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# A systematic review of economic analyses of active transport interventions that include physical activity benefits

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ABSTRACT

Physical inactivity is one of the leading causes for the growing prevalence of non-communicable diseases worldwide and there is a need for more evidence on the effectiveness and cost-effectiveness of interventions that aim to increase physical activity at the population level. This study aimed to update a systematic review published in 2008 by searching peer-reviewed and unpublished literature of economic evaluations of transport interventions that incorporate the health related effects of physical activity. Our analysis of methods for the inclusion of physical activity related health effects into transport appraisal over time demonstrates that methodological progress has been made. Thirty-six studies were included, reflecting an increasing recognition of the importance of incorporating these health effects into transport appraisal. However, significant methodological challenges in the incorporation of wider health benefits into transport appraisal still exist. The inclusion of physical activity related health effects is currently limited by paucity of evidence on morbidity effects and of more rigorous evidence on the effectiveness of interventions. Significant scope exists for better quality and more transparent reporting. A more consistent approach to the inclusion of benefits and disbenefits would reinforce the synergies between the health, environmental, transport and other sectors. From a transport sector perspective the inclusion of physical activity related health benefits positively impacts cost effectiveness, with the potential to contribute to a more efficient allocation of scarce resources based on a more comprehensive range of merits. From a public health perspective the inclusion of physical activity related health benefits may result in the funding of more interventions that promote active transport, with the potential to improve population levels of physical activity and to reduce prevalence of physical activity related diseases.


## 1. Introduction

Physical inactivity is the fourth leading risk factor for mortality worldwide (World Health Organisation, 2014) and is one of the main contributors to the global burden of non-communicable diseases. Physical inactivity increases the risk of many adverse health conditions, including obesity, coronary heart disease, stroke, breast and colon cancer, diabetes, dementia and depression (Pratt et al., 2014; Blondell et al., 2014; Lee et al., 2012). Rates of physical inactivity are high worldwide, with technological progress meaning that we now spend less energy in our everyday lives than our predecessors (Spence and Lee, 2003; Cordain et al., 1998). Coupled with the fact that we also have more access to energy dense foods, this constitutes increasingly obesogenic environments requiring ecological solutions (Hallal et al., 2012; Egger and Swinburn, 1997; Stokols, 1992). In order to address the observed low levels of physical activity across populations, it is widely recognised that the incorporation of more incidental physical activity into everyday life is required through environmental, social, cultural and behavioural approaches (Sallis et al., 2006).

Active forms of transport, such as walking, cycling and use of public transport, have been recognised as possible avenues to

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increase the daily physical activity levels of populations through incidental exercise, providing an alternative to more traditional physical activity domains such as sport and exercise (Heath et al., 2012; Sahlqvist et al., 2012; Reynolds et al., 2014). Active transport is often referred to as utilitarian physical activity, as it involves walking, cycling or use of public transport for functional purposes. It is increasingly recognised that synergistic policies in sectors outside of health, including that of transportation, may have significant potential to improve physical activity rates and hence the health status of populations (Pratt et al., 2012). Ecological evidence suggests that countries with higher rates of active transport have lower rates of obesity (Bassett et al., 2008) and that a positive association may exist between motor vehicle usage and body weight (Sugiyama et al., 2013; Ding et al., 2014; Frank et al., 2004; Jacobson et al., 2011). Although establishing the health effects of active transport policies and interventions is challenging, a recent systematic review of trials and cohort studies found consistent support for the health benefits of active transport over longer periods and distances (Saunders et al., 2013).

This has led to increasing recognition of the importance of using a broad definition of benefits in the economic evaluation of transportation policies and infrastructure (Litman, 2014; Mulley et al., 2013; de Nazelle et al., 2011). Table 1 lists the most common methods for economic evaluation, with a brief definition given for each method. The transport sector traditionally uses cost benefit analysis (CBA) for project appraisal, where costs and benefits are expressed in monetary terms and health effects are most commonly limited to the effects of injuries and exposure to environmental effects such as air pollution. This narrow incorporation of health potentially undervalues active transport projects, especially in light of the emerging evidence on the potential health benefits of walking and cycling for transport and the well-recognised health benefits of physical activity (Pate et al., 1995).

Following a number of early, pioneering studies (Rutter, 2006; Krag, 2007; Sælensminde, 2004), recent methodological advances have been made in the inclusion of physical activity related health effects in transport appraisal. A systematic review conducted in 2008 by Cavill et al. found 16 economic evaluations of transport infrastructure and policies incorporating physical activity related health effects (Cavill et al., 2008). At that time the approaches to the inclusion of physical activity related health outcomes differed considerably among studies, as did study quality and transparency. The review by Cavill et al. called for a more harmonised approach and identified the method taken in the study by Rutter (2006) as having the greatest potential for inclusion of physical activity related health effects into transport appraisal.

This knowledge was used in the development of the World Health Organisation (WHO) Health Economic Assessment Tools (HEAT) for walking and cycling, with the aim of devising a more consistent approach to monetising the physical activity related health impacts of active transport for inclusion into CBA of transport projects (Kahlmeier et al., 2014). The HEAT tool estimates the mean and maximum annual reduction in mortality attributable to an increase in walking or cycling. The assessment of mortality benefits relies on a number of assumptions which are clearly stated in the HEAT user guide (Kahlmeier et al., 2014). The economic value of decreased mortality is estimated by applying the value of a statistical life (VSL). The main justification for using the VSL lies on planners who are accustomed to this valuation technique as the end users of HEAT. Due to a lack of evidence for the effect of walking and cycling on morbidity HEAT currently however only incorporates mortality effects, although the inclusion of morbidity effects has been identified as important in future refinements of the tool.

It has now been several years since the original systematic review by Cavill et al. (2008) and the availability of the WHO HEAT tools. Whilst methodological advances in the incorporation of physical activity related health effects into transport appraisal have been made, it is uncertain whether this has translated into more routine incorporation of these effects. In this paper we aim to provide an up-to-date overview of the literature through the conduct of a systematic review of economic evaluations of transport interventions and policies that include health effects of physical activity.

## 2. Methods

### 2.1. Inclusion criteria

To be considered for inclusion, studies had to meet the following criteria:

1. Be published in English between 1 January 1990 and 3 July 2014.
2. Be in the public domain, either as academic papers in peer reviewed journals or studies from the ‘grey’ literature such as government reports and commissioned documents.
3. Be a primary study. Reviews and commentaries were excluded.
4. Present a full economic evaluation (including CBA, cost utility analysis (CUA) or cost effectiveness analysis (CEA)) of a real or hypothetical transport intervention or policy in an urban setting that included health effects related to a change in physical activity. Full economic evaluations consider both costs and consequences of all alternatives examined and methods are listed in Table 1 (Drummond et al., 2005).
5. Interventions must have resulted in changes to predominantly utilitarian physical activity (i.e. strictly leisure time physical activity (LTPA) interventions were excluded).
6. All age groups were considered.
7. Interventions and/or policies targeting special groups, such as patients with a disability or any other health condition, were excluded.

### 2.2. Search strategy and data sources

A comprehensive search of the literature was conducted independently by two researchers (VB and BZ) based on Cochrane's

**Table 1**
Methods for full economic evaluation.

| Economic evaluation method | Definition |
|---|---|
| Cost Benefit Analysis (CBA) | The expected benefits of an intervention are measured in monetary terms and compared to the costs of the intervention. Results are reported as cost per unit of benefit. |
| Cost Utility Analysis (CUA) | The expected health outcomes of an intervention are measured in terms of the quality and quantity of life attributable to the intervention. Health outcomes can be expressed as disability adjusted life years (DALYs) or quality adjusted life years (QALYs). Results can be presented as cost per averted DALY or gained QALY. |
| Cost Effectiveness Analysis (CEA) | Health outcomes are expressed as a unit of effect, for example life years saved or prevalent cases averted with an associated cost. Results can be presented as cost per life year saved or prevalent cases averted. |