

# Transport and health

## 1. Introduction

The primary function of transport is in enabling access to people, employment, goods and services. In doing so it also promotes health indirectly through the achievement and maintenance of social networks. Some forms of transport, such as cycling and walking, promote health directly by increasing physical activity and reduction of obesity. Lack of transport may damage health by denying access to people, goods and services and by diverting resources from other necessities. Furthermore, transport may damage health directly, most notably by accidental injury and pollution. (Acheson Report, 1998)

### What is health?

The World Health Organisation defined health as “a state of complete physical, mental and social well-being and not merely the absence of disease”.

In New Zealand the Whare Tapa Wha model similarly recognises the physical, mental, social and spiritual elements of health (Durie 1998).

### What determines health?

There is now increasing recognition that health is determined by more than individual genetics and behaviour, and that ‘upstream’ factors in the social and physical environment have an important influence on health status.

This health impact assessment considers how transport policy can affect the following determinants of health:

- physical activity
- access
- accidents
- community connectedness
- stress

Other determinants affected by transport such as air pollution and noise are not covered in this HIA, but are covered in the environmental impact assessment.

## 2. Physical Activity

Because mechanisation has reduced the exercise involved in jobs and housework and added to the growing epidemic of obesity, people need to find new ways of building exercise into their lives. (Wilkinson and Marmot, 2003)

Physical activity is not just exercise and sport. It includes taking the stairs instead of the lift, hanging out the washing, walking to the shops or to work and school, gardening, vacuuming and sweeping, and carrying objects(MOH, 2006).

## 2.1 How does physical activity affect health?

Regular physical activity significantly reduces the risk of:

- premature death
- cardiovascular disease (heart attack and stroke)
- type two diabetes
- bowel and breast cancers
- osteoporosis and fracture
- depression and anxiety
- obesity (Warburton et al., 2006)

It has been estimated that 9% of all deaths in New Zealand (2,600 per year) can be attributed to physical inactivity, and that the prevalence of physical inactivity is likely to increase 4% by 2012. Inadequate physical activity is thus a significant public health problem in New Zealand (Tobias and Roberts, 2001). According to the 2000/1 Hillary Commission Physical Activity Survey nearly one third of New Zealanders are inactive, getting insufficient regular physical activity (SPARC, 2002).

The more physical activity done, and the more intense, the more the health benefit (Warburton et al., 2006). In New Zealand the Ministry of Health recommends at least 30 minutes of moderate intensity activity (such as cycling or brisk walking) on most days for adults, with a higher level of activity recommended for children (MOH, 2006), and this in keeping with international guidelines.

## 2.2 How does transport affect physical activity?

“Transport policy can play a key role in combating sedentary lifestyles by reducing reliance on cars, increasing walking and cycling” (Wilkinson and Marmot, 2003)

### Using active modes of transport

Short to medium length journeys are opportunities to use active modes of transport (such as walking and cycling) and incorporate physical activity into daily life. Given that 46% of motor vehicle trips that begin and end at home are less than 10 km long, and 19% are less than 4 km, there is considerable opportunity for increased active journeys (Turner et al., 2006).

Barriers to active transport include heavy traffic, not enough cycle lanes or paths, footpaths not being well maintained, and not enough footpaths (Sullivan et al., 2003). Those using mobility aids such as walking sticks or wheelchairs require sufficiently wide and even footpaths, as do those with young children in pushchairs.

### Public transport

Public transport can also play a role in encouraging physical activity. It has been estimated that on average a journey by public transport requires 10 minutes walking (to and from the bus stop or station) (Gorman et al., 2000). Thus policies that facilitate public transport use can also increase physical activity.

### Accessing recreation facilities

Transport policy also has a role to play in facilitating access to places such as parks, gymnasiums and swimming pools where people can undertake recreational physical activity. Community

severance caused by major roads was identified as a barrier to accessing community facilities (including recreational facilities) in a recent New Zealand report (PHAC 2003).

### **Car travel**

There is evidence that New Zealanders are relying increasingly on private motor vehicles for transport (MOT, 2005). Journeys made by car, particularly short journeys, are missed opportunities for active travel and hence physical activity.

### **2.3 Groups affected**

Children in developed countries, including New Zealand, are becoming more sedentary, with a resulting increase in childhood obesity (BMA, 1997). In New Zealand fewer children are undertaking active journeys to school (walking or cycling) than was the case ten years ago (MOT, 2005).

People with lower incomes are also less likely to own cars, but little research has been done on how this influences levels of activity (PHAC, 2003). Low income is commonly identified as a barrier to physical activity (MOH, 1999). The 1996/7 NZ health survey found that lower levels of vigorous activity were associated with low household income, educational level, and deprivation (MOH, 1999).

### **2.4 What works in terms of transport policy to increase physical activity?**

#### **Building cycleways and walkways**

Strong evidence was found by the Community Guide Taskforce for creation of, or enhanced access to, places for physical activity, which includes interventions such as creating walking trails and providing access to nearby exercise facilities (Kahn et al., 2002).

#### **Urban design**

Urban design measures, including increasing the walkability of neighbourhoods, and mixed land use developments with walkable distances between residential, commercial, and educational sites, have been shown to increase physical activity (CDC, 2006a).

#### **Targeted behaviour change**

A recent systematic review (Ogilvie et al., 2004) found that behavioural interventions such as education, resources, and subsidies, given to motivated groups of volunteers or tailored to a group's particular requirements, resulted in a significant shift towards active transport (5% of all household journeys shifted from car to walking or cycling). Short-term health benefits were demonstrated after taking up active commuting. Workplace travel plan evaluations were included in this group of studies.

#### **Providing alternative services**

One study in the Netherlands has found a significant shift away from car travel after a new train station was opened in a small town. Other studies considering car-sharing schemes and telecommuting did not produce a significant mode shift (Ogilvie et al., 2004).

### **Walking school buses**

Evaluations of walking school bus initiatives, including a recent pilot study in Auckland, suggest that walking school buses create opportunities for children to become more physically active, but also encourage children to think of walking as a normal transport mode, and may have broader health benefits such as encouraging physical activity at other times and helping to make neighbourhoods safer for children (Neuwelt, 2005).

### **Making combining modes easier**

Other interventions to encourage cycling by making it easier to combine cycling with other modes include bicycle storage at railway/bus stations and bicycle carriage on trains have the potential to promote increased cycling.

## **3. Access to services**

Can people get to key services at reasonable cost, in reasonable time and with reasonable ease? (SEU, 2003)

### **3.1 What is the evidence that access to services impacts on health?**

#### **Access to health care services**

Advances in medical technology in recent decades have made health care an increasingly important determinant of health status (McKee, 1999). There is evidence that primary health care services (for example the local GP) in particular have an impact on population health status (Starfield et al., 2005).

#### **Access to workplaces**

Participation in paid employment is important for attaining adequate income, and also enhances social status, improves self-esteem, and provides an opportunity to participate in community life, all of which enhance health (NHC, 1998).

#### **Access to educational institutions**

Educational attainment is important in determining social and economic position later in life, and there is good evidence that poor educational attainment is associated with worse health outcomes (NHC, 1998).

#### **Access to food outlets**

Ready access to food shops is essential given that very few New Zealanders grow their own food. It is also important that healthy food such as fresh fruit and vegetables is available, as most of the nutrition related burden of disease in New Zealand is related to high intake of foods rich in fats and sugars (MOH, 2003).

## **Access to facilities for social, cultural and sporting activities**

Access to social services and community facilities such as churches, cultural centres, libraries, community halls, parks, playgrounds, youth centres, sports clubs and other meeting places is important for social participation and community functioning. Access to these services develops social cohesion and social capital (“those features of social structures ... which act as resources for individuals and facilitate collective action” (Kawachi and Berkman, 2000)). High levels of social capital have been linked to higher population health status with lower all cause mortality and better self-rated health (Kawachi and Berkman, 2000).

### **3.2 How does transport impact on access to services?**

#### **Availability and physical accessibility of transport**

Public transport is particularly important for people on low incomes, who are much more likely than those on higher incomes to use public transport for the majority of their journeys, and to access essential services (SEU, 2003).

Inadequate public transport is the main transport problem mentioned by people with difficulties accessing services (SEU, 2003).

Public transport services tend to run into the centre of town from peripheral areas (radial routes), making access to peripheral services such as employment destinations and primary health care centres difficult. Services also tend to be concentrated around peak commuting times, with infrequent services at other times, when people might be accessing services such health care or shopping for food.

Access for those with physical disabilities requires not only accessible public transport vehicles (such as buses that can “kneel”), but also accessible street and bus stop/ train station infrastructure, including safe pedestrian crossings adjacent to bus stops and train stations, and accessible platforms, and shelters deigned to accommodate those with disabilities. Public transport can also provide access problems for those with sensory and intellectual disabilities, for example through complicated timetables written in small print.

#### **Cost of transport**

The cost of public transport is most important for those on low incomes who do not have cars, for whom cost can provide a barrier to accessing services.

The costs associated with car use such as petrol, road user charges, parking, and congestion charging, are not likely to prevent access to services unless there is no alternative to car travel (no public transport option). This is a particular issue for people in rural areas where regular public transport is less viable.

#### **Safety and security of roads, walkways, public transport**

Freedom of walkways and public transport from vulnerability to harassment or attack by other users is an important factor in determining people’s willingness to use these modes of transport, especially for women and the elderly, and especially at night (BMA, 1997).

## Acceptable services

The reliability and frequency of services is particularly important to women, who are more likely to combine several tasks in one trip, such as journeys to work, school, childcare and shopping (SEU, 2003). Ease of use is another factor that can make services more or less acceptable.

### 3.3 Who is most affected?

People without cars must rely on public transport and active modes to make essential journeys, and are therefore dependent on the public transport service being affordable and appropriate to make longer journeys such as travelling to hospitals for outpatient appointments. They also have reduced access to services that are designed assuming car use, such as supermarkets and suburban malls. Carlessness has been found to be associated with reduced access to social support services (Bostock 2001).

Car usage is lower in women, in Maori and Pacific peoples, and in people with low incomes (LTSA, 1999).

Accessible and affordable transport has been identified as a key service gap for people with disabilities in New Zealand (PHAC, 2003). Getting on and off public transport is the principle barrier for adults with disability to using public transport (MOH, 2004).

People living in relatively deprived areas often have fewer services within easy access, including fewer walkable green spaces and fewer health service providers (Galea and Vlahov, 2005). In New Zealand there are substantial differences in the accessibility of local services between urban neighbourhoods (Pearce et al., 2006).

Rural people are more likely to be dependent on car travel to access services, which are likely to be further away. Those on low incomes and/or without cars living in rural areas are thus likely to be doubly disadvantaged, because of the high cost of car travel and the lack of alternatives (PHAC, 2003).

### 3.4 What transport interventions help to improve access?

Integrated ticketing, where a single ticket can be used across different modes of transport, and integrated timetabling, where services are coordinated to allow for easy transition between modes, is used extensively in the UK and elsewhere. These measures make services easier to use, especially for those with disabilities and the elderly.

Affordable public transport is important in enabling access for those on limited incomes. Many countries provide subsidies for those with disabilities, the elderly and young people. In the United Kingdom over 60s and those with disabilities pay at most half price fares, and in some areas travel for free. Subsidies have also been used successfully to aid people getting to work or study in certain areas. Public transport provided to all users at a highly subsidised rate improves access for the most disadvantaged groups.

Services designed people with disabilities, including accessible mainstream public transport, and publicly or community provided alternative services (such as door to door services), have been effective in many countries in improving access for this group (SEU, 2003).

## **4. Accidents**

### **4.1 How do accidents affect health?**

Physical injury from accidents ranges from minor cuts and bruises to broken bones, head injuries, and fatal injuries. By the year 2020 road accidents are predicted to be the 3<sup>rd</sup> leading cause of disability adjusted life years lost internationally (WHO, 2003). In New Zealand unintentional injury is the leading cause of death for children and young adults, and motor vehicle accidents make up a large proportion of injury deaths (NZHIS, 2006). New Zealand has a high rate of road fatalities compared to other countries in the OECD (Kjellstrom and Hill, 2002).

The total social cost of motor vehicle injury in New Zealand for 2005 was estimated at 3 billion dollars, of which 2.5% (75 million dollars) was health care costs (MOT, 2006b). This cost removes money from the rest of the health system and reduces funding that could be made available to other departments

In addition to physical problems many people involved in accidents suffer, psychological health effects including posttraumatic stress disorder (PTSD). Recent evidence has shown that up to 14% of survivors have diagnosable PTSD and 25% have psychiatric problems one year post accident (Dora and Phillips, 2000).

The risk of accidents is also an issue in determining parents willingness to allow their children to walk to school, with the reduction in children walking to school in recent years resulting in lost opportunities for physical activity (PHAC, 2003).

### **4.2 How does transport affect accidents?**

Between 1998 and 2001 motor vehicle traffic was the most common mechanism of death by injury in New Zealand (IPRU, 2006). 363 people have been killed on New Zealand roads in the past 12 months (as at 24/7/06) (LTNZ, 2006b). The road toll in New Zealand has steadily declined over the past decade, but traffic injury remains a significant cause of injury and distress (PHAC, 2003). Approximately seven people are injured on the roads for every death, and only a proportion (approximately 66%) of crashes are reported (Kjellstrom and Hill, 2002).

#### **Mode of transport**

Pedestrians and those using bicycles or motorbikes are most vulnerable to road traffic injury (Ameratunga et al., 2006). However car-occupants are make up the large majority of fatally injured road users in New Zealand (80% in 2000) because of the high proportion of journeys made by car and the size of the vehicle fleet (Ameratunga et al., 2006).

Data from Britain in 1992 shows that bus and rail travel are comparatively safe at 0.04 and 0.1 fatalities per hundred million passengers per km travelled respectively, while car fatality rates are higher at 0.4 per hundred million passengers per km, with cyclists (4.3), pedestrians (5.3) and motorcyclists (9.7) at the highest risk (Anonymous, 1997).

While cycle travel poses an increased risk of accident compared to car travel, a British Medical Association review has concluded that the health benefits of cycling substantially outweigh the risks (BMA, 1994). A cohort study in Denmark followed 30, 000 people for 14 years and found that cycling to work was associated with a 40% decrease in the risk of death (Anderson et al., 2000).

## **Speed**

Faster speed is associated with greater stopping distances and an increased likelihood of death if a pedestrian is hit. WHO research suggests a 1km/ph reduction in speed could reduce accidents 3% (Dora and Phillips, 2000).

### **4.3 Who is affected by transport accidents?**

People of low socio-economic status bear the main burden of accidents. A recent British study found that while child injury death rates have fallen 63% in Wales and England in the twenty years to 2001, there has been almost no change in rates for children from the poorest families, and for deaths among child pedestrians and cyclists children from the lowest socio-economic group were found to have a cause specific mortality more than twenty times that of the highest group (Edwards et al., 2006). New Zealand research has found similar disparities in child injury rates, and has highlighted differences in exposure to risk and environmental risk factors (such as the speed and density of traffic, access to safe play areas, and fenced driveways) as underlying socio-economic differentials seen (Roberts et al., 1996).

Drink driving in New Zealand has been shown to be much higher in rural areas, where most fatal or serious injury alcohol-related crashes occur (MOT, 2006a). The lack of alternative transport is often cited as a reason for drink-driving in rural areas (Hamilton, 1996).

Drivers of Maori or Pacific ethnicity face higher risk of injury per distance driven than other drivers, with the hospitalisation risk for Maori and Pacific peoples approximately three times that for other ethnicities. Maori youth have high rates of road traffic mortality when compared to other (MOH, 2004).

### **4.4 What transport interventions work to reduce accidents?**

#### **Safer Roads**

The construction of separate cycle lanes alongside urban roads has been shown to be effective in reducing cyclist casualties (Ameratunga et al., 2006). Footpaths are also important for reducing the risk of pedestrian injury (Ameratunga et al., 2006).

Traffic calming measures to reduce traffic speed have also been found to reduce deaths and injuries by 11% by a recent systematic review (Bunn et al., 2003). UK 20 mile/hour (about 30 km/hr) speed limits, supported by physical measures such as speed humps and traffic islands, have been shown to reduce road accidents by 67% and child pedestrian injuries by 70 % (SEU, 2003).

#### **Measures to reduce the severity of accident injuries**

Measures such as seatbelts, child restraints, and cycle helmets have been shown to reduce the severity of accident injuries (Morrison et al., 2003).

#### **Public Transport**

Policies that facilitate reductions in motor vehicle traffic and promote the use of safer modes of transport such as public transport are likely to reduce road crashes and the risk of injury to vulnerable road users (Ameratunga et al., 2006).

## **5. Social connectedness and community severance**

The influence of transport on social cohesion is complex. Transport provides an important means of contact between family members, friends, and members of voluntary organisations and communities. At the same time, roadways and traffic act as physical and psychological barriers to contact. (Kjellstrom and Hill, 2002)

In the context of transport policy, community severance can be defined as “the sum of the divisive effects a road has on those in the locality” (Dora and Phillips, 2000).

Social connectedness can be defined as “the relationships people have with others” and “people joining together to achieve shared goals which benefit each other and society as a whole”(MSD, 2005).

### **5.1 How do connectedness and severance affect health?**

The level of cohesion or connectedness in a society is related to the health of individuals and communities (NHC, 1998). High levels of social support are thought to promote health directly and to buffer the adverse effect of stressors, and good social support networks are particularly important for vulnerable groups such as older people and children (PHAC, 2003). A strong social network can reduce the risk of depression and susceptibility to infection (Wilkinson et al., 1998), and low social contact has been linked to an increase in all-cause mortality (Berkman and Syme, 1991).

Community severance involves disruption of social support networks, and reduces access to facilities and services, especially for those with restricted mobility. Thus it can impact on health by removing the protection of social support, and by preventing easy access to essential services such as health care and education. Large roads passing through communities can also cause stress, which can result in depression and anxiety (PHAC, 2003).

### **5.2 How does transport promote or disrupt connectedness?**

Appleyard and Lintell (1972) conducted a study in San Francisco in the 1970s that considered the impact of traffic flow on community connectedness. Three similar streets with different volumes of traffic were compared, and it was found that the number of social contacts residents had, and the perceived ‘liveability’ of the street, was inversely proportional to the traffic flow. Large volumes of motorised traffic can also reduce access to facilities for walking and cycling (PHAC, 2003). The construction of large roads through residential areas thus has the potential to cause community severance, reducing the health promoting social networks of residents and the likelihood that residents will choose active transport.

The situation of roads in relation to residential areas, traffic volumes, and the design and layout of the road and footpath system, can affect the social impact of the road and the degree to which it disrupts or prevents social connections (Read and Cramphorn, 2001).

Transport systems can also promote social connectedness. For example, good access to local amenities such as shops, cafes, sports and social facilities has been found to promote social interactions (JRF, 1999). The design of public spaces, including walkways, cycleways, footpaths and roads, also contributes to the degree to which people feel comfortable in and a sense of ownership over these spaces, and thus the degree to which social interactions occur in these spaces. Transport can facilitate social support, such as enabling better access to friends and family (PHAC, 2003).

### **5.3 Who is affected?**

Those without cars are more vulnerable to community severance, as they are more likely to make local journeys on foot and to have social contacts in their immediate neighbourhood. Those who spend more time at home, such as older people and those with young children, are also particularly vulnerable to community severance, as they are likely to rely more on social contacts in their immediate neighbourhood (PHAC, 2003).

### **5.4 What works to prevent community severance and promote community networks?**

There is a move internationally to promote sustainable urban growth through initiatives such as the “urban villages” movement in the UK and the US, and other “smart growth” programmes. These initiatives seek to reduce urban sprawl and design communities to facilitate short and easy local journeys by means other than car (Eley, 2003). The “walkability” of communities has the potential to impact on the social networking of residents, particularly those without cars or with limited mobility.

## **6. Stress**

The term stress can be used to refer to both a set of circumstances which are perceived as threatening, and to the resulting state of physiological and psychological disturbance or distress (VanItallie, 2002). The body has its own mechanisms for adapting to stressful stimuli, which can be protective (such as the “fight or flight” response), but can also go astray and cause illness.

### **6.1 What are the health effects of stress?**

It is generally accepted that stress has a significant effect on health. Excess stress can lead to continuing anxiety, insecurity, low self-esteem, social isolation and a lack of control over home or work life and can result in significant health problems (Wilkinson and Marmot, 2003). These health problems commonly result from the sympathetic response to stress and are wide ranging including hypertension, headache, impaired immune function (which may precipitate cancer, infection, and disease), stomach ulcers, stroke, diabetes, depression, asthma, osteoporosis, arteriosclerosis, myocardial ischemia, heart rhythm disturbances, platelet stimulation, increased blood viscosity (via hemoconcentration), endothelial dysfunction and coronary vasoconstriction in the presence of arteriosclerosis of the coronary arteries (VanItallie, 2002).

### **6.2 How does transport cause stress?**

#### **Congestion**

Road congestion leads to frustration due to a driver’s inability to drive at a speed consistent with his or her own wishes (TAG, 2003), with a feeling of not having control being a major factor in determining the level of stress (Hennessy and Wiesenthal, 1997). Stress due to congestion has been shown to decrease task motivation, increase absenteeism from work, and decrease job satisfaction, all of which affect work performance (Wener, Evans et al. 2003).

#### **Noise**

Noise is known to have an adverse effect on health, causing annoyance and sleep disturbance (both of which contribute to stress) (Kjellstrom and Hill, 2002). Studies have found that stop/start traffic,

and vibration or low frequency noise, are most annoying, particularly early in the morning and late at night (Kjellstrom and Hill, 2002). Socio-economic status is reported to influence exposure to noise, with those who can afford to living away from busy roads resulting in less exposure to traffic noise (therefore widening inequalities) (FPHM, 2000).

### **Public transport and stress**

International research suggests that a degree of “commuter stress” is associated with public transport use. The quicker and more reliable to service, and the less crowded, the less stress it causes (Wener, Evans et al. 2003).

## **6.3 What transport interventions work to reduce stress?**

### **Strategies to reduce congestion**

Effective strategies for reducing congestion include road pricing (particularly congestion charging), programmes encouraging the use of alternative modes for commuting, flexitime and telework, improvements to public transport systems, High Occupant Vehicle (HOV) priority, access management (coordinating road design and land use, to minimise intersections, pedestrian crossings etc.), parking pricing, and “smart growth” (VTPI 2005).

On the other hand, increasing road capacity was found to reduce congestion in the short term, but have only as modest effect in the medium to long term, because of extra capacity being filled by induced peak period traffic (the rebound effect, where reduced congestion means more people choose to drive) (VTPI 2005).

### **Strategies to reduce noise**

Some road surfaces produce less noise than others. A recent New Zealand report found that chipseal surfaces are significantly louder than bitumen surfaces, even at 50km/hour (Dravitzki, Walton et al. 2006). Noise insulation in new houses or houses in vulnerable areas (i.e. near new or high traffic roads) can reduce exposure to noise inside houses.

### **Strategies to reduce public transport stress**

There is evidence that more predictable transport systems induce less stress in those who use them (Wener, Evans et al. 2003). Reliability and good information (such as electronic information systems at bus stops and train stations) are both important factors in making public transport more predictable.

## **7. References**

ACHESON, D. (1998). *Independent Inquiry into Inequalities and Health: Report (The Acheson Report)*. London, The Stationery Office.

AMERATUNGA, S., HIJAR, M. & NORTON, R. (2006) Road-traffic injuries: confronting disparities to address a global-health problem. *Lancet*, 367, 1533-40.

ANDERSON, L., SCHNOHR, P. & SCHROLL, M. (2000) All-cause mortality associated with physical activity during leisure time, work, sports and cycling to work. *Archives of Internal Medicine*, 160, 1612-8.

- ANONYMOUS (1997) Fasten your safety belts. *Economist*, 342, 55-57.
- APPLEYARD, D. & LINTELL, M. (1972) The environmental quality of city streets: the resident's viewpoint. *American Institute of Planners*, 38, 84-101.
- BMA (1997) Road Transport and Health. London, British Medical Association.
- CDC (2006a) The Community Guide. Centers for Disease Control and Prevention.
- CDC (2006b) Physical Activity. Guide to Community and Preventive Services Website. Centres for Disease Control and Prevention.
- DORA, C. & PHILLIPS, M. (Eds.) (2000) *Transport, Environment and Health*, Copenhagen, World Health Organisation, Regional Office for Europe.
- DRAVITZKI, V., D. Walton, et al. (2006). Road Traffic Noise: determining the influence of New Zealand road surfaces on noise levels and community annoyance. Wellington, Land Transport New Zealand (research report 292).
- ELEY, C. (2003). *Smart Growth Downunder*. Ian Axford Fellowship in Public Policy.
- FPHM (2000). Carrying out a health impact assessment of a transport policy - guidance from the Transport and Health Study Group. London, Faculty of Public Health Medicine.
- GALEA, S. & VLAHOV, D. (2005) Urban health: evidence challenges and directions. *Annual Review of Public Health*, 26, 341-65.
- GORMAN, D., DOUGLAS, M. & CONWAY, L. (2000) Health Impact Assessment of the City of Edinburgh Council's Urban transport Strategy. Edinburgh, Scottish Needs Assessment Programme.
- HENNESSY, D. and D. WIESENTHAL (1997). "The relationship between traffic congestion, driver stress, and direct versus indirect coping behaviours." *Ergonomics* **40**(3): 348-62.
- JRF (1999) Social cohesion and urban inclusion for disadvantaged neighbourhoods. *Foundations, Ref 4109*. Joseph Rowntree Foundation.
- KAHN, E., RAMSEY, L., BROWNSON, R., HEATH, T., HOWZE, E., POWELL, K., STONE, E., RAJAB, M. & CORSO, P. (2002) The effectiveness of interventions to increase physical activity. *American Journal of Preventive Medicine*, 22, 73-107.
- KAWACHI, I. & BERKMAN, L. (2000) Social Cohesion, Social Capital, and Health. IN BERKMAN, L. & KAWACHI, I. (Eds.) *Social Epidemiology*. Oxford, Oxford University Press.
- KJELLSTROM, T. & HILL, S. (2002) New Zealand Evidence for Health Impacts of Transport. Wellington, National Health Committee.
- LTSA (1999) The New Zealand Transport Survey. Wellington, Land Transport Safety Authority.
- MCKEE, M. (1999) Does health care save lives (editorial). *Croatian Medical Journal*, 40, 123-8.

- MOH (1999) Taking the Pulse: The 1996/7 New Zealand Health Survey. Wellington, Ministry of Health.
- MOH (2004a) Looking Upstream: causes of death cross-classified by risk and condition New Zealand 1997. *Public Health Intelligence Occasional Bulletin No. 20*. Wellington, Ministry of Health.
- MOH (2004b) A Portrait of Health: Key results of the 2002/03 New Zealand Health Survey. Wellington, Public Health Intelligence, Ministry of Health.
- MOH (2004C) Living with Disability in New Zealand. Wellington, Ministry of Health/ Intersectoral Action Group.
- MOH (2006) Physical activity homepage. Ministry of Health.
- MOT (2005) The New Zealand Travel Survey 2003-4 (preliminary results). Wellington, Ministry of Transport.
- MSD (2005) The Social Report. Wellington, Ministry of Social Development
- NEUWELT, P. (2005) Walking is good for my health! Report of a pilot study on the perceived health benefits to children of walking school buses in the Auckland region. Auckland, Health Promotion Forum of New Zealand, for the Auckland Regional Transport Authority.
- NHC (1998) The social, cultural and economic determinants of health in New Zealand: action to improve health. Wellington, National Advisory Committee on Health and Disability.
- OGILVIE, D., EGAN, M., HAMILTON, V. & PETTICREW, M. (2004) Promoting walking and cycling as an alternative to using cars: systematic review. *BMJ*, 329, 763-8.
- PEARCE, J., WITTEN, K. & BARTIE, P. (2006) Neighbourhoods and health: a GIS approach to measuring community resource accessibility. *J Epidemiol Community Health*, 60, 389-395.
- PHAC (2003) Intersections Between Transport and Health. Wellington, Public Health Advisory Committee.
- READ, M. & CRAMPHORN, B. (2001) Quantifying the Impact of Social Severance Caused by Roads. Wellington, Transfund New Zealand.
- ROBERTS, I., NORTON, R. & TANA, B. (1996) Child pedestrian injury rates: the importance of "exposure to risk" relating to socioeconomic and ethnic differences in Auckland, New Zealand. *Journal of Epidemiology and Community Health*, 50, 162-5.
- SEU (2003) Making the Connections: final report on Transport and Social Exclusion. London, Social Exclusion Unit.
- SPARC (2002) SPARC Facts '97-'01. Wellington, Sport and Recreation New Zealand.

- STARFIELD, B., SHI, L. & MACINKO, J. (2005) Contribution of primary care to health systems and health. *Millbank Quarterly*, 83, 457-502.
- SULLIVAN, C., OAKDEN, J., YOUNG, J., BUTCHER, H. & LAWSON, R. (2003) Obstacles to Action: a study of New Zealander's physical activity and nutrition. Profiling others oriented. Wellington, SPARC.
- TAG (2003). Transport Analysis Guidance: The Journey Ambience Sub-Objective (TAG Unit 3.3.13), Department of Transport (UK).
- TAYLOR, R., BROWN, A. & EBRAHIM, S. (2004) Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomised controlled trials. *American Journal of Medicine*, 116, 682-92.
- TOBIAS, M. & ROBERTS, M. (2001) Modelling physical activity: a multi-state life-table approach. *Australian and New Zealand Journal of Public Health*, 25, 141-8.
- TRB (2005) Does the built environment influence physical activity? (TRB special report 282). Washington, Transport Research Board, Institute of Medicine.
- TURNER, S., ROOZENBURG, A. & FRANCIS, T. (2006) Predicting accident rates for cyclists and pedestrians. Christchurch, Beca Infrastructure Ltd, for Land Transport New Zealand.
- VAN ITALLIE, T. B. (2002). "Stress: A risk factor for serious illness." *Metabolism* 51(6): 40-45.
- VTPI (2005 (last updated)). *TDM Encyclopedia: Congestion Reduction Strategies*, Victoria Transport Policy Institute. 2006.
- WARBURTON, D. E., NICOL, C. W. & BREDIN, S. S. (2006) Health benefits of physical activity: the evidence. *CMAJ Canadian Medical Association Journal*, 174, 801-9.
- WENER, R., G. EVANS, et al. (2003). Running for the 7:45: The effects of public transit improvement on commuter stress. *Transportation* 30(2): 203-220.
- WHO (2003) World Health Report 2003. Geneva, World Health Organisation
- WILKINSON, R. & MARMOT, M. (Eds.) (2003) *Social Determinants of Health: The Solid Facts*, Geneva, World Health Organisation.
- WILKINSON, R., KAWACHI, I. & KENNEDY, B. (1998) Mortality, the social environment, crime and violence. IN BARTLEY, M., BLANE, D. & DAVEY SMITH, G. (Eds.) *Sociology of Health Inequalities*. Oxford, Blackwell.