

**CENTRE FOR PRIMARY HEALTH CARE AND  
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**A REVIEW OF THE EVIDENCE OF THE  
IMPACT OF PUBLIC TRANSPORT ON  
POPULATION HEALTH IN AUSTRALIA**



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### ***1. Introduction***

#### ***1.1 Purpose***

This paper summarises evidence published on the impact of public transport on the health of populations, with particular emphasis on peer reviewed publications from Australia but also including two international reviews. The paper is intended to inform assessments of the potential impact of some features of public transport on the health of the population. The evidence presented may also provide information to guide policy decisions, helping to ensure the health effects of public transport planning are positive for populations and communities.

Health Impact Assessment (HIA) is an internationally recognised mechanism to improve decision-making by predicting and making recommendations concerning the health impacts of proposed plans, projects, programs or policies before they are implemented (WHO, 2008a, 2008b, Harris, Harris-Roxas et al. 2007). HIA is an approach that assists in providing greater consideration of the potential pathways between actions proposed in a potential policy or plan and their effects on the health of populations. HIA is also concerned with reducing the likelihood of those proposals resulting in health inequalities that are unfair and modifiable (Harris, Harris-Roxas et al. 2007). In doing so an HIA can be used to guide action to enhance or maintain positive effects and/or to mitigate detrimental health effects. This summary can be used to inform all stages of an HIA.

#### ***1.2 Audiences for this summary review***

The intended audiences for this summary are practitioners and policy-makers from sectors including but not limited to population health, transport, environment, land-use planning, environment and conservation, and local government – who may be using HIA to assist in decision-making on policies relevant to transport planning and health. It may also be useful for others with a general interest in HIA or healthy transport planning.

### ***1.3 Scope and limitations of this review***

This review has been limited to consideration of research-derived evidence of the impact of **public** transport on the health of populations. It is not a systematic review. It focuses only on the impact of public transport – rather than on transport, more broadly.

Research on the relationship between public transport and the health of populations is an emerging area. Australian evidence is limited in total and has, to date, focused on only some of the factors linking the provision and use of public transport to population health. Therefore it is important to note that an absence of evidence does not mean that no relationship between public transport and the health of a population has been identified; it is far more likely that this relationship has yet to be studied empirically. Further most of the studies that were identified for inclusion in this review have been cross-sectional and descriptive. They had not been designed to test the strength or directions of any associations found. It is recommended that this summary be used as a guide to identify original sources of evidence that can be used to provide more detailed, specific information about the research and its findings.

## **2. Methods:**

The questions for the review were:

- What is the evidence of the relationship between public transport and health and between public transport and the social, behavioural and economic determinants of health in Australia?
- What have been the health outcomes, if any are reported, of interventions to increase the availability, accessibility, and satisfaction with public transport in Australia?

The review began with searches of Web of Science and Scopus databases. Searches were limited to articles published from 2000 to January 2009. The search terms entered were “Australia” and “public transport” in combination with “health”, “mental health”, “physical activity”, “quality of life”, “access”, “social exclusion”, and “air OR noise pollution”. Database searches were then supplemented by articles, data sources and reports identified by reviewing reference lists of selected articles. Relevance of articles was determined by title, keywords and abstract.

A total of 20 articles and one report were included in this review as well as health and transport statistics from Australian and NSW (if available) government sources.

**Table 1: Topics addressed by articles in relation to public transport and health**

Topics addressed by reviewed articles	Number of articles
Physical activity for transport	7
Motivators and barriers for active transport	4
Air pollution	2
Food insecurity / access to food	2
Social exclusion and equity	6

*Note: several articles addressed more than one topic*

### ***Definitions***

#### ***Public Transport***

For the purpose of this review public transport is defined as being a form of passenger transport that is accessible to any member of the public for a fee. Public transport is, essentially, passenger conveyance by bus, tram, train, and ferry. Taxis or airlines were excluded from the working definition used in this paper. Evidence on the impact of private transport on the health of populations was included only when it had been used in comparison with public transport, for example car use in comparison with public transport use.

#### ***Health***

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (World Health Organization 1948).

Indicators of health used to assess the impact of public transport included:

- Injury and injury-related deaths
- Mental health problems and stress
- Physical activity
- Personal safety

Indicators used to measure the impact of public transport on environmental determinants of health were, in this review:

- Air and noise pollution

Indicators used to measure the impact of public transport on social determinants of health were, in this review:

- Access to goods, people and services (social inclusion)

#### ***1.4 The relationship between public transport and health***

Modern economic and social life is dependent upon the availability of reliable, accessible forms of transport. Transport is necessary to provide access of raw and manufactured goods to markets, to supply individuals and populations with food and other products, to deliver services, and to enable people to travel reach employment, education, health care, and recreational facilities. It is also vital to enable people and communities to build and maintain social networks. In short, transport is an essential resource for creating and maintaining positive health in populations.

However, transport can also have negative effects on the health of individuals and populations – air pollution, noise, and injuries, and, less directly, through its demand for land, and through the environmental costs associated with obtaining and transporting the resources necessary to enable some forms of transport to run (e.g. oil).

## ***2. Australian evidence: What is known?***

The following summarises the research conducted in Australia and reported in the peer review literature on the relationship between public transport and the health of the Australian population.

### ***3.2 Results***

#### **Death and injury**

The search found no studies investigating or reporting the effects of interventions that had been designed to increase safe, efficient use of public transport in order to prevent injuries and deaths among users. However, older people aged 65 or more are at greater risk of serious injury while boarding or alighting from a train than people of younger ages (Flood, Berry et al. 2007).

#### **Physical activity**

Some Australian studies have demonstrated a positive association between use of public transport and increased levels of physical activity when compared to car use (Wen, Orr et al. 2006; Booth, Okely et al. 2007; Villanueva, Giles-Corti et al. 2008; Wen and Rissel 2008). It has also been shown that walking to and from public transport can, potentially, mean that people achieve levels close to the recommended daily level of physical activity (Burke and Brown 2007). However, although these results were positive, their validity in relation to populations has been questioned because of the sample characteristics (undergraduate university students, aged primarily 16 to 20

years (Villanueva, Giles-Corti et al. 2008), assessment methods (self-report rather than objective measures) (Wen, Orr et al. 2006; Booth, Okely et al. 2007) and lack of separation between recreational and transport related physical activity (Wen, Orr et al. 2006; Booth, Okely et al. 2007).

Another study based on self-reports of train passengers in Perth showed that the likelihood of walking to the station increased with the density of the residential area the passenger lived in. About 6-18% of train passengers walked to the station and 50% of these passengers came from further than 1km away - greater than the 400-800m catchment standard used commonly in urban planning - (Ker and Ginn 2003).

Evidence based on self-report of primary and secondary school students found that the distances walked to and from public transport to school were much shorter than the recommended daily level of physical activity (Booth, Okely et al. 2007). Further, students from rural areas were found to use more active modes of transport, especially walking and cycling, than their urban counterparts, although residential density was not included in the study. Students from non-English speaking backgrounds were found to be more likely to travel to school by car rather than by public transport

An analysis of New South Wales transport data since the 1970s found that there had been a considerable shift away from public transport to the car as mode of transport to school among school children (van der Ploeg, Merom et al. 2008).

### Overweight / Obesity

Assuming that use of public transport would mean higher rates of physical activity, and hence, lower rates of overweight and obesity, a study tested the hypothesis that there should be an inverse relationship between the use of public transport and overweight and obesity (Wen and Rissel 2008). Results showed lower rates of overweight and obesity among male public transport users compared to men who drove to work but no difference for women (Wen and Rissel 2008). Further a causal link between actual public transport use and reduced overweight or obesity could not be established; the results were based on a cross-sectional survey which meant that both variables - overweight and transport mode - were assessed at the same time point rather than assessing which of the variables occurred first.

### ***Exposure to air pollutants generated by modes of transport***

There is some evidence that occupants of motor vehicles are exposed to higher levels of air pollutants (especially benzene) than commuters using other modes of transport, with the lowest level of nitrogen dioxide (NO<sub>2</sub>) exposure being found among train commuters (Chertok, Voukelatos et al. 2004). Use of public transport, therefore, appears to result in lower levels of exposure to air pollutants

**Public transport and access to goods, people and services: impact on social inclusion and health**

There is some Australian research assessing the relationship between access to public transport and some social determinants of health – work, social inclusion, and food security.

*Access to public transport and its impact on access to other social determinants of health – work and social inclusion*

An analysis of data on public transport and private motor vehicle use from Australian Government sources found that most public transport is provided in central business district areas, and that it benefits higher income earners more than lower income earners (Cox 2007). Studies analysing Australian census data have shown that people living in outer suburbs of major cities or in rural areas are less likely than people who live in or close to the CBD in cities to have access to suitable transport (Murray and Davis 2001; Corcoran 2005).

Long-term unemployed people identified transport as one of the factors which prevented them from obtaining work. 4% of those who lived in inner metropolitan Melbourne, 14% of those who lived in outer metropolitan Melbourne and 28% of those who lived outside Melbourne identified this as a factor. The differences reflect, in part, the relative availability of public transport services. (Perkins 2005, cited in Stanley and Stanley 2008).

Low-income populations and the elderly have been found to have limited access to public transport because they are more likely to live in outer urban or rural areas (Murray and Davis 2001; Corcoran 2005). A study of travel patterns of children in Melbourne showed that boys aged 10-12 from higher socio-economic status were reported as cycling or walking to public transport destinations more often than children from lower socio-economic background (Timperio, Crawford et al. 2004).

*Food security*

A large cross-sectional survey of households in three disadvantaged areas in Sydney found that cheaper public transport and increased public transport routes could help overcome food insecurity that was associated with difficulty in accessing shops (Nolan, Williams et al. 2006).

Evidence from a small qualitative study supported these findings and suggested that poor access to public transport disadvantages low income households more than the elderly and people with disabilities as these two latter groups often have access to community transport services (Coveney 2009).

### Facilitators of and barriers to the use of public transport

Strategies to promote up-take of active commuting have shown mixed outcomes in relation to health and the known transport-related determinants of health - such as reduced car use or increased physical activity - (Wen, Orr et al. 2005; Merom, Miller et al. 2008). The 'Australia's Walk-to-Work-Day' campaign has been shown to increase public transport use in combination with walking and to reduce car use (Merom, Miller et al. 2005). The campaign was particularly effective for individuals who perceived active commuting (walking, cycling and public transport) as important for their health. It was also effective among people who were concerned about improved air quality, who wished to avoid driving stress and parking hassles and/or to save costs of transport. People over the age of 45 and people who are usually inactive (less than 30min of physical activity per week) were found to be least likely to take up active commuting (Merom, Miller et al. 2008).

On the other hand a tailored social marketing strategy to promote active commuting in the workplace did not result in a significant reduction in the use of cars on weekdays but did result in more positive attitudes toward active transport and increased the number of weekend trips made without a car (Wen, Orr et al. 2005).

A survey of university staff and students found that 20-30% of car-users would consider changing to active transport modes (Shannon, Giles-Corti et al. 2006). The circumstances under which participants would make the change included reduced costs and increased frequency of public transport services. Travel time was reported to be the biggest barrier, independently of the distance they needed to travel.

A cross-sectional survey of households with children found that children walk and cycle up to 60% less if their parents perceive road crossings as dangerous (no signs or traffic lights), that their children would have to cross several roads to get to playgrounds and that public transport in their area is limited (Timperio, Crawford et al. 2004).

### ***3. International reviews of evidence***

No systematic review of impacts of public transport on the health of populations has been published to date. However, there have been two comprehensive international reviews of the evidence of the impact of all forms of transport on health (Douglas, Thomson et al. 2007; Kavanagh, Cathal et al. 2005). Both of these reviews included evidence from the grey and peer reviewed literature.

Both reviews identified a range of pathways linking transport with the health of populations and with some of the other social, environmental and economic determinants of health. The results of both reviews indicate that there has been very little research to identify the impact (positive or negative) of public transport on the health of populations anywhere in the world, and even more limited research on this issue in Australia.

The findings from the two international reviews concerning the impact of public transport on the health of populations are summarised here.

#### Injury-related deaths and injuries

There is evidence confirming that the number of fatalities from train, bus and ferry crashes is much smaller than the number of fatalities from car accidents, and there is strong evidence that measures to reduce numbers of cars on the road lead to reductions in car crashes. However, there is no evidence that increasing access to public transport results in reduced volume of cars on roads and hence, in reductions in the number of road traffic crashes (Douglas, Thomson et al. 2007; Kavanagh, Cathal et al. 2005).

#### Premature mortality and morbidity associated with transport-generated air pollution

The link between air pollution and adverse health effects is well established and there is some evidence that air pollution resulting from public and private passenger transport modes is more harmful to health than pollution from other sources (Douglas, Thomson et al. 2007). There is strong evidence of an association in the short term between air pollution and increases in premature death from cardio-respiratory causes, respiratory hospital admissions, exacerbation of pre-existing asthma, respiratory symptoms and reduction in lung function (Douglas, Thomson et al. 2007). Evidence of adverse impacts on health in the longer term is weaker and is linked particularly to nitrogen dioxide (NO<sub>2</sub>) exposure – which is also used as a marker for exposure to traffic related emission (WHO 2003).

Exposure to air pollution also has an established equity dimension. In the short term traffic related air pollution is most harmful to the health of groups such as older people, children, and people with impaired health (Douglas, Thomson et al. 2007). Further, people who earn low

incomes may experience higher levels of exposure to air pollution as a result of the work they do and the areas in which they live (Douglas, Thomson et al. 2007).

Concerning exposure itself, studies in the U.K and U.S. have found concentration of many air pollutants is found to be considerably higher inside motor vehicles (cars and buses) when compared to general roadside pollution levels (Douglas, Thomson et al. 2007). This means that passengers in cars and buses have higher exposure to pollutants than people who walk or cycle on the same road. However, little is known about the levels of exposure to pollution for users of other public transport modes such as train users, trams and ferries. In addition, cross-country variation was not taken into account.

There is some evidence that measures to reduce road traffic volume, i.e. number of cars on the road, can reduce air pollution considerably. In France, interventions to reduce traffic volume led to an increase in public transport use but the impacts on the air quality were unclear (Douglas, Thomson et al. 2007).

#### Stress and mental health

There is limited evidence of the impact of public transport on the mental health of populations. There appear to have been no studies reporting on the stress or dangers of using public transport, nor of living near railway lines, bus routes, or ferry terminals. The impact of overcrowding in public transport on levels of stress among passengers has shown inconclusive results (Douglas, Thomson et al. 2007). However, there is some evidence that a direct train line reduced stress levels among commuters who previously had to change train lines on their journey (Douglas, Thomson et al. 2007).

#### Physical activity

Use of public transport often involves walking to and from transport stops and hence, has been widely proposed as being an effective means of increasing physical activity. However, while there is some evidence that changing from driving to work to walking or cycling increases fitness levels and mental wellbeing, there is no evidence that walking to and from public transport is sufficient physical activity, on its own, to produce measurable health benefits (Douglas, Thomson et al. 2007).

Incorporation of physical activity into daily routines such as active transport (walking, cycling and including public transport) to work has been shown to be more sustainable in making the change to a more active lifestyle (Kavanagh, Cathal et al. 2005). Active transport, furthermore, is

perceived as attainable, cheap and accessible for the whole population (Kavanagh, Cathal et al. 2005).

Public transport may provide access to recreational facilities which in turn can increase physical activity (Kavanagh, Cathal et al. 2005). At the same time, evidence shows that people with access to a car report higher levels of recreational activity (as opposed to active transport) compared to people without a car, due to greater access to recreational activity facilities (Douglas, Thomson et al. 2007).

There is some evidence of an indirect association between active transport modes (walking, cycling and public transport) and increased physical activity leading to better mental health (Douglas, Thomson et al. 2007).

More active transport can be found in high density residential areas; but the built environment is only one factor influencing transport behaviour. In addition, the authors of the Scottish review concluded that the socio-economic status of the residents of a neighbourhood has been found to be at least as important as the density of the built environment as an influence on the use of active transport (Douglas, Thomson et al. 2007).

Most interventions designed to promote changes toward the use of more active forms of transport have aimed to shift people away from car use to walking or cycling. Some studies have found that the modal shift from car to train use after such interventions has been minimal, although the impact on health has not been assessed (Douglas, Thomson et al. 2007).

#### Social inclusion

Affordable, available and accessible public transport has the potential to improve social inclusion and helps people build and maintain social networks (Kavanagh, Cathal et al. 2005). However there is no evidence of the contribution of public transport, in particular, to the creation and maintenance of effective social networks within and across communities.

#### Effects on community

There is some evidence of new transport routes (such as train lines or bus routes) created through existing infrastructure and communities leading to reduced access on the part of some community members to local amenities and disruption of local social networks. However there is no research-derived evidence of an association between community severance caused by the imposition of new transport routes and the health of affected populations (Douglas, Thomson et al. 2007). This is an example of the need for empirical evidence to support (or refute) the anecdotal evidence of strong community resistance to the division of communities by new transport routes.

### Personal safety and perception of safety

Evidence from qualitative studies suggests that fear for personal safety can be a barrier to the use of public transport use (Douglas, Thomson et al. 2007). There is some evidence that the installation of CCTV cameras may reduce crime on public transport (Douglas, Thomson et al. 2007).

#### **4. Summary**

Despite the limited evidence base, this review was able to identify the following trends in the literature on the impact of public transport on the health of populations.

The potential health benefits of public transport are created mainly through the access it provides to the material resources and services needed for good health. Public transport has the potential to contribute to improved social inclusion for low-income and outer urban households as well as for individuals who have mobility problems due to age or disability. It enables people to travel to work, education, health care, and to participate in a variety of social and recreational activities – all of which are known to influence, positively, the health of populations. Further, the provision of public transport services that are convenient, affordable, accessible, safe, and frequent is vital if there is to be a measureable improvement to the health of affected populations. Potential for modal change away from car use to active transport appears to vary according to the investigated population. Increased physical activity appears to be linked to active transport modes, of which public transport is one. In regards to air pollution in relation to public transport the evidence is limited but suggests lower exposure to air pollutants for train users when compared to motor vehicle occupants. However there is a lack of research concerning the efficacy or effectiveness of interventions to increase use of public transport and/or reduce reliance on car transport.

The potentially harmful effects of public transport on health and its determinants are different for different transport modes. Motorized public transport road vehicles are likely to result in increased air pollution exposure, along with private cars.

Risk of injury is smaller for public transport users. However, among those users, the highest risk of injury exists for older people. This might act as barrier to older people accessing public transport, and consequently increasing their likelihood of social isolation and reduced mobility. However, research into injury prevention for different modes of public transport is not available. Likewise, research investigating interventions to increase personal safety for public transport users is also not available for the Australian context.

Unequal provision of public transport services seems to exacerbate social exclusion, as those population groups with already low social inclusion, such as the aged, are more disadvantaged by current public transport provision. However, more research is needed to investigate to what extent current public transport provision contributes to health outcomes for disadvantaged groups, such as the elderly, young people, women, low-income households and people with disabilities. Access to health services is part of social inclusion. How public transport contributes to improved access to health services has not been investigated yet.

##### ***5. Limitations in the evidence base and suggestions for further research***

This review indicates a lack of research in either the disciplines of public health or transport planning that focuses on the health effects, including health inequalities, of public transport. The body of Australian academic literature concerning the impact of public transport on the health of populations is small. Likewise the two international reviews included suggest limited empirical analysis elsewhere. Further, public transport as distinct from transport in general is rarely delineated, limiting the knowledge base concerning the causal pathway between public transport and health (Dora 1999).

Thus, the current body of evidence has to be interpreted carefully to account for research gaps and biases, particularly in the Australian context. The greatest volume of evidence to date addresses the impact of public transport on physical activity. This is due, in part, to the heightened awareness of the importance of physical activity to the health of individuals and populations among the public and policy makers. Deeper understanding of the literature reveals that other more complex issues such as social inclusion and equity might be equally or more important in the relationship between public transport and health, but these issues have received far less attention to date. For example the extent to which Indigenous Australians are transport disadvantaged has not been investigated yet. In addition, there is inconclusive evidence about the socio-economic and demographic factors that determine use of public transport, and most studies have controlled for and therefore not reported, excluded, or not fully reported the influence of these factors. Much more research is needed to untangle the complexity inherent in social disadvantage as an effect modifier or confounding factor on the causal pathway between public transport and health.

Finally, evidence on the health effects of public transport policies and interventions can be generated by either the Health or Transport sector. Recognising the current limitations in the evidence base the WHO recently recognised the need for policy and research integration on transport, environment and health to avoid conflicting policy and planning in these areas (WHO

Charter on Transport, Environments and Health 1999). Hopefully, this will improve our understanding of the health impacts of public transport while improving public transport policy and planning.

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