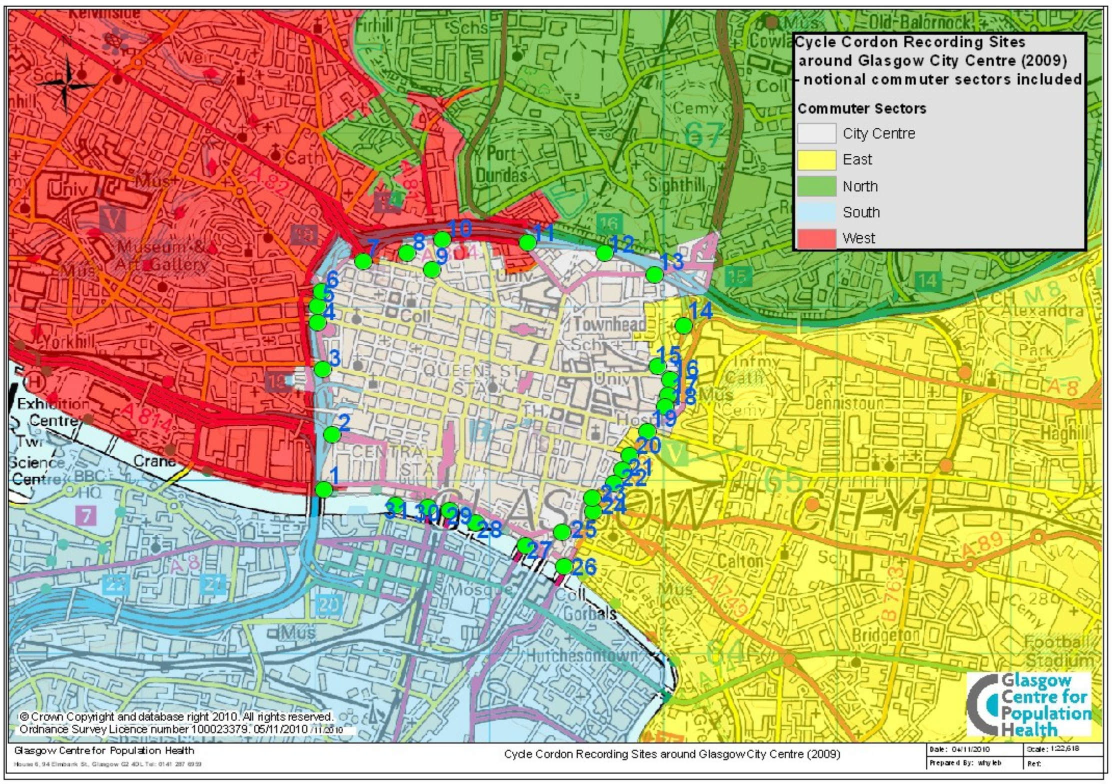

Figure 1: Cordon recording sites in Glasgow

Figure 2 overleaf shows cycle counts for 2009-2012. Following relatively stable cycle counts between 2009 and 2011, the 2012 data showed a rise in cycle trips into and out of the city.

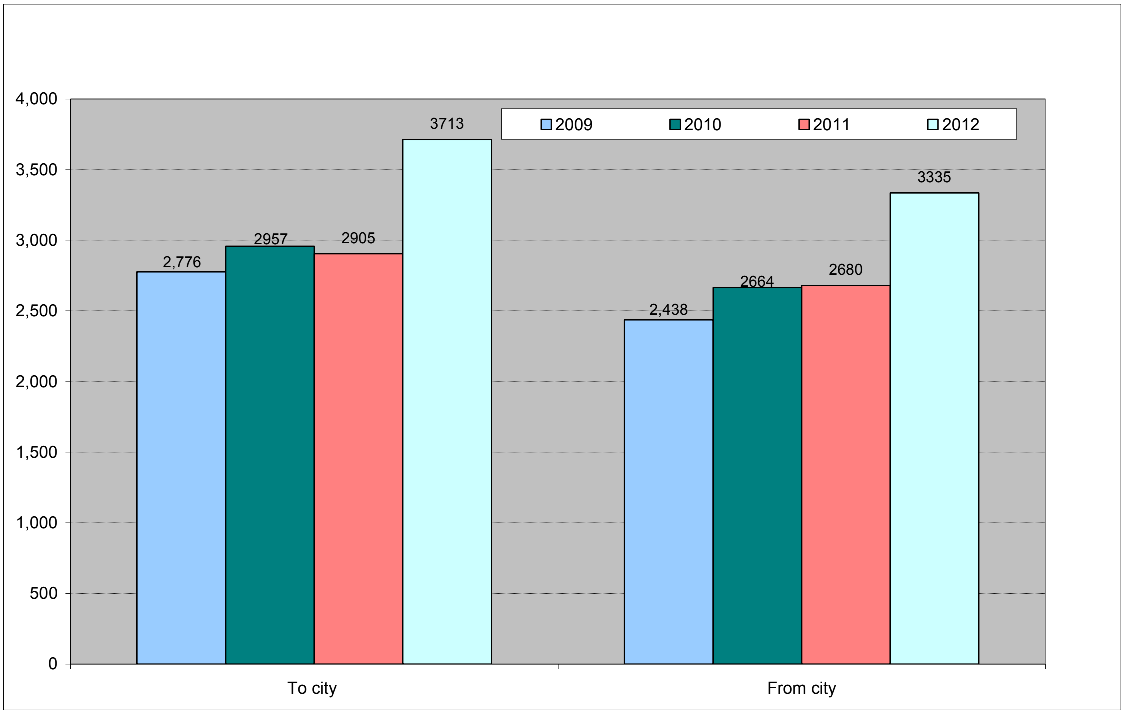

Figure 2: Glasgow cycle counts at all cordon sites, 2009-2012
(Source: Land & Environment Services, Glasgow City Council)

Due to interest in the potential financial returns that can be gained through policies, infrastructure change and initiatives that increase levels of cycling in Glasgow and other cities, the WHO online HEAT tool for cycling[14] was applied to cordon count data to get a sense of potential health economic benefits arising from cycling and to assess the utility of the tool.

3 Research aim and methods

3.1 Research aim

The main aim of the analysis was to explore the potential health economic benefits of cycling at a local level.

3.2 Methods

The HEAT tool was applied to local cycling data for Glasgow using the following basic formula:
If x people cycle y distance on z days in a year, what is the value of the health benefits that occur as a result of the reduction in mortality due to their increased activity?

Two main datasets were utilised:

a) Data on travel to work or study from the 2001 Census
b) Cordon counts from surveys undertaken in Glasgow from 2009-2012, providing a count of cyclists entering the city at specific entry points over a two day census period.

The Census data provide a specific measure of cycle commuting, while the cordon count data provide more up-to-date estimates of journeys into the city, not all of which will be commuting journeys. The data from each source are recorded in different ways, over different time periods and are likely to cover different types of journeys (although there will be overlap). As a consequence, the model results using each data source are not directly comparable. These points are also reflected in the interpretation of results in the discussion section.

The study population comprised Glasgow residents commuting into the city centre which, using 2001 Census data, was estimated to be 20% of all cycling journeys to work made by Glasgow residents
The main output of the calculation is the **mean annual benefit** in Euros due to reduced mortality as a result of cycling. The calculation assumes a time period for the build-up of benefit (normally set at five years) and averages the benefit over a timeframe (normally set at ten years). The tool requires a number of other parameters to be set as part of the calculation. Our analysis of health economic gain is based on a comparison of health gains due to cycle commuting into the centre compared to a notional situation where no one commuted into the city centre by bike. An average distance for this commute has been derived from 2001 Census data for Glasgow residents who commuted into the centre of the city by bicycle.

3.3 Assumptions and parameters

The estimated mean number of days cycled per year was 203 based on the following assumptions. The average person works five days per week. There are 52 weeks per year: 52 x 5 = 260 weekdays per year. Assume 25 days holiday per year: 260 - 25 = 235 days. Bank holidays vary but are estimated at 12 days per year. 235 - 12 = 223 days worked per year. To allow for poor/winter weather when cycling is less likely, subtract another 20 days (four working weeks): 223 - 20 = 203.

The mean trip length is assumed to be four kilometers based on the average commute distance for Glasgow residents who cycled into the centre of Glasgow as recorded by the 2001 Census data.

Table 1 Parameters for calculation

	Census data	**Cordon count data**			
Parameter	**2001**	**2009**	**2010**	**2011**	**2012**
Number of trips per day[1]	1,200	4,171	4,497	4,468	5,638
Mean trip length (km)	4				
Mean number of days cycled per year	203				
Mean proportion of working age population who die each year (calculated from NRS[2] mortality data)	0.003862				
Value of life (in euros) Standard value of a statistical life	1,574,000				

[1] Corrected by reduction of 20% to allow comparability with Census data.
[2] NRS = National Records of Scotland.

3.4 HEAT estimates (output from online calculations)[14]

3.4.1 2001 Census

The cycling data you have entered corresponds to an average of 1,624km per person per year. This level of cycling provides an estimated protective benefit of: 30% (compared to persons not cycling regularly). From the data you have entered, the number of individuals who benefit from this level of cycling is 600. Out of this many individuals, the number who would be expected to die if they were not cycling regularly would be 2.32. The number of deaths per year that are prevented by this level of cycling is 0.69.

Financial savings as a result of cycling

- The value of statistical life applied is €1,574,000
- The annual benefit of this level of cycling, per year, is €1,084,000
- The total benefits accumulated over 10 years are €10,844,000
- When future benefits are discounted by 5% per year, the current value of the average annual benefit, averaged across 10 years is €837,000; the current value of the total benefits accumulated over 10 years is €8,373,000

3.4.2 2009 Cordon count

The cycling data you have entered corresponds to an average of 1,624km per person per year. This level of cycling provides an estimated protective benefit of 30% (compared to persons not cycling regularly). From the data you have entered, the number of individuals who benefit from this level of cycling is 2,086. Out of this many individuals, the number who would be expected to die if they were not cycling regularly would be 8.06. The number of deaths per year that are prevented by this level of cycling is: 2.39.

Financial savings as a result of cycling

- The value of statistical life applied is €1,574,000
- The annual benefit of this level of cycling, per year, is €3,769,000
- The total benefits accumulated over 10 years are €37,692,000
- When future benefits are discounted by 5% per year, the current value of the average annual benefit, averaged across 10 years is €2,910,000; the current value of the total benefits accumulated over 10 years is €29,105,000

3.4.3 2010 Cordon count

The cycling data you have entered corresponds to an average of 1,624km per person per year. This level of cycling provides an estimated protective benefit of 30% (compared to persons not cycling regularly). From the data you have entered, the number of individuals who benefit from this level of cycling is 2,086. Out of this many individuals, the number who would be expected to die if they were not cycling regularly would be 8.06. The number of deaths per year that are prevented by this level of cycling is 2.39.

Financial savings as a result of cycling

- The value of statistical life applied is: €1,574,000
- The annual benefit of this level of cycling, per year, is €3,769,000
- The total benefits accumulated over 10 years are €37,692,000
- When future benefits are discounted by 5% per year, the current value of the average annual benefit, averaged across 10 years is €2,910,000; the current value of the total benefits accumulated over 10 years is €29,105,000

3.4.4 2011 Cordon count

The cycling data you have entered corresponds to an average of 1,624km per person per year. This level of cycling provides an estimated protective benefit of 30% (compared to persons not cycling regularly). From the data you have entered, the number of individuals who benefit from this level of cycling is 2,234. Out of this many individuals, the number who would be expected to die if they were not cycling regularly would be 8.63. The number of deaths per year that are prevented by this level of cycling is 2.57.

Financial savings as a result of cycling

- The value of statistical life applied is: €1,574,000
- The annual benefit of this level of cycling, per year, is €4,037,000
- The total benefits accumulated over 10 years are €40,375,000
- When future benefits are discounted by 5% per year, the current value of the average annual benefit, averaged across 10 years is €3,118,000; the current value of the total benefits accumulated over 10 years is €31,176,000

3.4.5 2012 Cordon count

The cycling data you have entered corresponds to an average of 1,624km per person per year. This level of cycling provides an estimated protective benefit of 30% (compared to persons not cycling regularly). From the data you have entered, the number of individuals who benefit from this level of cycling is 2,819. Out of this many individuals, the number who would be expected to die if they were not cycling regularly would be 10.89. The number of deaths per year that are prevented by this level of cycling is 3.24.

Financial savings as a result of cycling

- The value of statistical life applied is: €1,574,000
- The annual benefit of this level of cycling, per year, is €5,095,000
- The total benefits accumulated over 10 years are €50,947,000
- When future benefits are discounted by 5% per year, the current value of the average annual benefit, averaged across 10 years is €3,934,000; the current value of the total benefits accumulated over 10 years is €39,340,000

4 Results

4.1 Census 2001 data

2001 Census data indicated that 600 Glasgow residents commuted in and out of the city centre resulting in a total of 1,200 trips per day each with a mean trip length of four kilometres. Application of the HEAT tool calculation to these data yielded a mean annual benefit of **nearly £1,000,000** (€1,084,000).

4.2 Glasgow City Council cycle cordon count

Cordon count data for 2009-2012 was then used to estimate total numbers of commuting trips per day, in and out of the city centre by Glasgow residents based on a similar mean trip length of 4km (based on the 2001 Census; and corrected by a reduction of 20% to remove the impact of non-Glasgow residents' commuting – an estimate based on Census 2001 data).

Table 2 shows the estimated number of trips per day and associated mean annual benefit for each year. Estimated mean annual benefit was just **over £3,000,000** in 2009 increasing between 2009 and 2012 to **over £4,000,000**.

Table 2: Estimated annual benefits based on Glasgow cordon count data 2009-2012

Year	Number of trips per day	Estimated mean annual benefit
2009	4,171	£3,133,530 (€3,769,000)
2010	4,497	£3,133,195 (€3,769,000)
2011	4,468	£3,355,697 (€4,037,000)
2012	5,638	£4,235,393 (€5,095,000)

5 Discussion

Census-based figures are much lower than the cordon count estimates. However, as previously noted, there are various reasons why the Census data are not directly comparable with the cordon count data. The Census data are collected in April and are based on a single commuting question which asks residents to select their 'usual' mode of travel to work from a range of options. If a respondent uses multi-modal means of travel or cycles for some but not all commuting journeys s/he may not select cycling as the 'usual' mode of travel to work. Cordon count data were recorded at least eight years later and are collected over a two-day period in September each year. Given that these data are collected over a working day, it is likely that different types of journeys are included and not just commuting journeys. Differences in weather conditions, seasonality, traffic conditions and other factors may influence the number of journeys undertaken in this 'two-day window'. The period of recording was 6am to 8pm. This is likely to lead to an undercount of commuting journeys as some people such as students or part-time/shift workers may commute during other times during the day/evening. On the other hand, there may also be double-counting, for example, of cycle couriers. Non-commuting journeys will also be included such as for shopping and leisure and these journeys may well include young people rather than adults who are cyclists.

Cordon count data indicate that levels of cycling in and out of the centre of Glasgow appear to have risen by more than 25% since data were first made available in 2009. Other analysis has found that greater numbers of cyclists enter the city from the West[15]. Proposed reasons for higher levels of cycling from the West include greater levels of affluence in the resident population, as well as a greater length of cycling infrastructure and accessibility to safer cycle routes into the city.

These results provide an illustration of the substantial economic benefits that can be realised through cycling. As has already been discussed, these are conservative estimates since calculations do not take account of reduced morbidity and other health benefits conferred by cycling. Other caveats to bear in mind are that the HEAT tool does not take account of the pace (or intensity) of cycling or the possibility that health benefits from the same amount of cycling may be greater for less-fit individuals than for individuals who are relatively fit already. The guidance for use of the tool advises that the tool should only be applied to assess habitual behaviour at a population level, that it is designed for adult populations and that it should not be used for populations with high average levels of physical activity. In our study we have assumed that the Glasgow cycling population represented in our data do not in general breach these conditions. Our analysis of the Census data was limited to commuting cycling trips into and out of the centre of Glasgow, which on the basis of the 2001 Census only make up 20% of all cycling commuter trips. Trips for other purposes such as shopping or leisure are not included in the Census data, contributing to a further under-estimate of the potential current health economic benefits of cycling to Glasgow's population.

Further analyses could cast more light on the impact of changes in future cycling levels in Glasgow on estimated health economic benefits. These analyses could be extended when the Census data from 2011 become available to compare commuting trends in cycling between 2001 and 2011. The HEAT analysis could also be expanded using Census 2011 data to encompass all commuting journeys – not just those into the city centre – and results could be compared across Scotland’s four largest cities – Glasgow, Edinburgh, Aberdeen and Dundee.

6 Conclusions

This relatively limited health economic analysis has demonstrated that current levels of cycling in Glasgow confer significant economic benefits in relation to reduced mortality. These economic benefits have increased from around £3 million in 2009 to over £4 million by 2012, as levels of cycling have risen. Clearly this is an estimate, subject to the limitations of the model, the data and a set of assumptions, but it is still a substantial sum. Given that the model only estimates the benefit of cycle journeys into and out of Glasgow’s city centre – about a fifth of all commuting journeys (2001 Census) – and does not include the economic benefits of reduced morbidity, the overall health economic benefits of everyday cycling in Glasgow are likely to be much higher.

It should also be remembered that the commercial benefits of increased cycling to the local economy have not been included in this calculation. Furthermore, there are other important individual health benefits, not explored by this analysis, such as reduced morbidity and enhanced wellbeing. Travelling by bicycle rather than by car also helps to reduce vehicle emissions which are a major contributor to climate change. Levels of cycling are much lower in Scotland than in other European countries[16]. Over the last decade, there have been repeated calls from many quarters for leadership and political commitment to create better, safer pedestrian and cycle infrastructure accompanied by other measures to stimulate a shift towards active, sustainable travel. Not only would this boost population levels of physical activity, it would also reduce congestion and vehicle emissions as well as improve quality of life in communities.

A policy review conducted by GCPH in 2010 concluded that if levels of active, sustainable travel are to increase, clearer political leadership and commitment is needed in terms of strategic resource allocation and fiscal measures that positively discriminate in favour of walking, cycling and use of public transport over the car.[17] A recent consultation in Scotland identified four key factors that could encourage more people to cycle: better routes; drivers giving more space to cyclists; restricting parking and traffic-free cycle routes[18]. A health inequalities impact assessment of Glasgow’s Strategic Plan for Cycling[19] included recommendations to extend Glasgow’s commitment to 20mph zones and to invest in the city’s cycling network as means of encouraging more people to cycle. In 2010, the UK Faculty of Public Health and the Royal Society for Public Health called for a 25% increase in cycle lanes and cycle racks and a 20mph speed limit in all built up areas[20]. The National Institute for Health and Clinical Excellence has recently published practical guidance for organisations and institutions, such as schools, workplaces and local authorities to encourage them to promote physical activity specifically through walking and cycling[21].

This type of modelling using the HEAT tool, is currently used by the UK Department of Transport[10], and could be utilised more widely by Transport Scotland and other Scottish transport agencies to provide more comprehensive and meaningful cost benefit analyses regarding new infrastructure and different types of transport model.

In conclusion, this analysis adds to the evidence base on the public health benefits of cycling and adds further weight to the arguments that promoting cycling represents extremely good value for money for both the individual and for public health.

7 References

[1] Physical Advisory Guidelines Advisory Committee. *Physical Activity Guidelines Advisory Committee Report.* Washington, DC: US Department of Health and Human Services; 2008.
[2] Department of Health, Physical Activity, Health Improvement and Protection. Start Active, Stay Active. A report on physical activity for health from the four home countries' Chief Medical Officers. London: HMSO; 2011.
[3] Scottish Government. Scottish Health Survey 2011.
[4] Woodcock J, Edwards P, Tonne C, Armstrong BG, Ashiru O, Banister D, Beevers S, Chalabi Z, Chowdhury Z, Cohen A, Franco OH, Haines A, Hickman R, Lindsay G, Mittal I, Mohan D, Tiwari G, Woodward A, Roberts I. Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. *Lancet* 2009;374(9705):1930-43.
[5] British Medical Association. *Cycling Towards Health & Safety*. Oxford: Oxford University Press; 1992.
[6] Warren J. Towards a Healthier Economy. Why investing in sustainable transport makes economic sense. Edinburgh: Transform Scotland Trust; 2008.
7 Department of Transport. Evaluation of the Cycling City and Towns Programme. January 2011 **http://www.dft.gov.uk/publications/cycling-city-and-towns-programme/** (accessed 5th November 2012)
[8] Warren J. Civilising the streets: how strong leadership can deliver high quality of life and vibrant public spaces. Edinburgh: Transform Scotland Trust and Sustrans Scotland; 2010.
[9] Health economic assessment tools (HEAT) for walking and for cycling. Methodology and user guide. Economic assessment of transport infrastructure and policies. Copenhagen, Denmark: World Health Organization Regional Office for Europe; 2011.
[10] Transform Scotland. Towards a Healthier Economy. Why investing in sustainable transport makes economic sense. Edinburgh: Transform Scotland Trust; 2008.
[11] World Health Organization. Examples of applications of the health economic assessment tool (HEAT) for cycling. http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/Transport-and-health/activities/promotion-of-safe-walking-and-cycling-in-urban-areas/quantifying-the-positive-health-effects-of-cycling-and-walking/health-economic-assessment-tool-heat-for-cycling-and-walking/examples-of-applications-of-heat-for-cycling (accessed 15 Jan 2013).
[12] Scottish Government. Cycling Action Plan for Scotland (CAPS), 2010. http://www.scotland.gov.uk/Resource/Doc/316212/0100657.pdf (accessed 18 Dec 2012).
[13] Glasgow City Council. Glasgow's Strategic Plan for Cycling 2010-2020. 2010. http://www.glasgow.gov.uk/CHttpHandler.ashx?id=3521&p=0 (accessed 28 Nov 2012).
[14] WHO/Europe Health Economic Assessment Tool Website. http://www.heatwalkingcycling.org/. (accessed 3 Sep 2012).
[15] McCartney G, Whyte B, Livingston M, Crawford F. Building a bridge, transport infrastructure and population characteristics: Explaining active travel into Glasgow. *Transport Policy* 2012;21:119-125.
[16] Understanding Glasgow. The Glasgow Indicators Project. http://www.understandingglasgow.com/indicators/transport/cycling/scottish_vs_european_cities (accessed 12 March 2014)
[17] Glasgow Centre for Population Health. Briefing Paper Findings Series 26: Moving in the right direction? Findings from a review of transport policy in Scotland. Glasgow: GCPH; 2010.
[18] Steer, Davies & Gleave. CAPS Public and Stakeholder Consultation Facilitation, 2008. http://cyclingscotland.msol.org.uk/Uploads/1281438902_Focus_20groups_20report.pdf (accessed 9 Oct 2012).
[19] A health inequalities impact assessment of Glasgow's Strategic Plan for Cycling. Glasgow: Glasgow City Council; 2011.
[20] Faculty of Public Health and Royal Society for Public Health. 12 steps to better public health: a manifesto. www.fphm.org.uk/resources/AtoZ/manifesto/manifesto.pdf (accessed 26 Oct 2012).
[21] National Institute for Health and Clinical Excellence Guidance PH41. Walking and cycling: local measures to promote walking and cycling as forms of travel or recreation. http://publications.nice.org.uk/walking-and-cycling-local-measures-to-promote-walking-and-cycling-as-forms-of-travel-or-recreation-ph41. (accessed 14 November 2012).

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