Cycling

Getting Australia Moving

Barriers, facilitators and interventions
to get more Australians physically
active through cycling

Australian Government

Department of Health and Ageing

This report was funded by the Australian Government Department of Health and Ageing. The views expressed in this report do not necessarily represent the position of the Australian Government.

About this report

In August 2007, the Cycling Promotion Fund was commissioned by the Commonwealth Department of Health and Ageing to develop a report on bicycle participation by Australian adults.

The Cycling Promotion Fund was specifically asked to investigate the contribution cycling can make to the health of adult Australians, what barriers exist to increasing participation and what can be done to overcome these hurdles.

The Cycling Promotion Fund engaged four notable academics/practitioners from the fields of health, transport and economics to address these questions.

About the authors

Professor Adrian Bauman

Sesquicentenary Professor of Public Health (Behavioural Epidemiology and Health Promotion)
University of Sydney

Adrian has an active interest in physical activity, public health, health promotion and mental health epidemiology.

Associate Professor Chris Rissel

Director
Health Promotion Service
Sydney South West Area Health Service
University of Sydney

Chris has a health promotion research focus directed towards tobacco control, sexual health and active transport (walking and cycling). Chris is currently involved in implementing and evaluating a three year cycling promotion program in western Sydney on the impact of increases in cycling on overall population health.

Dr Jan Garrard

Senior Lecturer
School of Health and Social Development
Deakin University

Jan's research is primarily concerned with understanding the socio-environmental and personal determinants of physical activity (particularly active transport) for women and evaluation of interventions aimed at promoting physical activity.

Adjunct Associate Professor Ian Ker

Research Associate
Planning and Transport Research Centre
Curtin University

Ian is an economist by training, with extensive experience in transport planning. This includes almost 15 years with the Western Australian Department of Transport and several with ARRB Consulting. He now runs his runs his own consulting firm CATALYST.

Ms Rosemarie Speidel

Program Director
Cycling Promotion Fund

Rosemarie has qualifications and experience in community development, adult education and public policy. She played an instrumental role in setting up the Cycling Promotion Fund in 2000 which, under her leadership, established itself as a credible national body in cycling promotion and advocacy. She has a particular interest in interventions for women and people with low physical activity levels.

Mr Elliot Fishman

Policy and Research
Cycling Promotion Fund

Elliot is a former health professional who turned his attention to transport planning. He is interested in the health, social, environmental and economic benefits of increasing the role of active transport. He is also Director of the Institute for Sensible Transport.

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Summary

Physical inactivity is a major contributor to poor health in Australia – with around half the population insufficiently active to protect against sedentary lifestyle diseases, such as diabetes.

The trend of decreasing rates of physical activity cuts across all ages and social groups. Modern lifestyles have engineered physical activity out of everyday life.

Cycling offers significant potential to increase physical activity levels in adults. It is already the fourth most popular physical activity for adults, it can be undertaken by a wide variety of ages and fitness levels, it is affordable and can be integrated into people's daily life and used as a form of transport.

This report has been developed to assist practitioners, policy makers and planners to increase adult physical activity levels through bicycle riding. It does this by first setting the scene on Australian cycling and then outlines current barriers and facilitators to greater participation. Finally, the report delivers a set of recommendations to overcome these barriers and increase bicycle riding among Australian adults.

Cycling is on the increase!

Over 1.68 million adults cycled in 2006; an increase of 244,000 from 2001. Australian capital cities have also experienced an average 22% increase in bicycle journeys to work, with Melbourne's growth rate soaring 42% between 2001 and 2006.

A range of interventions exist to encourage cycling; from cycling events attracting thousands of people, behaviour change programs targeting trips to work and school, social marketing campaigns and multifaceted community based programs. Those programs are successful in encouraging people to ride more often but their reach is currently limited and effectiveness will be enhanced with the development of more supportive physical environments, such as bicycle lanes and paths.

Valuing cycling

The value of current cycling to the economy is approximately $227.2 million per annum. Other benefits calculated for this report include reduced congestion ($63.9 million) and greenhouse gas emissions ($9.3 million).

What barriers exist to greater cycling participation?

Despite the significant increase in cycling over recent years and the multitude of benefits stemming from increased participation, a number of substantial barriers exist for large segments of the population.

Individual barriers, such as a lack of skills and confidence have been found to prevent many people from cycling.

Social and cultural factors can also influence rates of cycling. For instance, low income areas were found to have reduced opportunities for cycling and their residents make less short trips by either foot or bicycle.

Environmental factors (urban design and bicycle infrastructure) were found to be a major influence on levels of cycling. Higher density development reduces trip distance and this provides a major boost for cycling, as does the provision of on and off road bicycle routes. In fact, the current lack of bicycle infrastructure in Australia presents a particularly strong barrier for women, who comprise only 20% of commuter cyclists.

Safety concerns were consistently found to be among the most significant barriers preventing people from cycling. It was even found to be a concern for those that cycle regularly. Yet the perception of risk from cycle accidents is often disproportionate to the actual risk. For instance, the hospitalisation rate from cycling is seven times lower than that of football, per 100,000 participants. Moreover, the evidence clearly points to the fact that the more cyclists there are, the safer it becomes.

Policy and regulatory factors governing key influences on cycling, such as congestion charging, urban density and motor vehicle speed limits have been identified as non-health sector issues that nonetheless have important outcomes for public health through their effect on cycling.

Recommendations

Establishing a cycling-friendly policy and regulatory environment is a significant challenge and one that is not entirely within the direct control of the health sector. A multi-faceted, whole-of-government approach is required. Each of the following recommendations are largely dependent upon one another and should be implemented in an integrated, coordinated way to increase bicycle participation:

- Mass marketing campaigns highlighting the benefits of cycling
- Bicycle education programs to increase skills, confidence and safety
- Behaviour change initiatives to market alternatives to car use
- Cycling events to provide incentives for people to ride in a supportive environment particularly for novice riders
- Urban planning/bicycle infrastructure/funding focused on increasing bicycle friendly design.

As Australians continue to lead increasingly busy lifestyles, cycling is in a unique position for its ability to combine physical activity, recreation and transport. This provides an important health benefit for a population failing to meet minimum physical activity requirements. Cycling is also a carbon neutral, petrol free form of transport, simultaneously helping Australians fight climate change and reduce fuel costs. For peak hour journeys in particular, the bicycle can reduce congestion and increase the efficiency of the transport system.

Creating more cycle friendly communities can also play an important role in creating better places to live, work, raise a family and grow old.

For Australia to fully capitalise on the benefits of cycling, a whole-of-government approach is required, with commitment from the health, transport, environment, education and planning portfolios. Only through a combined approach can the benefits of cycling be fully realised.

Executive Summary

Physical inactivity is a major contributor to poor health in Australia. Approximately half the Australian population are insufficiently active, which significantly increases their risk of cardiovascular disease, type 2 diabetes and obesity. A lack of physical activity also increases the risk of breast and bowel cancer, depression and anxiety. The rate of obesity in Australia is among the highest in the OECD. There is now convincing, yet under-recognised evidence that boosting levels of physical activity through cycling is an effective method of improving health and fostering social connectedness.

Cycling offers significant potential to increase physical activity levels in adults:

- It is already the fourth most popular physical activity for adults
- It can be undertaken by a wide variety of people of different ages and fitness levels
- It is affordable and can be easily integrated into people's daily lives and used as a form of transport.

This report has been developed to assist practitioners, policy makers and planners to increase participation in bicycle riding by Australian adults. It does this by first setting the scene on Australian cycling and then outlines current barriers and facilitators to greater cycling participation. Finally, the report makes a set of recommendations to increase bicycle riding among Australian adults.

Australia has a comprehensive network of cycling organisations with many of these having established partnerships with Government

1 Setting the scene

Cycling is becoming increasingly popular in Australia. Between 2001 and 2006 the number of Australians aged 15 years and older who cycled for recreation in the previous 12 months increased by 244,500, with 1.7 million having cycled in 2006. In the same period bicycle journeys to work have risen 22% in Australian capital cities, with Melbourne achieving an increase of over 42%. Women and older Australians are less likely to cycle, a pattern which is not consistent with international cycling prevalence data. Countries with high rates of cycling for transport and recreation have few gender and age differences in cycling, while countries such as Australia, which have relatively low rates of cycling (particularly for transport), have large gender and age differences in cycling. Cycling also appeals to a large number of people who wish to avoid high impact forms of physical activity.

Valuing Cycling

The value of current cycling participation to the health system is calculated to be approximately $227.2 million per annum. In addition, benefits have been quantified in terms of reduced congestion ($63.9 million per annum) and greenhouse gas emissions ($9.3 million). Substantial increases in these benefits will flow from future growth in cycling participation.

Interventions to encourage cycling

An overview of the Australian cycling sector and current interventions is included in this report. These range from cycling events attracting thousands of people, behaviour change programs targeting ride to work and school, social marketing campaigns and multifaceted community based programs. These programs are successful in encouraging people to take up cycling or ride more often but their reach is currently limited and effectiveness will be enhanced with the development of more supportive physical environments, such as bicycle lanes and paths.

2 Current barriers and facilitators to greater cycling participation by Australian adults

Cycling participation in many industrialised countries is higher than in Australia. However, bicycle ownership in Australia is high, indicating an underlying interest in cycling, with considerable potential for increased participation.

There is a range of significant barriers to the take up of cycling in Australia. These have been described using the *ecological model of physical activity* and divided into five sections focused on the following factors influencing cycling. This report also provides evidence-based options for overcoming these barriers.

- Individual factors
- Social and cultural factors
- Environmental factors
- Safety
- Policy and regulation

Individual factors

This review found that a lack of skills, confidence and knowledge are all significant barriers to cycling. Consistent Australian research indicates that motivations for cycling are principally focused on individual concerns, such as health and fitness. With this in mind, measures to increase cycling participation include the provision of riding skills classes and the development of mass marketing campaigns focusing on key motivations such as health, social interaction, and the convenience and low cost of cycling for transport. Large-scale cycling events are also effective in promoting cycling participation. These events are not simply one-off activities. Participant surveys consistently indicate that cycling events generate increases in pre and post event cycling.

In addition, it may be necessary to challenge widely held perceptions that act as barriers to cycling, such as the need to be 'super fit' in order to start and that cycling in traffic is inherently hazardous.

Social and cultural factors

Social and cultural factors were found to have an important influence on cycling levels. Lower socio-economic groups are less likely to make short trips by foot or bicycle and the physical environment in some low income areas is less conducive to active forms of travel. However the marked social gradient evident for leisure time physical activity is less prominent for cycling. This highlights the role of bicycle riding in promoting more equitable participation in both physical activity and personal mobility for population groups who do not own cars (up to 30% in some suburbs).

Social norms which tend to exclude women, older Australians and culturally diverse groups from cycling can be challenged through information and education campaigns. It is also necessary to address Australia's current culture, whereby short local trips are almost invariably completed by motor vehicle, which could easily be undertaken by bicycle.

Environmental factors

The evidence reviewed in this report identified the physical environment as a key influence on cycling. This was divided into general urban design features and bicycle specific infrastructure.

Urban design: The literature is very clear on the influence urban design and land use planning has on 'walkability' and this can generally be extended to include cycling. For instance, low density development, with zoning that separates residential and commercial areas was found to increase travel distances which acts as a barrier to cycling. Higher density, mixed use development works to reduce average trip distance and this makes cycling and walking more attractive.

> "There is growing evidence that low density neighbourhoods with poorly connected street networks affect how much time we spend walking, cycling and our ability to use public transport"
>
> **Research Australia, 2007, p. 15**

Bicycle infrastructure: Domestic and international literature highlight the important impact bicycle infrastructure provision has on cycling participation. Although exceptions can be found, the overwhelming trend identified in this report is that well designed and connected bicycle infrastructure

"…it is imperative that new suburbs are planned with active transport in mind, so that bike routes are laid down when the streets and sewers are mapped out"

Senator Penny Wong, Minister for Climate Change and Water

encourages participation and a lack of it is a major barrier for non-cyclists, infrequent-cyclists and even regular riders.

> "The lack of infrastructure for bikes is a barrier. That's a fear, being injured if I got on a bike"
>
> **(Non-rider, female, cited in Daley et al, 2007, p. 4).**

Australian cities and towns generally lack integrated networks of good quality bicycle paths and lanes and this is a significant barrier to greater participation.

Long term reform in urban design to create more compact, vibrant urban and regional centres is vital. Widespread adoption of bicycle friendly design, such as integrated, connected on and off road bicycle routes is essential. Secure bicycle parking and showers at workplaces were also found to help more people make the daily commute by bicycle.

Australian cities and towns generally lack integrated networks of good quality bicycle paths and lanes and this is a significant barrier to greater participation

This report also found a strong case for better integration of bicycling with the public transport system. In countries with high rates of cycling, such as the Netherlands, some 38% of train journeys begin with a bicycle trip. Developing a strategic network of bicycle routes to transport hubs, providing secure bicycle parking at stations and facilitating the carrying of bicycles on public transport have all been shown to be effective methods of encouraging cycling and have a high level of applicability to the Australian context due to its low density land use.

This report also examined the effect of 'invisible infrastructure' on cycling. Invisible infrastructure refers to policy measures and general design features that indirectly impact on cycling, rather than specific bicycle infrastructure. Material reviewed in this report show invisible infrastructure offers cost effective benefits that often result in win-win situations, whereby cyclists and the wider community benefit. For instance, lower speed limits result in more attractive conditions for cyclists, whilst at the same time increasing safety for all road users and improving neighbourhood amenity.

Safety

Surveys and focus group research reviewed for this report show safety concerns to be among the most significant barriers preventing people from cycling, including among those who cycle regularly.

Safety concerns were found to be amplified by aggressive motorist behaviour. Motor vehicle speed is both a perceived and actual safety hazard for vulnerable road users such as cyclists. An accident at 64km/h puts cyclists at 17 times the risk of a fatality than if the vehicle was travelling at 32km/h.

A combination of speed, volume of traffic and a lack of designated space for people to ride were found to be significant barriers to cycling. This was exacerbated by aggressive driving and features as a regularly reported deterrent to cycling.

These barriers can be reduced by implementing neighbourhood speed limits of between 30km/h to 40km/h, road user education and improved bicycle infrastructure.

The perception of risk from cycle accidents is often disproportionate to the actual risk. However, perceptions of risk were found to decrease with cycling experience. Whilst acknowledging the legitimate concerns people have to bicycle riding, the evidence demonstrates that in Australia, per 100,000 participants, an individual is seven times more likely to be hospitalised playing football than riding a bicycle. Risk-benefit analyses consistently report that the health

benefits of cycling outweigh the risks by factors ranging from five to one, to 20 to one.

Another consistent feature in the literature is the robust finding that the more cyclists there are, the safer it becomes. In fact, if cycling doubles, the risk per kilometre falls by 34%.

3 Recommendations

This review has highlighted the need to overcome some significant barriers to further promote regular cycling among adult Australians. The following interventions are recommended to meet this challenge:

- **Mass marketing campaigns**
  To promote the multiple health, environmental, transport, economic and social inclusion benefits of cycling, and address perceived barriers such as safety, required fitness level and road user behaviour. These campaigns can be supported through the extensive network of cycling organisations around Australia and should be combined with bicycle infrastructure improvements.
- **Bicycle education programs**
  To increase confidence and skill levels in both the child and adult population.
- **Behaviour change programs**
  such as *TravelSmart*, *Ride to School* and *Ride to Work* programs: To help more Australian children and adults make the daily commute and other trips by pedal power.

If cycling participation doubles, the risk per kilometre falls by 34%.

- **Cycling events**
  To encourage infrequent and novice riders to cycle in a supportive social environment.
- **Urban design**
  To create a physical environment more conducive to cycling, such as higher density, mixed use development and shorter trip distances.
- **Improved bicycle infrastructure**
  To provide safe, attractive and enjoyable on and off road bicycle routes as well as high quality end of trip facilities. The health sector can provide a powerful advocacy voice for intersectoral action to provide supportive environments for cycling.
- **Funding**
  To better reflect the role and value of cycling in a range of areas including transport, health and sustainability, with support from all levels of government.

Australia currently faces a number of emerging health challenges, many of which are caused in part by increasingly sedentary lifestyles.

Cycling is an effective method of helping to reduce sedentary lifestyle diseases such as cardiovascular disease, obesity and diabetes. As Australians continue to lead increasingly busy lifestyles, cycling is in a unique position for its ability to enable people to integrate physical activity into everyday living. Active communities also have stronger social connections and improved liveability.

Cycling also offers a wide range of additional benefits when used as an alternative to the private automobile. Cycling is a carbon neutral, petrol free form of transport, simultaneously helping Australians fight climate change and reduce fuel costs. For peak hour journeys in particular, the bicycle can reduce congestion and increase the efficiency of the transport system.

Yet for all these important benefits to be realised, a number of challenges need to be overcome. The health sector can play a key role in promoting this popular, but under-utilised form of physical activity.

Cycling is a carbon neutral, petrol free form of transport, simultaneously helping Australians fight climate change and reduce fuel costs

Contents

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1.1 The importance of physical activity and cycling to health

Approximately half of all Australian adults are not meeting even the modest current national recommendations that:

> "every adult should accumulate half an hour of moderate-intensity physical activity on at least 5 days per week"
>
> **(Commonwealth Health National PA guidelines, 1999; United States Surgeon General, 1996; Haskell et al, 2007).**

This lack of physical activity is a major contributor to Australia's rising obesity levels.

Physical activity is an important part of overall health promotion and disease prevention. Physical inactivity ranks in the five leading risk factors of ill health, alongside tobacco use, obesity, high cholesterol levels and high blood pressure (Australian Institute of Health and Welfare, 2006). In fact, given the interaction between physical inactivity and the latter four risk factors, reducing inactivity may indeed be the most important thing we can do for our health and wellbeing (Morris, 1994). Overall health and well being, quality of life, and reduced risk of morbidity and mortality are all dimensions of the benefits for adults achieving at least moderate-intensity physical activity on most days of the week (Haskell, 2007; United States Surgeon General, 1996; Bauman, 2004). The specific disease prevention benefits of being active include reduced risk of cardiovascular disease, some cancers, reduced diabetes risk, improved mental health, and reduced risk of falls in the elderly (WHO, 2000).

Australia's obesity rate is among the highest in the OECD

Australian Institute of Health and Welfare, 2006

Beyond health specific benefits, it appears that physical activity is also linked to community well-being (Chau et al, 2007), social capital and community engagement. It has also been found to foster community participation in sport and recreation, encourage public transport usage, as well as promoting the use of community facilities, parks and recreational resources. Moreover, there are social, economic and environmental benefits to population level physical activity that go beyond the health benefits alone (Bauman, 2003). Being physically active has different benefits across the lifespan, from childhood participation in sports and games, through to maintaining functional status and social engagement among older adults. Among older adults, physical activity will allow more tasks to be undertaken for daily living, for longer, such that even the older age groups will have greater functional independence (Bauman, 2004).

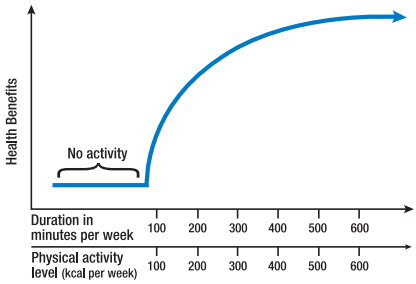


Figure 1 Schematic illustration depicting the relationships between physical activity and health benefit. Adapted from Bouchard, 2001

The overall relationship between physical activity and health is summarised in figure 1(top). This illustrates that the benefits of physical activity accrue most rapidly when moving from sedentarism to moderate levels of physical activity. Encouraging even short, but regular bicycle journeys is an effective means of achieving significant health gains.

It is now acknowledged in the literature that the health benefits of physical activity are cumulative (Department of Health and Aged Care, 1999, cited in Milligan et al, 2007). In practical terms, this means three 10 minute cycle trips still provide sufficient levels of physical activity to protect against sedentary lifestyle diseases (WHO, 2000). By contrast, public health researchers Frank et al (2004) have shown that each additional hour in a motor vehicle increases the chance of being obese by 6% - adjusting for socio-economic status.

There are a number of specific health and disease outcomes that are prevented by regular physical activity. The epidemiological evidence for each of the major health conditions prevented by physical activity is summarised in table 1 (see following page). As a form of moderate-vigorous physical activity, cycling can contribute to the multiple health benefits of physical activity.

Cycling also has a number of additional benefits:

- As a low-impact form of physical activity, it appeals to people who cannot participate in high-impact activities
- As a form of active transport and recreation, it enables many people to combine physical activity with transport and recreation
- There is also evidence that the public generally prefer unstructured forms of physical activity (Hahn & Craythorn, 1994, cited in Sallis et al, 1998) and cycling certainly fits into this category
- It appeals to people across the age spectrum, from childhood to adults
- The promotion of 'lifestyle' physical activity such as walking and cycling is more cost-effective than promotion of structured exercise programs
- As a form of active transport, cycling contributes to the additional benefits associated with reduced car use (improved air quality, reduced greenhouse gas emissions, reduced noise pollution, improved community liveability and social connectedness).

The promotion of moderate intensity physical activity has been described as todays 'best buy in public health'

Morris, 1994

In addition to the fact that cycling is beneficial to health, there is evidence that car commuting is associated with

negative health outcomes. Wennberg (2006) reported an independent and increased risk of myocardial infarction (heart attack) in those who reported prolonged car transit time (74% increased risk) compared to physically active commuters. Furthermore, a study in China examined the transition from active modes of transport (typically cycling rather than walking) to motorised transport. They found a two fold increase in the risks of obesity over an eight year follow up period, compared to those that continued to actively commute (Bell, 2001)[1].

> 'The main sources of health-enhancing physical activities encompass normal and simple activities such as walking, cycling…'
>
> **World Health Organisation, 2006, p.4**

The evidence reviewed in this report clearly points to the need for increased levels of physical activity, in order to combat the growing problems of obesity and diabetes, as well as other lifestyle diseases. Cycling is well suited to provide sufficient levels of physical activity to protect against the diseases of a sedentary lifestyle. It is able to do this at minimal cost to the individual and wider community and can act as a replacement for car journeys, especially for short trips and this has been shown to have additional health benefits.

Table 1 Potential Health Benefits of Cycling

Coronary Heart Disease	Physical activity reduces the risk of coronary heart disease by around 40%, compared to those that remain inactive. Cycling may be useful in angina and other aspects of coronary heart disease as well.
Stroke and Cerebro-vascular events	Physical activity reduces the risks of ischaemic stroke (insufficient blood supply to the brain)
High blood pressure (Hypertension)	Physical activity reduces blood pressure by 3-5 mm (both systolic and diastolic), with a greater effect seen from moderate intensity physical activity (more than for vigorous physical activity); this has been shown in serial meta analyses of the research base (Kelley et al, 2001a; Kelley & Kelley, 2001; Kelley et al, 2001b).
Cholesterol and Lipid levels	Physical activity lowers total cholesterol and improves the high density lipoprotein sub-fraction (protective component of cholesterol, in terms of cardiovascular risk)
Stress, Anxiety and Depression	Physical activity may contribute to improved well being, and reduces anxiety and depression symptoms
Overweight and Obesity	Physical activity has a role in population level obesity prevention, but here the recommendation is more than the 30 minutes per day; for weight maintenance or obesity prevention, populations need to expend more energy; around 60-90 minutes of moderate physical activity per day is required (Saris et al, 2003). This assumes that dietary intake remains constant.
Type 2 Diabetes	Physical activity reduces the risk of developing Type 2 Diabetes in those at risk, shown through several population based prevention trials; in epidemiological studies, physical activity reduces the incidence of diabetes. In clinical studies, physical activity improves glucose uptake and insulin metabolism, providing biological mechanisms for these benefits. Similar mechanisms reduce the risk of chronic liver disease, as well as obesity, high blood pressure and elevated cholesterol levels.
Falls prevention in the elderly	Physical activity strengthens muscles, and improves joint stability and balance, and this reduces the risk of falls and fractures in the elderly. Physical activity could prevent up to 16% of these falls (Stephenson & Bauman, 2000), and these injuries, through fractured hips and related conditions are a very common cause of hospital admission and morbidity among older adults.
Osteoporosis	Physical activity improves bone deposition during adolescence, resulting in stronger bones and reduced risk of osteoporosis later in life.
Colon and Breast Cancer	Physical activity reduces the risks of developing colon cancer by about 40% and the development of breast cancer, especially among post menopausal women. The amount of physical activity required may be 30-45 minutes daily, and moderate-vigorous activities are required. For cancer prevention, lifelong physical activity patterns may be important (whereas for other health benefits, recent physical activity participation is preventive). Other cancers, possibly prostate cancer, lung cancer and cancer of the uterus may also be prevented, in part, by physical activity, although the evidence is less clear here.

Source: Adapted from Bauman, 2004

[1] It may also be possible that those who transfer from bicycle to car travel have also experienced increased income. This may be a confounding factor, as it could be associated with increased dietary intake which may increase obesity levels. The authors did attempt to control for confounders measured in this study.

1.2 Cycling participation in Australia

Australians have shown a strong inherent interest in cycling. Figures from Bicycle Industries Australia (2006) have shown a rapid increase in bicycle sales, with over 1.4 million sold in 2007, outnumbering new car sales for the eighth consecutive year. The rise in the number of Australians purchasing bicycles has been accompanied by an increase in cycling participation.

An analysis of the Australian Sports Commission Exercise Recreation and Sport Survey (ERASS) reveals that cycling is Australia's fourth most popular physical activity for adults. Moreover, in terms of frequent participation, it is Australia's third most popular physical activity, as demonstrated in table 2 below.

Cycling is the third most popular physical activity in terms of regular participation
(Australian Sports Commission, 2006)

One of the strongest growth areas for cycling in recent years has been as a mode of transport to work (commuting). The latest Census data released by the ABS show Australian capital cities are experiencing an average increase of 22% between Census 2001 and 2006. Melbourne and Adelaide experienced the most rapid increase, at 42.57% and 31.25% respectively. It should be noted that the Census takes place in August, which is typically a less popular month for cycling than the warmer periods of the year.

This analysis of cycling participation in Australia demonstrates that Australians are both buying more bicycles than ever before and using them in increasing numbers. More Australians are using the bicycle to get to work and as a form of recreation, with the middle age groups reporting the highest participation levels.

The graph below presents the involvement of each adult age group in cycling – for both commuting and recreational purposes.

Table 3 Bicycle Journeys to Work 2001 & 2006

	2001 No. of individuals who cycled to work	2006 No. of individuals who cycled to work	% Change
Melbourne	14,443	20,592	42.57%
Adelaide	5,101	6,695	31.25%
Hobart	707	886	25.32%
Perth	6,218	7,240	16.44%
Canberra	3,505	4,062	15.89%
Brisbane	7,890	8,889	12.66%
Sydney	11,131	12,132	8.99%
Darwin	1,653	1,536	-7.08%

Source: ABS Census 2001 & 2006

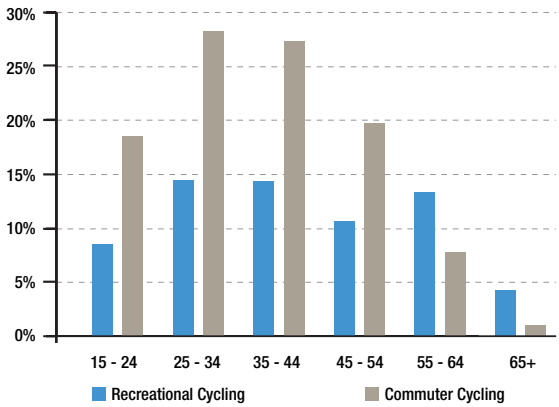


Figure 2
Participaton in Cycling by Age

Source: Australian Sports Commission 2005, ABS Census 2006.

Table 2 Most frequent exercise, recreation and sport activities in Australia, 2006

Activity	Number of participants	Participation Rate (%)	Number of participants with a frequency of more than 104 times per year
walking	6,001,700	36.2	3,615,900
aerobics	3,161,300	19.1	1,307,700
swimming	2,256,900	13.6	317,900
cycling	**1,682,800**	**10.1**	**417,400**
tennis	1,130,700	6.8	43,600
running	1,224,100	7.4	385,600
golf	1,132,000	6.8	84,400
bushwalking	774,000	4.4	79,500
football (outdoor)	697,400	4.2	74,000

Source: Australian Sport Commission, 2006

1.3 Economic benefits of cycling participation

It is well recognised that cycling offers considerable benefits to the individual, in terms of improved health, reduced transport expenses and lifestyle enhancements. Placing a value on current and potential cycling participation is challenging as there are a number of different methodologies used and the value varies depending on the profile of the person cycling in terms of their age and current physical activity levels and frequency and lengths of their cycling trips. Nevertheless, attempting to determine the value of cycling participation is important for policy formation and decision making.

Government and the wider community benefit from cycling in the following ways:

- Increased physical activity levels, with subsequent reductions in health care costs.
- Reduced cost of transport 'externalities'.

Externalities are the costs imposed on non-users or those not directly met by the user. These include air and noise pollution, road traffic injuries, congestion and climate change.

This report brings together different sources of evidence to quantify, in monetary terms, the value of current cycling participation.

Health Benefits of Leisure Cycling

The health benefits generated by cycling are drawn from the seven key medical conditions that are considered to have a strong causal relationship with physical inactivity.

According to a recent study (Econtech, 2007) the direct gross cost of physical inactivity to the Australian health budget in 2006/07 was $1.49 billion.

The value attributable to physical inactivity is based on an estimated prevalence of 54.2% of the population between 18 and 75 years of age classified as inactive.[2]

Based on this calculation, the cost of each inactive adult person to the health budget is $198.57 per year.[3]

THE COSTS OF INACTIVITY

Coronary Health Disease	$ 371.5 million
Stroke	$ 162.4 million
Type 2 diabetes	$ 210.7 million
Breast cancer	$ 42.2 million
Colon cancer	$ 61.4 million
Depression Symptoms	$ 177.3 million
Falls	$468.7 million
Total Gross Costs	**$ 1,494.4 million**

Source: Econtech, 2007

To gain health benefits from physical activity, participation has to be regular and of moderate intensity. These benefits are gained from both recreational and commuter cycling.

The benefits of recreational cycling have been simplified for this report to only include the positive health effects of physical activity.

In 2006, over 1.68 million Australians cycled for recreation and of those 417,400 cycled more than 104 times a year (ERASS, 2006). These individuals can be classified as meeting the levels of physical activity to protect against sedentary lifestyle diseases from cycling alone.[4]

Using the Econtech (2007) calculation, the savings to the health budget from regular recreational cycling in 2006 is estimated at $82.9 million.

Benefits of Commuter Cycling

The benefits of commuter cycling include both the positive impact on public health, as well as the reduction in the 'externalities' of transport, such as reduced air and noise pollution, congestion and climate change mitigation. It should be noted that a significant amount of additional transport-based cycling occurs (visiting friends, shops etc…), but are not collected by the Census and for reasons of consistency are not included in these calculations. According to the Australian Greenhouse Office (2006), around 66% of personal transport is for non-commuting purposes.

Commuter cycling offers an important opportunity for the Australian workforce to get much needed physical activity. Sports Medicine Australia (2007) found that the modern lifestyle can act as barrier to physical activity. Cycling to and from work helps to counter increasingly sedentary behaviours and the negative health outcomes associated with them.

The number of people who cycle to work in Australian cities has increased markedly between Census 2001 and 2006 (rising 22% on average).

The primary aim of this analysis is to estimate the value of the current bicycle commuting trips in Australia based on the 2006 Census.

Cyclists currently save the economy $63.9 million per year in reduced congestion costs and $72.1 million in reduced health costs.

Based on the information presented in tables 4 and 5, the economic benefit of commuter cycling is $144.3 million per year.

For additional information, including the assumptions upon which the above calculations are based, see Appendix 2.

Potential for improved road safety through the reduction in car use

Road trauma in Australia costs $17 billion a year. This is equal to 2.3% of Australia's gross domestic product (Centre of National Research on Disability and Rehabilitation Medicine, 2006). There is increasing evidence that higher levels of motor vehicle use increase the risk of road trauma. Strategies that provide non-motorised transport options are increasingly recognised as an effective road safety strategy (Litman & Fitzroy, 2005). In fact, policies aimed at reducing car use typically result in around a 10% reduction in vehicle kilometres travelled and this could cut road trauma costs by between $850 million and $1.7 billion per year (Victoria Transport Policy Institute, 2007).

The authors note that research on the economic benefits of current and future cycling participation is limited in Australia. Further research is required to gain a clearer understanding of these benefits, in order to inform public policy.

2 inactive is classified as not reaching the minimum level of physical activity levels recommended for health benefits which is 30 minutes of moderate physical activity levels over at least 5 sessions a week

3 Based on 2006 Census population aged between 18 to 75 years

4 According to a comprehensive survey (n+1,530) people cycling for recreation cycled an average 2.5 times a week and the average trip was 1hr 46 minutes (Garrard J., Crawford S., Hakman N., 2006)

Table 4 Bicycle Commuting Travel (Capital Cities)

	Bicycle Commuters (sole mode trips only)			Kilometres/Year		
	2001 Census	2006 Census	% Change	2001 Census	2006 Census	Change
Sydney	8,684	10,175	17.2%	30,394,000	35,612,500	5,218,500
Melbourne	12,179	18,047	48.2%	42,626,500	63,164,500	20,538,000
Brisbane	6,347	7,502	18.2%	22,214,500	26,257,000	4,042,500
Adelaide	4,376	6,085	39.1%	15,316,000	21,297,500	5,981,500
Perth	5,179	6,323	22.1%	18,126,500	22,130,500	4,004,000
Hobart	622	810	30.2%	2,177,000	2,835,000	658,000
Canberra	3,093	3,763	21.7%	10,825,500	13,170,500	2,345,000
Darwin	1,498	1,407	-6.1%	5,243,000	4,924,500	-318,500
TOTAL	41,978	54,112	28.9%	146,923,000	189,392,000	42,469,000

Source: ABS Census 2001 and 2006.

Table 5 Benefit Analysis of Commuter Cycling

Item	Value per km (2006)*	Total value (2006)*	Present Value (25 years @ 6% per annum*** discount rate)*
Externalities	$0.0599/car-km	$9.2 million	$127 million
Congestion	$0.125 - $0.666/car-km (peak)** $0.033 - $0.177/carkm (off-peak)** depending on city	$63.9 million	$909 million
Health and fitness	$0.376/cycle-km (mortality plus morbidity)	$71.2 million	$982 million
TOTAL Capital Cities	Benefit	$144.3 million	$1,527 million to $2,018 million

* Valued at resource costs (ie net of indirect taxes – GST and Fuel Excise)

** Subject to escalation of fuel cost component in line with progressive increase in real cost of petrol to $2/litre by 2016

*** Most jurisdictions use a higher discount rate that broadly reflects the market rate of interest. However, the market rate of interest includes inflation expectations that are specifically excluded from this assessment. The Australian Transport Commission (2006a) recommends using it as the long term government bond rate, which is currently around 6%.

For additional information, including the assumptions upon which the above calculations are based, see Appendix 2.

1.4 The Australian cycling sector

The Australian cycling sector is made up of an active and diverse range of recreation, advocacy and sporting organisations. In general, they have been very effective in providing cycling events and services to the Australian community for over three decades. For instance, between 1994 and 2004, Bicycle Victoria organised rides totalling 208,244 participants (Garrard et al, 2005). Promoting physical activity to this large group would be very costly for the health sector. These cycling organisations are constrained by a lack of resources to further promote cycling.

Strategically targeted funding from the health sector could result in substantial leveraged benefits to the community. Moreover, it would provide the opportunity to prioritise disadvantaged or under represented groups, as this is something largely outside of the cycling sector's current scope.

Local Bicycle User Groups (BUGs)

Australia has approximately 100 local BUGs which vary in size, focus and activities. They share a common desire to promote cycling and a commitment to develop a bicycle friendly Australia.

According to a survey undertaken on behalf of the Cycling Promotion Fund, BUGs have an estimated membership of around 20,000. The majority of members are between 25 and 55 years old and cycle for recreation and commuting. Some 60% of BUGs surveyed organise regular rides with the majority less than 30km long. Most BUGs are affiliated with their state cycling organisation and regular rides are promoted through websites and ride calendars. Some state cycling organisations offer ride leader training and insurance cover for BUGs. South Australia and NSW offer the most extensive BUG cycling calendar with regular rides most days of the week. The majority of rides are free and open to anyone, not just members.

Many BUGs also work with their local councils to provide input on bicycle plans and infrastructure and lobby councils and other agencies for better bicycle facilities.

Local BUGs provide valuable community based opportunities for people to ride and have a wealth of cycling knowledge to share

Local BUGs are run solely by volunteers and they provide an excellent grassroots service to members and the general community. They have a wealth of knowledge of local cycling facilities, are keen to share tips on cycling and provide valuable community based opportunities for people to ride regularly through social support and encouragement.

The survey highlighted that there is considerable potential to strengthen these valuable grassroots organisations by offering training, support and resources.

Table 6 State-based bicycle organisations

Organisation	Members	Services offered	Staff	Volunteers	Programs/Events
Bicycle Victoria	40,000	Information, resources, insurance, events, advocacy, consultancy services, bicycle parking	35	500	Cycling events, behaviour change programs (Ride2Work, Ride2School),
Bicycle NSW	10,000	Information, resources, insurance, events, advocacy, consultancy services, ride leadership training	10	100	Community cycling events, behaviour change programs (Ride2work, Ride2School), bicycle maintenance courses
Bicycle Queensland	5,000	Information, resources, insurance, events, advocacy, bike week, information sessions	5	120	Cycling events, women's ride, bike safety for kids, bicycle maintenance courses, leisure rides, film night, Ride2School challenge, Ride2Work and Ride2School
Bicycle South Australia	3,000	Information, resources, insurance, events, advocacy, bike hire scheme, bicycle maintenance	5	200	Cycling events, bicycle maintenance, skills training, Ride2Work and Ride2School, programs for disadvantaged kids
Bicycle Tasmania	250	Information, resources, insurance, advocacy	0	20	Cycling events and regular ride, Bike Week
Pedal Power (ACT)	1600	Information, resources, advocacy, insurance, skills courses	2	50	Cycling events, weekly recreational rides, primary school programs, Ride2Work, women training program
Bicycle Transport Alliance (WA)		Information, resources, insurance, advocacy	1	20	Bicycle maintenance and skills classes

Cycling Sporting Bodies

Cycling Australia

Cycling Australia is the peak body for the sport of cycling in Australia, with the aim of developing and promoting competitive cycling in Australia. Its main income is from the Australian Sports Commission and Australian Commonwealth and Olympic Games Grants and Athletes with disability grants.

Cycling Australia has affiliated state groups which together with local clubs have an overall membership of 12,000. There are 436 accredited coaches (most are volunteers). Cycling Australia and its affiliated organisations have expanded their regular competition program to include a recreation/skills/participation program which includes *Full Cycle, Skill Cycle* and *J Cycle* offering a pathway to competitive cycling. The regular competition events and skill programs are delivered through its state and local affiliated member groups.

Mountain Bike Australia (MTBA)

The objective of MTBA is to develop and promote mountain biking in Australia for the benefit and enjoyment of all members. MTBA has 4,200 members from 100 clubs around Australia and is affiliated with Cycling Australia. Clubs organise regular events and competitions and recorded 15,000 participants in 2006. Participation in mountain bike events has increased considerably, with some events attracting in excess of 1,000 riders. In 2006, clubs in Queensland attracted over 6,300 participants.

1.5 Current Australian interventions to encourage adult cycling

This section covers a range of current interventions used to promote and encourage cycling including education/cycling skills training, multifaceted community based programs, social marketing campaigns and cycling events. Interventions focused on creating supportive physical environments, policies and regulations are covered in section two of this report.

1.51 Cycling education and skills training

Intervention description

Lack of confidence and skills have been identified as barriers to cycling (discussed in Section 2.1), particularly for people who do not currently cycle. In response, a range of cycling education/skills training programs have been set up.

An evaluation undertaken by the Bicycle Federation of Australia on behalf of the Australian Greenhouse Office on Best Practice in Adult Cycling Proficiency Training (Bicycle Federation of Australia, 2006) indicated that Australia has a number of agencies currently offering cycling skills courses. This includes a broad range of stakeholders, such as non-government organisations, councils, cycling organisations, employers, bicycle retailers and independent training providers. Many target new and inexperienced riders. The survey highlighted that current cycling proficiency classes are effective in increasing skills and improving confidence but many lack formal evaluations, effective marketing and accreditation. Current availability was also found to be limited.

Population group/setting

Most cycling education programs are delivered in group settings either at a community level or in a workplace setting. Evidence suggests that more women participate in cycling education programs (Garrard et al, 2006).

Effectiveness

A recent review identified few rigorous evaluations of cycling skills programs for adults in Australia (Rissel & Garrard, 2006). Those that have been evaluated show that cycling education and skills training programs are effective in assisting people to gain the skills and confidence needed to cycle. An evaluation of a program run by the Health Promotion Unit of the Central Sydney Area Health Service resulted in 56% of participants cycling more often two months after the completion of the program. Interestingly, the follow up survey also showed an increase in other forms of physical activity by participants (Telfer at al, 2006).

Case Study

Cycling proficiency classes

In 2003 the Health Promotion Unit of the Central Sydney Area Health Service set up a pilot cycling proficiency training program for adults. The focus of the program was to provide practical skills and supervised training on bicycle paths and on-road. The aim of the intervention was to increase the number of people cycling, the frequency of cycling and the use of bicycles for transport. The program was designed for adults with low to moderate-level skills and confidence in cycling. From the 113 people starting the program, 72% completed at least one course and 93% took part in the pre-program and follow up interviews. Participants' satisfaction with all aspects of the course was very high and the course led to a significant increase in participants' self-reported skills and confidence in cycling (Telfer et al, 2006).

1.52 Community based programs

Intervention description

Community based cycling programs provide locally based interventions focussing on promoting cycling for health and/or transport. Programs offer information, incentives and/or the development of social networks (eg group recreational or training rides, buddy system for ride to work) that provide supportive structures to maintain behaviour change.

Population group/setting

Most community based cycling programs are delivered in a group setting at a community or workplace level. The *TravelSmart Communities* program (see below for further details) is an individualised social marketing program focusing on individual behaviour change.

Effectiveness

Many community based cycling programs have not been formally evaluated, but feedback from the organisations that run these programs indicate that they are effective in encouraging people to increase their physical activity levels through cycling.

The evaluation of the *Cycling 100* program (see below for further details) indicated that participants' physical work capacity improved, and cholesterol and coronary risk ratio decreased (Marshall, 2001).

In the town of Vincent in Western Australia, the *TravelSmart Communities* project achieved a 9% reduction in single occupant car use and an increase in cycling of 30%, with walking trips rising 22% and public transport up 11% (Social Data, 2005).

More details of these and related programs are provided in the case studies following.

Case Study

Bike Bus

Many non-commuter cyclists report a lack of confidence and awareness of bicycle friendly routes as major reasons for not riding to work. *Bike Bus* is an initiative aimed at addressing both these issues. Piloted in Sydney to encourage cycling for work journeys, each weekday morning, the 'bus' cycles a set timetabled route through Sydney's suburbs to the Central Business District. It picks people up along the way, in a similar manner to a regular bus.

Figure 3 The Bike Bus in Newtown, Sydney

Bike Bus has grown substantially, and there are now four routes. *Bike Bus* participants report a significant increase in their level of comfort, with each route designed to maximise the use of quieter streets. Riding in a group helps develop confidence, and provides support for those not experienced at riding in peak hour. The pilot program is funded in part by the Department of Environment and Water Resources and the Cycling Promotion Fund.

More information, including a YouTube Video of the *Bike Bus* in action can be found at http://www.bikebus.org.au/

Case Study

Cycle 100

In 2000/01 *Cycle 100* was developed with the objective of providing incentives for people to replace some of their car trips to work by bicycle, for health and environmental reasons. The trial program involved 100 people (average age 39 years) who lived between 10 to 15 km of their workplace. Participants were provided with a mountain bike equipped with lights, lock, cycle computer and helmet. As a result of the program, participants replaced over 12,000 kilometres of car commuting with cycling. The evaluation demonstrated that new riders gained significant health improvements as a result of the program (Marshall, 2001).

Figure 4 Cycle 100 participants

Photo: Public Transport Authority

In 2007 the Public Transport Authority in Western Australia adapted the *Cycle 100* program, to increase the level of physical activity of train drivers. Train drivers, due to the sedentary nature of their work, are at a higher risk of developing lifestyle diseases and this program focuses on integrating bicycle riding into their daily routine.

Participants agreeing to ride 60km each week for the duration of the 6-month program were provided with a free bicycle and accessories.

Cycle 100 proved very popular, with 160 participants signing up and 90% completing the program. Each participant underwent a medical examination before and after the program and the results showed significant improvements in both physiological and mental health. The program is intended to continue to provide benefits well beyond the 6-month period considered indicative of sustained behaviour change (Orleans, 2000).

Case Study

TravelSmart Communities

TravelSmart is an established program aimed at encouraging people to reduce the number of trips taken by car, and increase the number of trips using sustainable transport modes. This is done through the use of information and marketing tools focused on walking, cycling, public transport, car pooling and telecommuting.

TravelSmart directs its effort towards people with an identified willingness to consider ways of reducing their car use, as behaviour change programs have been shown to be more effective in populations already contemplating a change in their lifestyle (Milligan et al, 2007). *TravelSmart* has been operating since 2001 and has developed a comprehensive range of tools to assist individuals to make smarter travel choices. This can include personalised visits, targeted information packs, including public transport time-tables, cycle maps and bicycle maintenance/ riding skills classes. Programs are funded by all levels of government but currently reach only a very small proportion of the community.

1.53 Social Marketing

Intervention description

Coordinated social marketing campaigns are designed to motivate people to be more active through cycling, by raising awareness of the benefits of bicycle riding.

Population/Group setting

Large scale community wide campaigns with messages directed to a large audience through different types of media including television, radio, newspapers, mailings, and events.

Effectiveness

Messages highlighting health, fitness and family interaction are effective motivators in the promotion of cycling. Evaluation of the *Cycle Instead* campaign in Perth indicated that the majority of people exposed to the campaign correctly interpreted the main messages and for whom they were designed. The evaluation found significant increases in cycling behaviour, intentions to cycle and intentions to purchase a bicycle (Greig, 2001).

An additional evaluation of the *Cycle Instead* campaign indicated significant increases in the proportion of respondents who had cycled in the previous six months (29% vs 36%). This was backed up by bicycle counts, which recorded increases in cycling by up to 65% across the Perth Bicycle Network (ARRB, 2000). Further details of the *Cycle Instead* campaign are provided in the case study below.

Case Study

Cycle Instead campaign

The Western Australian Government developed a cycling promotion campaign, *Cycle Instead,* using a social marketing approach. Extensive research was undertaken prior to the development of the promotion strategy, through surveys and focus group discussions. This identified that the prime motivators that influence cycling are centred on the individual. While the campaign was promoting cycling as a mode of transport, it was clear that the most persuasive way of doing so was to promote the health and fitness aspects of cycling. Two 30 second television commercials were developed to reflect the main motivators of cycling - fitness for women, and spending time with children for men. These commercials were shown for four weeks with modest exposure levels (average 300 Target Audience Rating Points (TARPS) per week) and were run in conjunction with a range of supporting activities and media including; community events, *Cycle Instead* merchandise and a brochure about the benefits of cycling with frequently asked questions. Additionally a range of newspaper advertisements were developed, and bicycle retailers engaged to enable them to capitalise on the campaign.

1.54 Cycling Events

Intervention description

Cycling events provide a range of opportunities for people of most ages and fitness levels to be physically active. Australia offers a wide variety of cycling events from small community based events with less than 100 participants and short distances, to large more challenging events with more than 14,000 riders. Organisers of cycling events include bicycle recreation/advocacy organisations, charities, cycling clubs and private event operators. Most cycling events promote cycling as a healthy physical and/or sporting activity, while others such as *Ride 2 Work and Beyond* promote cycling as a practical and healthy transport option. Some event organisers provide people with interactive multimedia resources with training tips to enable them to improve their fitness and skills levels.

Population Groups/Setting

Cycling events attract people of all age groups and socio economic backgrounds (Godbold, 2005; Bowles et al, 2006; Cycling Promotion Fund, 2005). Event organisers are increasingly offering a range of distances to cater for a variety of fitness and skill levels. A small number of cycling events are for females only, to encourage more women to participate. The *Ride 2 Work and Beyond* program targets people travelling to work through workplaces.

Effectiveness

A number of evaluations have highlighted the effectiveness of cycling events in encouraging people to increase their physical activity levels through bicycle riding. *Ride 2 Work and Beyond* has become Australia's largest cycling event and has been effective not only in encouraging people to cycle on the day but also to maintain their behaviour after the event (Bicycle Victoria, 2007).

Recreational cycling events provide incentives for people to increase their physical activity levels in preparation for the event, and have also been effective in increasing participants' cycling participation after the event (Godbold, 2005; Bowles et al, 2006; Cycling Promotion Fund, 2005). Additionally, cycling events are also effective in encouraging social connections and team building with many events providing incentives for team entries, and a high proportion of participants citing social interaction as a motive for participation (Godbold, 2005).

Case Study

Ride to Work Day

Journeys to work are principally made by private motor vehicle in Australia (ABS, 2006b).

Riding to work is increasingly recognised as a healthy, sustainable and cost effective method of commuting.

Ride to Work Day commenced in Victoria in 1993. The first *National Ride to Work Day* was held on October 17th 2007 and attracted around 90,000 people, making it Australia's largest cycling event and one of the biggest work place events in the country.

RIDE TO WORK DAY - THE KEY FACTS

- Ride to Work Day has been running in Australia since 1993 (originating in Victoria)
- In 2007, there were 29,000 registered riders – up from 10,181 in 2006
- 26% of registered riders were riding to work for the first time
- Actual number of riders in 2007 was estimated at 90,000
- Participants have increased more than 5 fold since 2002.
- In 2007 there were almost 3000 registered workplaces
- In 2006, 63% of registered riders were men and 37% women.
- In 2006, for 25% of registered participants, it was the first time they had ridden to work that year. Over 60% said they usually travel to work by car.
- In both 2004 and 2006, 27% of first-time riders were still riding 5 months later.

Source Bicycle Victoria, 2006; Bicycle Victoria, 2007

In both 2004 and 2006, 27% of first time Ride to Work Day participants were still riding 5 months later

The *Ride to Work Day* event also recruits individual workplace coordinators to strengthen their capacity to provide ongoing support, information and incentives for colleagues. This helps to maintain the cycling to work after the *Ride to Work Day* event. This has been instrumental in ensuring that people maintain their behaviour in the long term.

See appendices 3 – 6 for more information on *Ride to Work Day*.

1.55

Recreational cycling events

Recreational cycling events have seen substantial increases in participation around Australia. The top 10 cycling participation events are organised by membership based cycling organisations and charities.

In 2007, 55,000 people took part in the top 10 cycling events around Australia (Table 7).

These cycling events are more than one-off events in terms of physical activity participation. Pre and post-event surveys indicate that participants increase their physical activity levels in preparation for the events. While activity levels may drop after the event, they remain above the levels reported by participants before they commenced training for the event (Godbold, 2005).

A number of interventions have been developed to increase cycling participation in Australia. These include efforts to increase bicycle riding knowledge and skills through the provision of cycling classes. In addition, the development of individualised and mass campaigns promoting the benefits of cycling have encouraged more people to take it up, as either a recreational or transport option (or both). Other programs focus on the provision of bicycles and/or the creation of a supportive social environment for cycling and this too has been successful in boosting cycling levels.

Table 7 Cycling events

Cycling Event	Organiser	Participants	Length
Great Victorian Bike Ride 2007	Bicycle Victoria	3,700	550 km 9 days
Cycle QLD 2007	Bicycle QLD	1,000	500 km 9 days
NSW Big Ride 2007	Bicycle NSW	1,000	500k m 9 days
Annual Tour 2007	Bicycle SA	200	500 km 9 days
Portfolio Partners Around the Bay in a Day 2007	Bicycle Victoria	14,000	50 km to 240 km 1 day
Wilson HTM Brisbane to the Gold Coast Cycle Challenge 2007	Bicycle QLD	5,700	100 km 1 day
Mutual Community Challenge 2007	Bicycle SA & SA Tourism	2,700	84 km to 128 km 1 day
City of Sydney Spring Cycle 2007	Bicycle NSW	8,500	5 km to 50 km 1 day
Freeway Bike Hike 2007	Asthma Foundation WA	7,015	10 km to 30 km 1 day
Portfolio Partners Sydney to the Gong Ride 2007	MS Society NSW	11,000	56 km & 90 km 1 day

Current barriers and facilitators to greater cycling participation by Australian adults

2

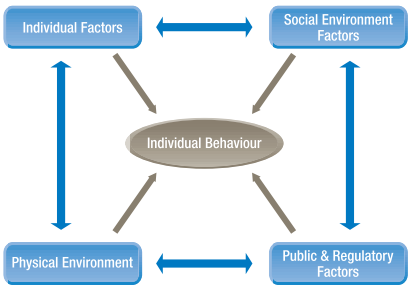
A general theme within this document is the need to create supportive environments for health. The *Ecological Model of Physical Activity* takes the view that environments can either support or restrict healthy behaviour. In this model, used to guide discussion in this section, individual, social/cultural, environmental, and policy factors all influence physical activity participation, often unintentionally (Sallis et al, 1998). Safety concerns have been added as an additional influence in this section, due to the strong effect it has on cycling participation. See figure 6 (right) for an overview of the Ecological Model of Physical Activity.

The reasonably high level of bicycle ownership but relatively low participation rate suggests strong interest, but the presence of a range of significant barriers[5]

Although cycling is an increasingly popular activity in Australia, a number of significant barriers need to be addressed before it can be adopted by a wider section of the Australian community. Women in particular are under-represented in Australia (see appendix 11) and there are some important barriers that prevent women from taking up cycling in a manner more representative of their proportion of the population and these will be discussed below. The various barriers and motivations discussed will differ, depending on each individual's circumstance. Non-riders may typically place a larger emphasis on personal factors and the physical environment, whereas regular riders might flag socio-political issues, such as the underlying basis of modal priorities (motorised over non motorised) as important factors (Daley et al, 2007).

Women represent half the Australian population but only 20% of commuter cyclists.

Figure 6 Ecological model of physical activity



It is particularly noteworthy that in countries such as the Netherlands, Germany and Denmark, bicycle riding is an inclusive activity, with a relatively even gender and age mix (see appendix 11 and 13). Children ride to school, adults, including the elderly make trips by bicycle and this helps them *build in* recommended levels of physical activity into their daily life, rather than having to make a special time for it.

The following section describes the evidence around barriers to cycling participation in Australia.

2.1 Individual factors

Health-related

Poor health is potentially a barrier to many forms of physical activity, including cycling. Around 10% of the population are physically unable to ride a regular bicycle due to disability (Rissel & Garrard, 2006) and this proportion grows with increasing age (Australian Institute for Health & Welfare, 2003).

Extensive research regarding the influences on physical activity has identified numerous individual factors that affect participation:

- confidence
- motivation
- knowledge, skills, beliefs and attitudes
- time and opportunity
- perceived benefits and barriers
- enjoyment

Confidence

Bandura (1997) demonstrated that confidence is a very important requirement in order for people to take up new activities such as cycling. This is supported by recent Western Australian research that found a lack of confidence features as a major reason for individuals choosing not to take up physical activities (Milligan et al, 2007). They found 34% of inactive adults described themselves as 'not at all confident' (p.46). Cycling is an activity that requires greater confidence than many other forms of physical activity – as it frequently involves interaction with motor vehicles and a variety of road surfaces.

OVERCOMING HEALTH-RELATED BARRIERS TO CYCLING

Some styles of pedalled vehicles (eg recumbents) are suitable for use by people with poor health or with a disability. Moreover, as a low-impact form of physical activity, cycling appeals to individuals who cannot participate in high impact activities. The 'need to swap to a low impact activity' was reported to be an 'important' or 'very important' reason for commencing cycling (Garrard et al, 2006).

Photo: Greenspeed

5 Australia's per capita sales of bicycles is one of the highest in the world (Bicycle Industries Australia 2005); a NSW survey indicated that 65% of people owning a bicycle wanted to ride more (Rissel C., New C., Pham S., Bindon J., 2008)

DEVELOPING THE SKILLS AND SUPPORT TO BEGIN CYCLING

Bicycle skills training is an effective way of boosting confidence for those new to cycling (Telfer et al, 2006). The Royal Society for the Prevention of Accidents (2001) found that cycle training increases individuals' propensity to cycle and reduces the chance of being involved in an accident (cited in Telfer et al, 2006).

Local Bicycle User Groups (BUGs) are able to provide social support for those looking to ride with others.

Motivations

A wide range of surveys have consistently found that motivations for cycling tend to be focused on the individual. Central to this is the desire to improve or maintain personal health and fitness (Garrard et al, 2006; Greig, 2007). In a large scale mass marketing campaign, pre intervention focus groups reported the desire to exercise four times more frequently than the next most common reason for choosing to cycle. Other motivations focused on the individual include stress reduction, social interaction and exercising with the family.

MASS MARKETING CYCLING

Mass marketing campaigns to encourage cycling should focus on the key motivations associated with cycling:

- Personal health and fitness
- Social interaction
- Cut fuel costs

They should also address the negative perceptions of cycling:

- cycling is too dangerous
- you need to be very fit
- it's only something you do if you cannot drive a car

Knowledge and Skills

The survey of 2403 cyclists by Garrard et al (2006) identified the following knowledge/skills barriers to greater levels of cycling:

- lack of knowledge of local cycling routes, the road rules that apply to cyclists, and the most appropriate bicycle to purchase.
- lack of cycling skill in regards to operating a bicycle, cycling in traffic, cycling in a group, and bicycle maintenance.
- concerns that you need to be fit to ride a bicycle, that the terrain needs to be flat, the weather fine, and the distance short (many of these perceptions and concerns are reduced with cycling experience).

Daley et al (2007) found that occasional riders studied in Sydney identified that a lack of knowledge about bicycle routes and basic mechanical issues was a deterrent to regular riding.

PROVIDE INFORMATION KITS ON CYCLING TO DEVELOP KNOWLEDGE AND SKILLS

Provide well publicised information packs on cycling that includes details of:

- recent bicycle route improvements in the local area
- cycle route maps
- the personal and community benefits of cycling
- bicycle skills training classes available
- a contact list of local, state and national cycling organisations
- cycle awareness tips for motorists (road safety)

Time and opportunities

Lack of time is a commonly reported constraint on all forms of physical activity, including cycling (Trost et al, 2002).

Perceived social norms

Rose's (1992) population-based theory of health improvement demonstrates that social and cultural norms shape individual behaviour, which in turn influences health risk factors and health outcomes at a population level. In Australia's car-oriented culture, the perceived norm is that most people think it is acceptable to always travel by car, regardless of distance (Hinde & Dixon, 2005; Woodward et al, 2002). This becomes normal, habitual behaviour that results in many short trips being undertaken by automobile. In Australian capital cities, 52% of car journeys are under 5km and 38% are under 3km (Austroads, 2005; RMIT, 1999). These distances are easily covered by bicycle.

The fitness image of cyclists, such as the wearing of lycra can act as a barrier to bicycle riding (Greig, 2001).

The evidence reviewed for this report demonstrates that there are a number of important individual factors that can act as a barrier to cycling. A lack of confidence, knowledge and riding skills have all been shown to reduce cycle participation. Interestingly, although a lack of time presents in the literature as a barrier to physical activity, cycling is in a unique position, in that it can be combined with transport, which means that in many cases, it can actually save time.

PROMOTE CYCLING AS A TIME SMART WAY OF GETTING AROUND AND STAYING HEALTHY

Develop a mass marketing campaign to highlight that cycling can be the perfect way for busy people to keep active, as it combines physical activity with transport and/or active recreation. In many cases it can be time equivalent to other transport modes and at times, the fastest way to get from A to B.

People frequently overestimate how long a trip takes by bicycle and underestimate the time required to undertake a journey by car (Tranter, 2004). As Australians try to fit more into their day, cycling offers an elegant solution for an increasingly time poor society by combining the need for transport and physical activity.

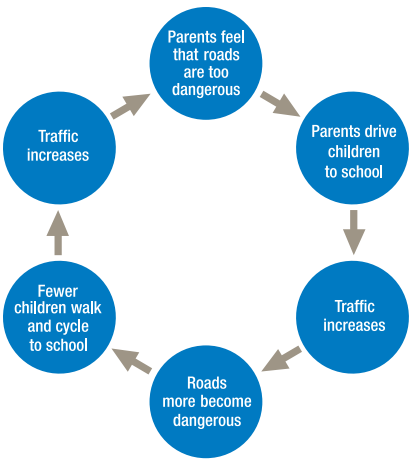
Many perceived physical barriers to cycling, such as poor weather and distance to destination are actually perceptual barriers that modify when people start riding (Rissel et al, 2002; Garrard et al, 2006).

In Australian capital cities, 52% of car journeys are under 5km and 38% are under 3km
(Austroads, 2005; RMIT, 1999)

2.2 Social and cultural factors

Cultural values and norms include systems of belief and codes of behaviour that shape the structure of society. These systems of belief, many of which are unstated or unconscious, influence behaviour in subtle ways. They can be difficult to identify, challenge or change. Nevertheless, successful public health strategies demonstrate that health enhancing changes in community attitudes are possible (eg tobacco control, drink-driving, bullying, and violence against women). This section describes some of the social and cultural factors that constrain cycling.

Figure 8 The effects of ever-increasing car use on walking and cycling to school



Source: Dora and Phillips, 2000

Socio-economic status and cycling

Lower socio-economic groups participate less in physical activity (Kavanagh et al, 2007; WHO, 2006; Dowler, 2001; World Health Organisation, 2004; Wardle & Steptoe, 2003; Coggins et al, 1999; Milligan et al, 2007).

Several studies have investigated the specific barriers experienced by low income groups to physical activity. The following factors were found to act as greater barriers to physical activity in low income areas than for higher income groups:

- Reduced access to supportive physical environments (Popkin et al, 2005; Estabrooks et al, 2003; Kavanagh, 2007).
- Lower financial capacity to pay for various activities (Sobal & Stunkard, 1989).

In a sample of 3361 adults from Western Australia, Milligan et al (2007) found obesity and inactivity were disproportionately high in those with low levels of education, the unemployed and the retired. Similarly, they found the propensity to undertake short walks or bicycle trips rather than car journeys increases with education level. The encouragement of cycling in populations of economic and educational disadvantage is therefore particularly pertinent. The promotion of more regular utilitarian cycling may help reduce the socio-economic differential in physical activity. A 'whole of community' childhood obesity prevention program in Colac, Victoria (*Be Active, Eat Well*) successfully reduced Body Mass Index relative to the control group. The program included a component on bicycle education and promotion, especially cycling to school. The results demonstrated a flattening of the gradient between socio-economic group and Body Mass Index (Sanigorski et al, 2007).

Recent evidence suggests that, in the US, 'lifestyle' physical activity (eg utilitarian walking and cycling) does not show the marked social gradient evident for leisure-time physical activity (Berrigan et al, 2006). Participation in cycling is a low cost activity and has the potential to actually save money if used to replace some car journeys (Tranter, 2004).

Social norms governing behaviour have tended to favour motorised travel over active transport, even for journeys short enough to be completed by bicycle. A paradoxical situation was found to exist whereby low income areas are less conducive to the most affordable and physically active forms of transport and recreation, such as cycling. Yet in comparison to other forms of physically active leisure, bicycle riding was found to display a more level social gradient. In order to allow Australians of all social and cultural backgrounds to live a healthy lifestyle, it is necessary to provide an environment supportive of cycling.

BRIDGING THE GAP – ENSURE CYCLING IS ENCOURAGED ACROSS THE SOCIO-ECONOMIC SPECTRUM

Develop bicycle friendly infrastructure initiatives in areas of low socio-economic areas to ensure they have the same level of access to cycling facilities as higher income groups.

Ensure new housing developments have cycle lanes integrated into their design from the planning stage.

2.3 Environmental factors

> The constructed environment… often seems intentionally designed by human beings to impose barriers to physical activity
>
> **Sallis et al, 1998, p. 381**

Environmental influences on physical activity, including cycling are well-documented. Community characteristics such as urban density, road and street design, housing type, accessibility to and connectivity of bicycle paths, lanes and trails, and location of community services all play a substantial role in promoting or discouraging cycling (Giles-Corti et al, 2005; Newman & Kenworthy, 1999; Handy, 2004). The following section on the physical environment's influence on cycling and health is divided into urban design and bicycle infrastructure, although it should be noted that there is considerable overlap.

2.31 Urban design

Public health researchers studying the link between environment and health have found that land-use mix has a strong association with obesity. Frank et al (2004) found in their study of over 10,000 people that each quartile increase in land use mix is associated with a 12.2% reduction in the likelihood of obesity across sex and ethnic groups.

There is growing evidence that low density neighbourhoods with poorly connected street networks affect how much time we spend walking, cycling and our ability to use public transport

(Research Australia, 2007, p. 15).

Professor Billie Giles-Corti of the University of Western Australia has demonstrated a clear link between the

quality of public space and levels of walking and cycling (Research Australia, 2007). Figure 9 (below) offers a good illustration of the sort of conditions that have been found to promote active transport, whilst figure 10 (below) is an example of poor amenity, which act as a barrier to active transport.

Photo: Elliot Fishman

Photo: Billie Giles-Corti, University of Western Australia

Low density development has been found to be a barrier to cycling, as it increases average journey distance and fosters a culture of car-dependence (WHO, 2006; Racioppi et al, 2005; Steele, 2007; Killoran, 2006; Handy, 2004; Giles-Corti et al, 2005).

> " We know there's a lot of evidence that people aren't healthy and aren't getting healthier and yet, up until recently, most of the focus was on health promotion campaigns focusing on the individual. There's no point telling people to cycle more if their environment is so unfriendly they can't"
>
> **Libby Darlison, Chair, NSW Premier's Council for Active Living**

CREATE AN URBAN ENVIRONMENT CONDUCIVE TO WALKING AND CYCLING

Encourage a diverse range of land use practices, by mixing residential, retail and office space. By boosting the density of urban areas and regional centres, trip distance can be reduced and this encourages active forms of transport.

Plan for active transport infrastructure in new suburbs – it is cheaper and more effective than retrofitting.

THE WHO EUROPEAN MINISTERIAL CONFERENCE ON COUNTERACTING OBESITY RECOMMENDED:

Removing barriers to physically active transport can be achieved, for example, by providing adequate infrastructure for cycling and walking, reducing speed limits in environments where vulnerable road users mix with motorised transport, reallocating space to cyclists and pedestrians and working with urban planners to ensure that services, jobs and amenities are situated within distances that can be conveniently covered on foot or by bicycle

Source: WHO, 2006, p. 22

A recent report commissioned by the Western Australian Government (Milligan et al, 2007) cited extensive research (Hill & Peters, 1998; French et al, 2001; Swinburn et al, 1999) demonstrating that 'obesogenic' environments are acting as barriers to physical activity, with corresponding increases in obesity.

This is supported by a major study of the effects of land use and transport policy in Atlanta, United States. The research team found that residents of suburbs with better active transport options drive less, are more physically active and less likely to be overweight or obese (Frank et al, 2007). Importantly, these results take into account self-selection. Self-selection relates to the possibility that the residents with a predisposition to physical activity chose to live in a particular area because it had good active transport options. Self-selection was taken into account by investigating the behaviours of people that did not live in their preferred neighbourhood type. Frank et al (2007) found that the residents with the most favourable environment for walking and cycling were 2.4 times as likely to undertake the 30 minutes of physical activity suggested by the United States Surgeon General (1996). In fact, the youth surveyed living within a kilometre of a recreational space, such as a bicycle path, or a retail destination were around 2.5 times more likely to report undertaking active transport (walking or cycling).

It should be noted that in many of these studies walking is more frequently undertaken than cycling and that walkability is the more commonly assessed item (rather than bikeability). Finally, the number of cars per household was found to be inversely proportional to physical activity levels.

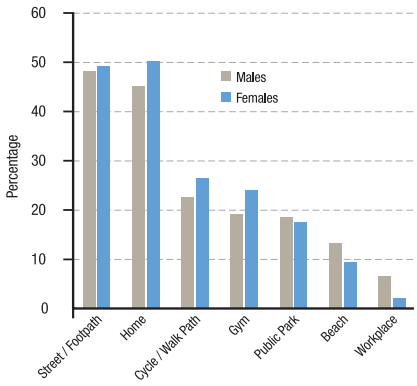


Figure 11 Public space is where most physical activity occurs for both sexes

Source: Milligan et al, 2007

To assess the influence of the physical environment on cycle participation, Pucher & Buehler (2006) examined why it is that Canadians ride to work three times more frequently than residents of the United States. They found that Canada's higher density and land use mix reduces trip distance (and superior bicycle infrastructure) encourages cycling. The cost of car ownership and usage is also higher in Canada and this was found to encourage active forms of transport. Canada's cooler climate was a less important determinant of cycling. Another Canadian study found that the development of a comprehensive and connected network of local roads and pathways encourages a higher level of commuter cycling (Aultman-Hall et al, 1997).

End-of-trip facilities

End of trip facilities, as their name suggests, refer to the provision of facilities designed to improve cyclists amenity at their destination. Secure bicycle parking is a basic minimum and may include the following additional facilities:

- Showers
- Lockers
- Change rooms
- Laundry facilities
- Bicycle repair

PROVIDE END OF TRIP FACILITIES FOR CYCLISTS

Encourage the introduction of legislation to require developments to include end of trip facilities for cyclists. See appendix 12 for further information.

CASE STUDY – BRISBANE CITY COUNCIL

Brisbane City Council has recently developed purpose built, high quality end-of-trip facilities for their staff. As the pictures below illustrate, the council has gone beyond simply providing bicycle parking; they also feature showers, lockers and ironing facilities.

Figure 12 Staff Bicycle Parking

Figure 13 Ironing facilities provided for cyclists

Figure 14 Secure bicycle parking outside a transport hub in Brisbane

The development of first class end of trip facilities at Brisbane City Council offers a very good demonstration of the importance of end of trip facilities in encouraging bicycle commuting. Prior to the development of the new facilities, Council provided 100 basic bicycle parking spots. The new facility accommodates 150 bike spaces and 200 lockers. The new facility reached capacity within a few months of opening and there is now a waiting list.

Photos: Courtesy of Brisbane City Council

A lack of end of trip facilities has been highlighted as a significant barrier to cycling, especially for journeys to work (Mellifont, 2001) and this finding was supported by a qualitative analysis of the needs of cyclists, using a sample of riders and non-riders (Daley et al, 2007). Conversely, the provision of workplace car parking has been found to decrease the likelihood of commuting by bicycle (Mobilität in der Schweiz, 2001, cited in WHO, 2006).

2.32 Bicycle infrastructure

A lack of bicycle infrastructure is regularly reported to be a major barrier to increase cycling participation in Australia (Garrard et al, 2006; Daley et al, 2007).

> The lack of infrastructure for bikes is a barrier. That's a fear, being injured if I got on a bike
>
> **(Non-rider, female, cited in Daley et al, 2007, p. 4).**

To assess the influence of bicycle infrastructure on the level of cycling participation, researchers have investigated the association between the number of kilometres of bicycle paths per 100,000 residents and the proportion of bicycle commuters. The study found that low levels of bicycle infrastructure have a negative impact on levels of bicycle use (Nelson & Allen, 1997). Importantly, this relationship remained after adjusting for weather, terrain and the number of university students. Their results are supported by the case study on page 16 which shows that increasing the length of the Maylands bicycle path in Western Australia contributed considerably to the increased volume of cycle trips made.

Figure 17 Many Australian roads lack bicycle infrastructure

This Australian data is consistent with the international findings on the relationship between the availability of active transport infrastructure, and the community's participation in cycling. Milligan et al (2007), after surveying over 3000 Western Australian adults on physical activity found that there is a strong and growing demand for walking and cycling paths and that when bicycle facilities are provided, they are used increasingly for the combined purposes of transport and exercise. They concluded that '*public infrastructure is important for providing opportunities to facilitate regular physical activity participation*' (p. 59). They found that the majority of physical activity occurs in public areas such as streets, footpaths and shared paths. Boosting the level of active transport infrastructure is therefore likely to bring about increases in physical activity levels and public health.

> "…it is imperative that new suburbs are planned with active transport in mind, so that bike routes are laid down when the streets and sewers are mapped out"
>
> **Senator Penny Wong**
> **Minister for Climate Change and Water**

Busy roads have also been found to act as a significant barrier to cycling, especially for women (Garrard et al, 2006). The overwhelming majority of commuter arterials lack adequate provision for cyclists and this is likely to explain part of the reason why bicycle journeys to work make up around 1 – 2% of commute trips and only 21% of these are female cyclists (ABS, 2007a).

BICYCLE INFRASTRUCTURE PROVISION IS ESSENTIAL

Ensure that street design encourages rather than discourages bicycle use through the provision of on road bicycle lanes.

Provide numerous off road options for those uncomfortable riding on the road.

Target bicycle route development around high demand locations such as schools, shops, community facilities and public transport nodes.

In countries with high bicycle transport mode share, cycling is a socially inclusive activity (Pucher & Dijkstra, 2003; Pucher & Buehler, 2008).

Garrard et al (2006) found that female cyclists often choose routes that separate them from traffic, even if it may result in longer journeys. This is testament to the notion that motor vehicle traffic is a significant barrier to cycling. International studies indicate a strong inverse relationship between bicycle mode share and female participation in cycling (Pucher & Buehler, 2008), suggesting that female participation in cycling may be an indicator of a cycling friendly environment. Consequently, *any measures that increase female participation in cycling may have a flow-on effect for other groups (eg more risk-averse males, children, older Australians)*.

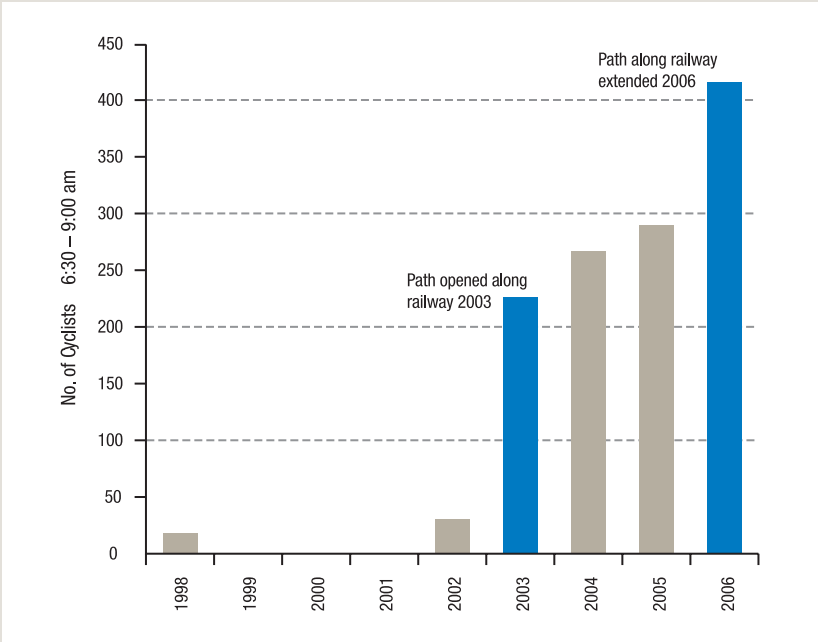
For instance, in the 2005 online survey of 2403 cyclists in Victoria, the majority of respondents who cycled for transport used roads with no bicycle facilities (83 per cent of females and 87 per cent of males) but only 6 per cent of females and 12 per cent of males actually preferred this option (Garrard et al, 2006).

CASE STUDY – EAST PERTH TO MAYLANDS PRINCIPAL SHARED PATH

The East Perth to Maylands Principal Shared Path offers a good example of the influence of high quality bicycle infrastructure on usage.

The below graph illustrates the substantial increase in cycling coinciding with the years in which improvements had been made to the bicycle route. The figures below reinforce the influence improvements in bicycle infrastructure have on participation (Ker, 2004; Cornwell & Barker, 2007):

- 708 extra cyclists used the route each weekday, of which only 102 were transferred from other routes
- 206,500 extra cycle trips per year
- A 50% increase in usage was recorded when the path was extended 2km
- Cost benefit ratio found to be 3.3:1.



Source: Ker, 2004; Cornwell & Barker, 2007.

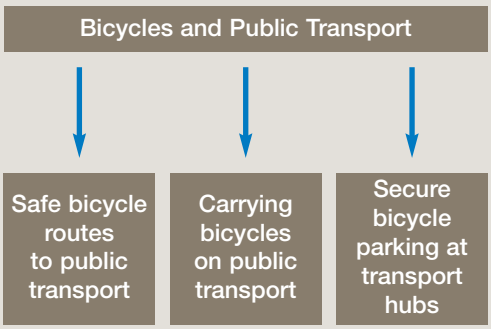
OVERCOMING BARRIERS TO CYCLING WITH TRAVEL DEMAND MANAGEMENT

Travel Demand Management refers to techniques aimed at reducing the need for car use and making alternative forms of transport more attractive. This can take a number of forms and the following outlines a few examples:

- Restricting motor vehicle access in city centres and creating a pedestrian and bicycle friendly inner core.
- Raising money through higher car parking charges and investing the revenue in pedestrian and bicycle facilities as well as improved public transport. Melbourne currently operates such a scheme.
- Congestion Charging: Since 2003, London has been charging cars for entering the inner city. This has resulted in less traffic congestion and a 43% rise in bicycle journeys. Revenue is invested in the public transport system and this has resulted in a large jump in passenger boardings and improved travel time (Transport for London, 2007).

It is important to stress that the 'stick' approach should be balanced with 'carrots' to ensure that a wide range of mobility options are offered. When used in the right balance, they provide a win-win as they improve the traffic environment for those that need to drive, whilst promoting a range of healthier, sustainable travel options for others in the community (Litman, 2007).

How to encourage better integration of bicycles with public transport



BICYCLES AND PUBLIC TRANSPORT

The combination of cycling and public transport offers the opportunity to cover distances not comfortably achieved by bicycle alone. In countries that have maximised opportunities for bicycling, such as the Netherlands, 38.6% of train trips involve a bicycle ride to the station (Cycle Council of the Netherlands, 2007).

The three key areas to encourage more people to integrate bicycle and public transport travel are:

- **Safe Bicycle Routes to Public Transport Hubs:** This is the essential first step required to enable more people to feel safe and comfortable when riding to the station/stop. Appendix 16 illustrates how an integrated network of bicycle routes leading to train stations can increase the catchment area of public transport hubs.
- **Secure Bicycle Parking:** Once passengers have cycled to the station, they will require a secure place to lock their bicycle – as it will typically be left unattended for a large portion of the day.
- **Taking bicycles on public transport:** Providing the opportunity for people to take their bicycles on public transport allows people to ride both to and from their public transport journey. This has proven to boost the attractiveness of each of these modes of transport, as demonstrated by a comprehensive review of current programs throughout the United States (Federal Transit Administration, 2005).

See appendix 17 for information on the opportunities available for carry bicycles on public transport.

THE NETHERLANDS MODEL FOR BICYCLE INFRASTRUCTURE

The pictures below demonstrate how well the Netherlands' efforts in providing safe bicycle routes to train stations and bicycle parking have been embraced.

Multi level bicycle parking outside a train station, Amsterdam

Photo: Ministry of Transport, Public Works and Water Management, The Netherlands 2007

Bicycle parking outside Groningen train station, The Netherlands

Photo: Elliot Fishman

The heavy demand for bicycle parking at train stations is not limited to major centres such as Amsterdam. Even regional centres have successfully fostered a culture of riding to the train station, as illustrated in the second photograph.

THE WESTERN AUSTRALIA EXPERIENCE WITH PUBLIC TRANSPORT CATCHMENT AREAS

A study on Perth's Northern Suburbs Transit System has found that 30-55% of those driving to the station live within 3km (Department for Planning and Infrastructure, unpublished).

At another station, with a relatively narrow catchment in an older developed area, nearly half the cars in the *Park and Ride* facility are registered at addresses within 800 metres of the station (Jim Krynen, Western Australian Public Transport Authority).

This pattern of vehicle usage reinforces the potential of cycling to replace short distance car trips to public transport facilities like railway stations.

2.4 Safety

Safety concerns are a significant and consistently reported barrier to cycling and this is true for non-riders, infrequent and even regular riders (Daley et al, 2007; Greig, 2007). This section discusses the issue of safety as a barrier to cycling and offers evidence based facilitators to help overcome these concerns.

Daley et al (2007) conducted a series of focus groups with riders and non riders in Sydney and found that fear was a significant and frequently reported theme when investigating barriers to initiating or maintaining regular riding. They also found that *'Cycling's dangerous image prevented many non-riders from contemplating riding'* (p. 4).

Hostile Road Behaviour

In a telephone survey of a random sample of 1880 adult Australians in 2004 by the Australian Associated Motor Insurers, a high proportion of respondents agreed or strongly agreed that "Aggressive drivers put me off cycling or walking" (46% of women and 38% of men) (Australian Associated Motor Insurers, 2004). Moreover, 66% of respondents in the 2005 survey of 2403 cyclists in Victoria reported experiencing intentional harassment from motor vehicle occupants in the previous 12 months (Garrard et al, 2006). The rate of cyclist harassment was an average of 24 incidents every 12 months (approx once a fortnight). These disturbing results are supported by a smaller survey of cyclists in South Australia (Brisco, 2006). Further evidence of road user behaviour acting as a barrier to cycling can be found in appendix 14.

Only one in five drivers knew that it was legal for cyclists to ride two abreast, 44% that cyclists were allowed to ride along a clearway, and 63% that cyclists were allowed to occupy a whole lane (Rissel et al, 2002).

The Transport Research Laboratory in the United Kingdom investigated driver's attitudes to cyclists, using both qualitative and quantitative methods. They found drivers often have a negative attitude to cyclists and see them as an 'out group'. This view was found to result in many cyclists experiencing aggressive and dangerous behaviours from motorists. Drivers were more annoyed by cyclists

In Australia, you are seven times more likely to be hospitalised playing football than riding a bike
(Flood and Harrison, 2006)

(30%) than by other drivers (13%), which the authors attributed to a consistent pattern of regarding *"the behaviour of 'out-group' members more negatively than the behaviour of 'in-group' members"* (Basford et al, 2002).

Speed

The evidence linking excessive speed and heightened road traffic danger could not be clearer (Whitelegg, 2006) and this is illustrated in the table below by the World Health Organisation:

DRIVING AT 64KM/H IS 17 TIMES MORE DANGEROUS THAN 32KM/H

Speed	Pedestrian Fatality Rate
32km/h	5%
48km/h	45%
64km/h	85%

Source: Dora, 1999

The table above shows a clear correlation of the impact vehicle speed has on the likelihood of pedestrian fatality. Cyclists, as a similarly vulnerable road user, can expect similar fatality rates. Killoran et al (2006), in their report *Transport interventions: Evidence briefing*, for the United Kingdom's National Health Service found clear evidence that speed reductions significantly increase safety levels and peoples' propensity to walk and cycle.

The combination of speed, volume of traffic and a lack of designated space for people to ride has been found to

KEY FINDINGS FROM THE 2006 AAMI CRASH INDEX

- **Most Australian drivers (88%)** exceed the speed limit at least some of the time
- **More than one third of Australians (36%)** sometimes speed to arrive at work or home sooner
- **Four in ten drivers (42%)** admit to having driven when over the legal drink-drive limit
- **One in ten drivers (10%)** say it is OK for them to drink and drive after a few drinks so long as they feel capable

be a most significant barrier to cycling (Daley et al, 2007; Garrard et al, 2006). It is often exacerbated by aggressive driving and this has been consistently identified as a major deterrent to regular cycling, as has the general lack of bicycle infrastructure (Greig, 2001).

Speed control in Australian cities and neighbourhoods is poor, with 50km/h acting as a standard, compared to 20/30 km/hr in many European cities (Whitelegg, 2006; Pucher 2006).

A review of the literature finds that the perception of bicycling as a high risk activity, due to possible collision with motor vehicles deters many potential cyclists (Garrard et al, 2006). Although it is necessary to acknowledge the legitimate concern of cyclists and non-cyclists, the data on road traffic injury presents strong evidence that riding may not be as hazardous as commonly perceived. In Australia, you are seven times more likely to be hospitalized playing football than riding a bike (Flood and Harrison, 2006).

Research conducted by the British Medical Association found that the health risks of inactivity are 20 times greater than the health risks posed by a potential cycling accident (British Medical Association, 1992).

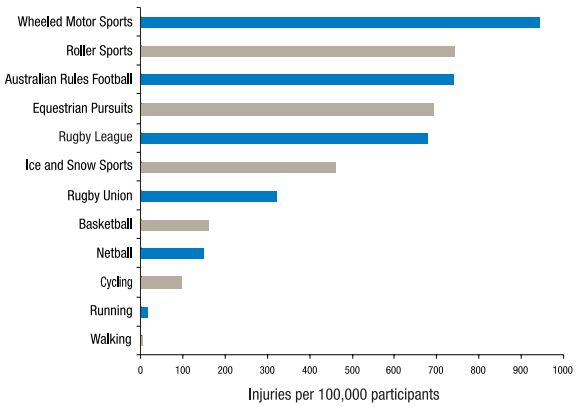
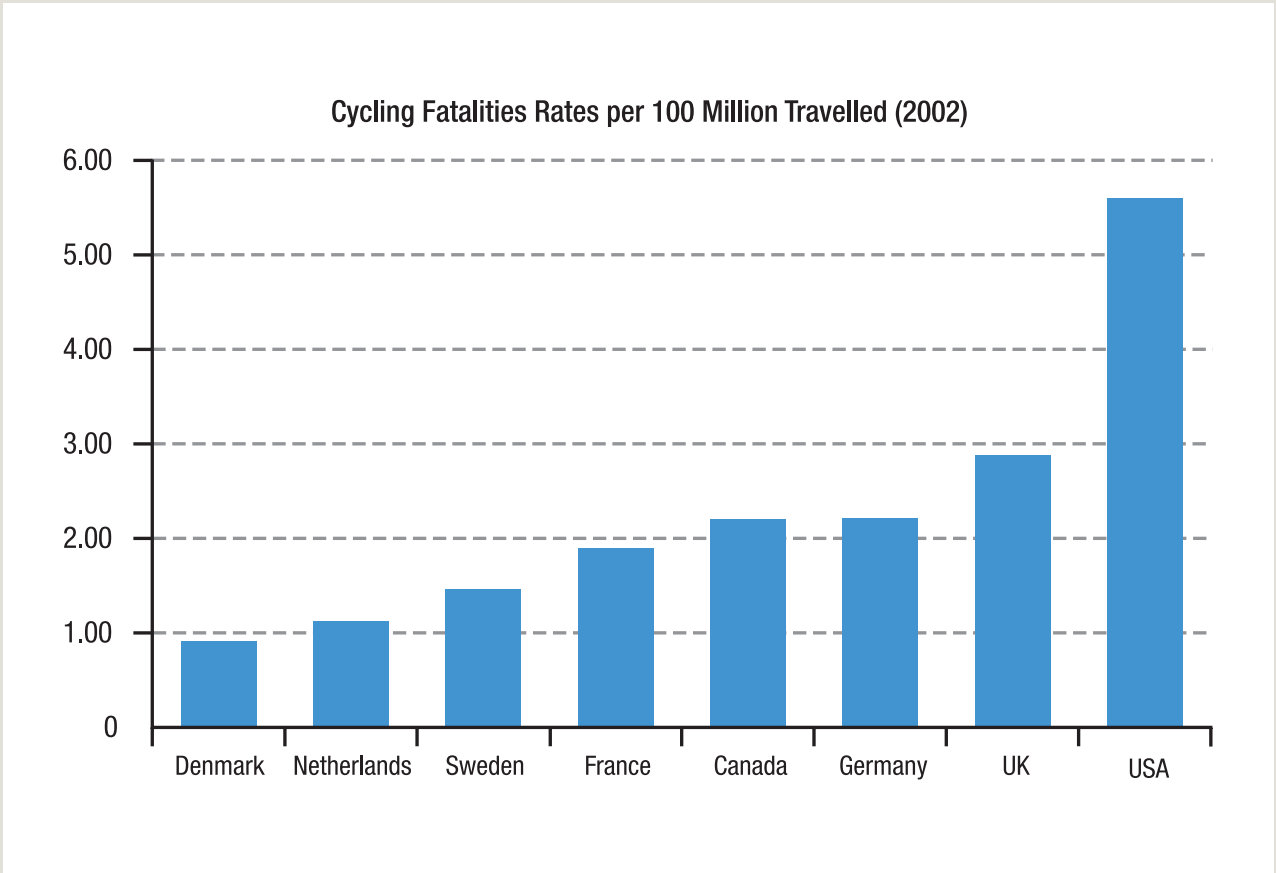


Figure 12
Cycling is Safer

THE MORE CYCLISTS THERE ARE, THE SAFER IT BECOMES



Source: (Organisation for Economic Cooperation and Development (2005), European Union (2003), US Department of Transportation (2003 & 2005) citied in Pucher, 2006)

The graph illustrates that countries with high cycling use have much lower cycling fatalities. The notion that, as the proportion of cycling trips increases so does safety, is also supported by Jocobson (2003) and Robinson (2005)–the latter investigated this relationship in the Australian context. Both authors found that increasing the number of cyclists on the road is an effective strategy to improve road safety. In fact, their investigation of transport injury and bicycle usage data allowed them to conclude "*If cycling doubles, the risk per kilometre falls 34%*" (cited in Robinson, 2005, p. 48). Numerous other authors have found that as the number of cyclists increase, the number of accidents dramatically reduces on a per kilometre basis (Litman & Fitzroy, 2005; Birk & Geller, 2007; Pucher & Dijkstra, 2003). For instance, cycling in London has increased 83% over the last 6 years, yet the number of serious crashes involving cyclists has fallen proportionally by 28% (Greater London Authority, 2007). The more cyclists there are, the more visible they will be to other road users, as people will be expecting to see cyclists. It is also more likely that car drivers will, themselves, ride a bike at some time – car drivers who also ride a bike are more likely to be aware of and respect the rights of cyclists (Transport Western Australia, 1996). See appendix 14 for additional information.

Research has shown that the more often you cycle, the safer it is. In fact, by riding twice a week instead of once a week, the chance of an accident halves, due to training and increased awareness of cars (Transport Western Australia, 1996).

The United Kingdom's Social Exclusion Unit found that roads with heavy motor vehicle traffic act as a barrier to walking and cycling (2003). This barrier can be ameliorated by placing restrictions on heavy vehicle traffic on roads that form part of a bicycle network.

A recent review by the World Health Organisation on the literature examining the effect of the road traffic environment on cycle and pedestrian safety found that area wide traffic calming significantly reduce road traffic injury (Bunn et al, 2003, cited in Killoran et al, 2006).

If cycling participation doubles, the risk per kilometre falls by 34%.

SOME KEY POINTS:

- The more cyclists there are, the safer it becomes.
- Motorists behaviour largely controls the likelihood of collisions with people walking and cycling.
- Comparison of pedestrian and cyclist collision frequencies between communities and over time periods need to reflect the amount of walking and bicycling.
- Efforts to enhance pedestrian and cyclist safety, including traffic engineering and legal policies, need to be examined for their ability to modify motorist behavior.
- Policies that increase walking and cycling appear to be an effective route to improving road safety.

(Jacobson, 2003)

2.5 Policy and regulation

Public health is affected by a range of factors not generally considered related to the health sector. As described above, transport and land use policies can have powerful influences on public health, in either a positive or negative direction.

Sallis et al (1998) in their paper *Environmental and Policy Interventions to Promote Physical Activity* noted that much of the available evidence suggests that many of the interventions necessary to increase physical activity will need to be funded outside the health sector. An acknowledgement by public health experts, including the World Health Organisation that the transport sector has an extremely important role to play in the creation of a physically active community (Dora, 1999) is an important precursor to the development of a transport system that works for rather than against the public's health.

A comprehensive review of the evidence supporting cycling by the National Institute for Health and Clinical Excellence in the United Kingdom recommended that 'Transport policies should be subject to more systematic use of health impact assessments' (Killoran et al, 2006, p. 5). It is essential that such health impact assessments be conducted on all major transport projects. The assessment would include impacts on road safety, noise and air pollution, liveability, and sedentary lifestyle disease. Importantly, it would also assess the project's impact on climate change, as it has now been established that climate change has profound public health implications (Research Australia, 2007).

INVISIBLE INFRASTRUCTURE

Physical bicycle infrastructure, such as bike lanes, signage, ramps etc are traditional, straight-forward strategies used to encourage cycling. Whilst these initiatives are evidence-based methods of encouraging cycling, there are additional solutions that do not directly involve the development of bicycle specific infrastructure. These initiatives have nevertheless proven to be an efficient method of improving bicycle friendliness and participation. 'Invisible Infrastructure' (Sully, 2005) focuses on regulatory and design features that are not directly bike-orientated. Examples include speed restrictions and traffic calming.

Sully (2005) argues that such policies, practices and physical measures encourage a modal shift in favour of cycling without a significant financial investment in cycle-specific infrastructure. An important advantage of invisible infrastructure is that it provides a range of additional benefits – not simply for cyclists, but for the community as a whole. For instance, speed restrictions have been shown to increase both the perceived and actual level of safety – for all road users (Dora, 1999; Hillman et al, 1991).

The effectiveness of invisible infrastructure is demonstrated in Hilden, Germany, which experienced a significant increase in cycling through the implementation of wide spread speed restrictions. Residents of Hilden report improved perceptions of safety as a principal reason for cycling more (King, 2005).

PRESCRIBING CYCLING

The World Health Organisation (2006) recommends that health professionals can play a lead role in the promotion of physical activity. Their role is unique in that they have a particular advantage at targeting those that stand to benefit the most from the activity, namely, physically under active groups. Moreover, they are an important and respected source of health information (Milligan et al, 2007). Encouraging GP's to effectively convey the importance of physical activity to appropriate patients is an under-utilised method of reducing sedentary lifestyle disease. Specifically, the World Health Organisation recommends:

- Increasing the level of eduction offered to health professionals during training on the importance of bicycle riding as preventative medicine.
- Providing financial motivation for health professionals prescribing physical activity.
- Encouraging the health sector to lead by example; encouraging active travel to/from health institutions.

A number of researchers in the field of physical activity promotion at a population level have suggested incentive based programs may be effective at boosting physical activity. According to Sallis et al (1998), providing discounts on health insurance for people that ride to work for instance may hold promise.

Western Australia's Premiers Council on Physical Activity (Milligan et al (2007) found that only 18% of overweight patients had received GP advice on physical activity, as demonstrated in appendix 9.

Recommendations to increase adult cycle participation

3

Physical inactivity and the resulting lifestyle diseases are reducing Australia's health status and quality of life.

> "We…have created an environment that makes it very convenient for people to be inactive, and subsequently develop unhealthy behaviours. The only way to combat this is to make it equally convenient for people to become active, and moreover, easier for them to inherit a better quality of life".
>
> **Libby Darlison,**
> **Chair, Premiers Council on Active Living, NSW.**

Boosting the level of bicycle riding offers significant opportunities to reverse the emerging trend of decreasing activity levels and spiralling rates of obesity and diabetes.

The following policy interventions are designed to respond directly to the barriers to cycling outlined earlier and are based on the best available, most domestically relevant evidence.

As previously highlighted, researchers have consistently found that a lack of time is one of the most frequently cited reasons for not participating in physical activity. Cycling, as a form of transport and active recreation, overcomes this issue, as individuals' health, transport and recreation needs are combined into the same activity – thereby saving time!

The World Health Organisation has established that a wide range of interventions, at a population-wide and individual level are required to boost levels of physical activity (WHO, 2006). Professor Boyd Swinburn has demonstrated the importance of comprehensive and long-term approaches to tackling such issues as obesity (Swinburn & Egger, 1996). It is for this reason that it is important to provide both a supportive physical environment for cycling and encouragement programs and events. It is this combination of the 'hard' and 'soft' infrastructure that offers the most effective strategy.

Cycling is certainly the healthy choice. Now we need to make it the easy choice

A significant body of evidence now exists to demonstrate that many public health issues have been successfully tackled with a population-wide approach; tobacco control and seatbelt wearing are good examples. Policy interventions to encourage physical activity using similar population wide measures are likely to be successful. This includes political support, appropriate funding and whole-of-government strategies (WHO, 2006). These policies must translate into an on the ground reality that makes the healthy choice the easy choice. Cycling is certainly the healthy choice. Making it the easy choice is the focus of this report's recommendations.

Recommendation 1

Mass marketing campaign

This report recommends that a national mass marketing campaign be developed to address perceived barriers to cycling. Key messages likely to be successful include:

- Cycling is safer than you think
- You don't need to be super fit to cycle
- Improve road user behaviour/safety/awareness of cyclists
- Benefits of choosing to cycle; health improvements, greenhouse gas and petrol savings, relief from congestion and parking problems.

It is important to ensure that mass marketing is done in coordination with infrastructural improvements to ensure new cyclists are not deterred from the experience.

Recommendation 2

Bicycle education programs

This report recommends that a national bicycle education program be developed and implemented across years 5 and 6, as well as community and workplace programs for adults.

Recommendation 3

Behaviour change programs

This report recommends the expansion of behaviour change initiatives such as *TravelSmart, Ride to School* and *Ride to Work* programs.

Recommendation 4

Cycling events

This report recommends government support for cycling events, to act as an entry point for new cyclists.

Recommendation 5

Urban design

This report recommends the establishment of national guidelines to ensure the built environment contributes to, rather than detracts from, public health. Design should be encouraged through legislation that increases density, combines residential with other land uses and prioritises active forms of transport.

Recommendation 6

Bicycle Infrastructure

This report recommends the provision of high quality, integrated bicycle routes (on and off road) to meet the challenge of increasing Australia's participation in active travel and recreation.

Recommendation 7

Funding

This report recommends that funding needs to be substantially increased at all levels of government to better reflect the contribution cycling makes to priorities in the transport, climate change, health and economic sectors.

Conclusion 4

Australians have reduced their level of physical activity over recent decades and this has impacted negatively on our health.

Physical inactivity is now a major cause of ill health, contributing to obesity, diabetes and cardiovascular disease, as well as breast cancer and depression.

It is now clear that cycling offers an effective but underutilised form of physical activity, providing significant contributions to public health. Moreover, when used as an alternative to motorised transport, cycling is an effective method of reducing greenhouse gas emissions, congestion and increasingly expensive fuel costs.

Although cycling is increasing in popularity, both as a form of recreation and transport, participation remains low by international standards and some significant barriers must be overcome before considerable gains can be expected. These barriers have been identified in terms of:

- Individual factors such as a lack of riding skills and confidence
- Social and cultural factors such as societal acceptance of heavy car use, even for short trips
- Environmental factors such as urban planning and bicycle infrastructure
- Safety issues
- Policy and regulation matters

Solutions to each of these challenges exist and a focus of this report has been to outline practical, cost-effective solutions to increase adult participation in cycling.

An integrated suite of solutions have been recommended that address each of the aforementioned barriers to cycling. These include:

- Mass marketing the benefits of cycling
- Providing bicycle education programs in schools, workplaces and community settings
- Supporting cycling events
- Improving urban design/planning to make cycling more attractive
- Boosting the quality and quantity of bicycle infrastructure networks such as on and off-road bicycle routes and end of trip facilities
- Better integration of cycling with public transport systems
- Reassessment of funding for cycling; to better reflect cycling's contribution to health, traffic congestion, climate change and high fuel costs.

As Australians continue to lead time poor lives, cycling is in a unique position for its ability to integrate physical activity into everyday living, especially through the use of the bicycle as a form of transport and active recreation.

The responsibility to create healthy conditions for cycling is not entirely within the direct control of the health sector. It is important to recognise a whole-of-government approach is required, with commitment from the health, transport, environment, education and planning portfolios. Only through a combined approach can the significant benefits of increased cycling be fully realised.

As Australians continue to lead time poor lives, cycling is in a unique position for its ability to integrate physical activity into everyday living, especially through the use of the bicycle as a form of transport and active recreation.

Appendices 5

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Appendix 1

Energy expenditure of physical activities, including cycling, according to an individuals weight

	Energy expenditure in kilojoules per hour (based on an individual's body mass)					
Physical activity	**50 kg**	**68 kg**	**77 kg**	**86 kg**	**91 kg**	**100 kg**
WALKING AND RUNNING						
Walking, 3.3 km per hour	276	376	426	477	502	552
Walking, 4.8 km per hour	368	502	568	635	669	736
Bushwalking, carrying 5kg load	828	1129	1279	1430	1505	1655
Jogging, 8 km per hour	849	1162	1317	1471	1547	1701
Running, 14 km per hour	1517	2069	2345	2621	2759	3035
CYCLING						
Bicycling, 15-16 km per hour	577	786	890	991	1045	1150
Bicycling, 21 km per hour	920	1254	1421	1588	1672	1839
OTHER DOMESTIC TASKS						
Trimming hedges	481	660	744	832	878	966
Vacuuming, window cleaning, car washing	343	468	535	594	627	690
OTHER PHYSICAL ACTIVITY						
Swimming (25 metres /minute)	552	752	853	953	1003	1104
Swimming (50 metres /minute)	1037	1413	1597	1789	1881	2069
Tennis (doubles)	506	690	782	874	920	1012

Source: Bauman, 2004

Appendix 2

Value of Commuter Cycling Assumptions

- Climate change cost savings of commuter cycling were calculated using A$40/tonne of carbon dioxide. This is higher than the Australian Transport Commission's (2006a) default value, but is still very low by European standards. The United Kingdom, for example, currently requires a value of approximately A$200/tonne for transport project appraisal.
- Road traffic congestion is calculated based on incremental values derived from the Australian Bureau of Transport and Regional Economics (2007) for each capital city.
- The value of reduced congestion was determined using capital city cycling to work only, as this is where congestion costs are greatest. Similarly, the assessment has been on the basis of cycle-only commuting trips, as bicycle + other mode trips (usually with public transport) will tend to be shorter and also occur in outer or middle suburbs, where congestion and the impacts of air pollution are less intense. Our estimates will be, if anything, underestimates of the true impact of cycling to work.
- The savings to the health system is calculated based on net mortality (death rate) reduction and reduced morbidity (disease) (updated values from Ker, 2004).
- The value for mortality improvement was estimated on the basis of (a) Hillman (1997), who concluded that for every life year lost due to cyclist fatalities there is a corresponding gain of 20 life years through improved health and fitness and (b) costs of cyclist fatalities in WA provided by the Road Safety Council of Western Australia, to derive a value for each life-year.
- Less research has been done on the value of morbidity improvements. The value used here was originally suggested by Ker (2003) as a sensitivity test, based on limited information available.
- The average length of bicycle commuting trips (with bicycle as sole mode) is around 7 kilometres each way (derived from data in ABS, 2006).
- In assessing the value of cycle commuting, all impacts have been valued at resource cost (ie net of pure financial transfers such as indirect taxes – GST and fuel excise) at 2006 prices. However, we have included a progressive increase in the price of petrol to $2/litre by 2016, reflecting a conservative increase in the real cost of oil. This has an impact on car operating costs and congestion costs, both of which have a fuel component.
- Cycling offers the potential for considerable personal savings, in terms of reduced transport expenses. This can occur through reduced need for car ownership and/or reduced car usage. These cost savings have not been calculated for this report but may be helpful for future investigations on the economic benefits of cycling.

Appendix 3

Ride to Work Day: An effective behaviour change tool

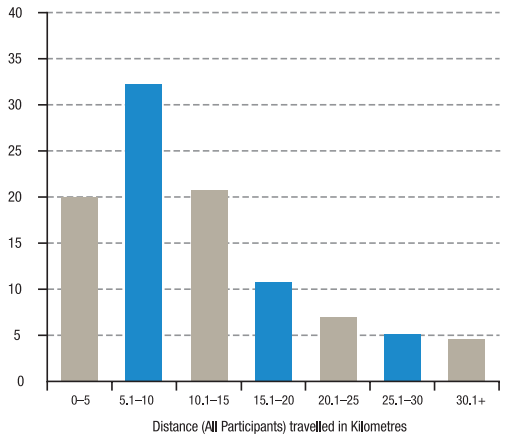
Ride to Work Day is an effective behaviour change event on a number of levels. It encourages people to contemplate, prepare for and trial the ride-to-work experience, then to maintain that behaviour after the event. As a tool for behaviour change it acts as:

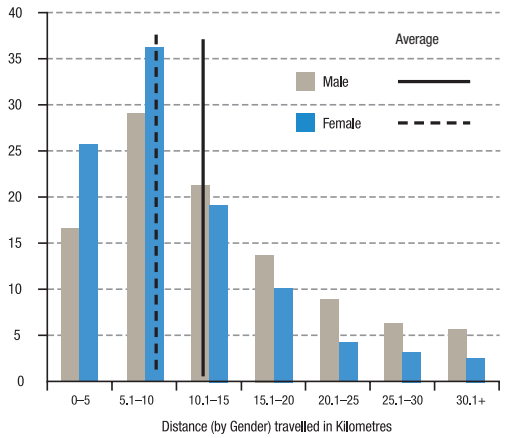
- A thought-provoker for those who are yet to commence riding to work.
- An opportunity to prepare for and trial the experience for those who have been giving riding some thought.
- A deadline to get ready for those who have already begun preparing.
- A reminder or prompt to get back into riding for seasonal or lapsed riders (maintenance).
- Behaviour reinforcement (maintenance) and an opportunity to support new and returning riders for regular riders.

Source: Bicycle Victoria, 2006, p. 9

Appendix 4

The Distance Travelled on Ride to Work Day (one way, all respondents)



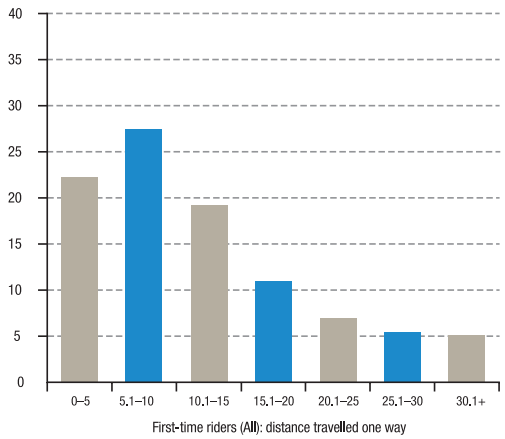


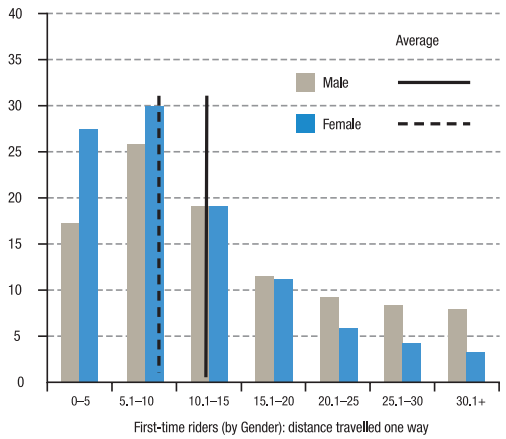
Note: The averages for graph 2 are calculated on distances less than 31Km (<31Km is 4% of the national data set) as this removes outliers that live large distances from work and whose figures would skew the avraged results

Source: Bicycle Victoria, 2006

Appendix 5

The Distance Travelled on Ride to Work Day (one way, first-time riders)

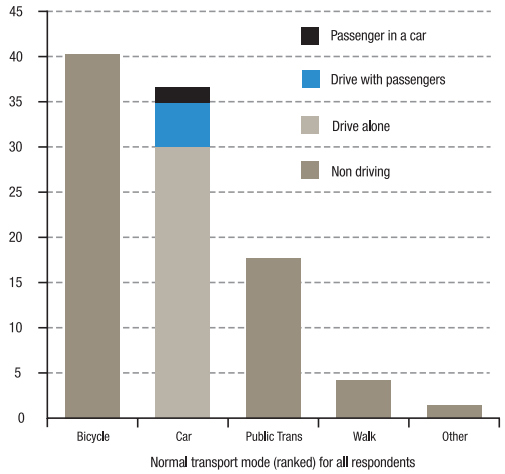


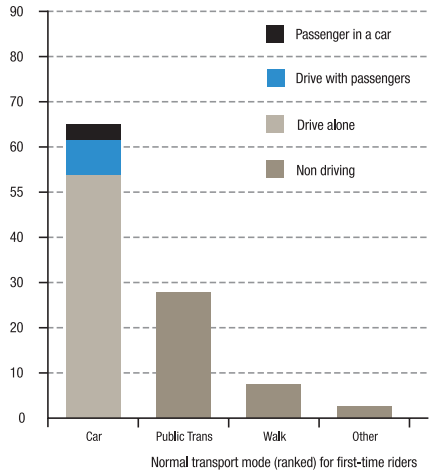


Source: Bicycle Victoria, 2006

Appendix 6

Normal transport mode for Ride to Work Day participants





Source: Bicycle Victoria, 2006

Appendix 7

TravelSmart Workplaces

TravelSmart Workplaces: develops partnerships with organisations to reduce car use, particularly to and from work. This typically involves the development of a *Green Travel Plan* for the organisation, highlighting a range of initiatives to promote alternatives to single occupant car use – including:

- Development of Bicycle User Groups (BUGs) and staff bicycle fleets
- Installation of end of trip facilities for cyclists, such as bike parking, showers and change rooms.
- *CycleSmart* software to help staff gauge how their decision to cycle helps their health (eg/ calories burnt), the environment (eg/ greenhouse gas saved), and their wallet (eg/ reduced fuel costs).
- Staff Bicycle Fleet: Operating in a similar manner to an organisation's motor vehicle fleet, a bicycle fleet is a healthy alternative for short trips. The Department of the Environment and Water Resources (2007) have recently released a toolkit designed to help organisations get started.
- Car pooling software into workplace intranet
- Information on public transport options
- On line toolkit to develop the business case for reducing car use

Appendix 8

The 2006 Brisbane to the Gold Coast Ride – A Snap Shot

- Participant total was 3,800, an increase of 73% from 2,200 in 2005
- 74% were Male and 26% were female.
- 79% were between 26 and 55 years of age
- Approximately 1,000 riders were from outside the greater Brisbane area
- 50% normally ride 5 to 10 hours per week
- 61% were not Bicycle Queensland members
- 40% had not previously been on a BQ event
- 87% entered the event online
- 99% of riders said they would recommend the event to others
- 97% were satisfied or very satisfied with their experience on the day.
- Funds raised for Diabetes research was $60,000 (increased from $22,000 in 2005

Source: Bicycle Queensland

Appendix 9

GP advice on physical activity

Times	Proportion (%)
Gender	
Male	15.5
Female	13.8
Age Group	
18 to 29 years	8.3
30 to 44 years	17.2
45 to 59 years	17.0
60 years or more	14.7
Location	
Perth metropolitan area	14.9
South West	14.1
Kimberley/Pilbara	15.9
Midwest/Goldfields	12.7
Activity Level *	
Inactive	15.5
Insufficient	17.3
Sufficient	13.2
BMI Category	
Underweight	8.8
Acceptable	6.6
Overweight	17.6
Obese	36.2
Overall	14.6

* Sufficient activity is defined at 150 minutes of moderate physical activity over five or more sessions or 60 minutes of vigorous physical activity per week (excludes gardening and household chores).

Source: Milligan et al, 2007

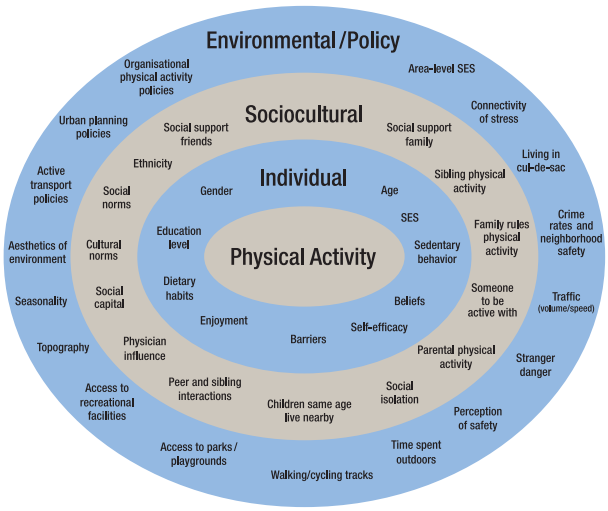
Appendix 10

The Ecological Model of Physical Activity

According to the Ecological Model of Physical Activity, the policy goal must be one that seeks to create a positive interaction between environmental, social and personal factors, to bring about increases in physical activity. A practical example of such an approach would be the simultaneous creation of improved bicycle infrastructure, combined with behaviour change programs to promote the adoption of cycling.

Whilst a combination of environmental and behavioural interventions are considered to be most effective in boosting levels of physical activity, it is essential to recognise that supportive physical environments should precede behaviour change programs (Sallis et al, 1998). After all, promoting the benefits of physical activity in an environment that is hostile to such behaviour is unlikely to be effective, enjoyable or sustainable.

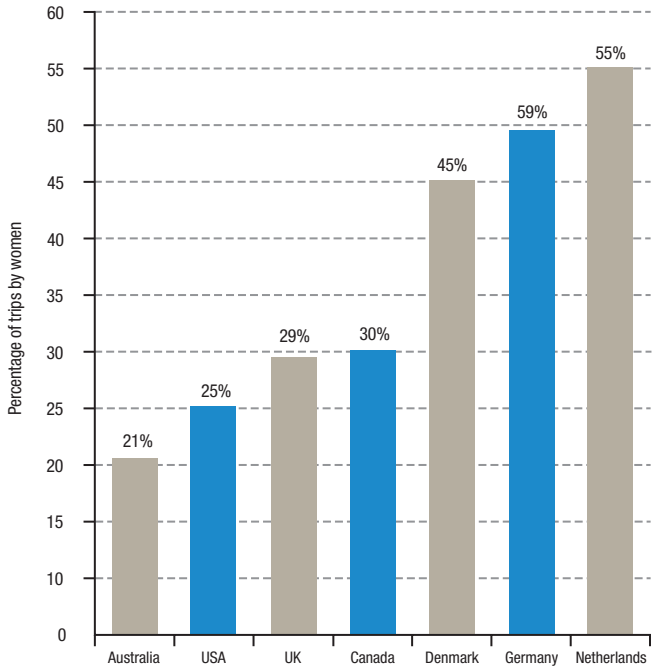
The figure below offers an overview of the Ecological Model of Physical Activity, providing an outline of where each influence sits in the model. It groups environmental and policy considerations as one, whereas in this report, they have been treated separately, but no less interrelated.



Source: Hume, 2007 (adapted from Davison & Birch, 2001)

Appendix 11

Women's share of bicycle journeys – an international comparison



Data sources:
Australian Bureau of Statistics (2007); Department for Transport (2007); Danish Ministry of Transport (2005); Statistics Netherlands (2005); German Federal Ministry of Transport (2003); U.S. Department of Transport (2003) and information provided directly by planners in Canadian provinces and cities

Source: Pucher & Buehler, 2008

Appendix 12

End of trip facilities for cyclists

Workplaces are beginning to provide end of trip facilities and legislation has been shown to streamline and coordinate the process of developing the wide spread adoption of end of trip facilities. This has already started to occur in select areas around Australia. For example, the Parking and Access Policy for the Town of Vincent (WA) states, for non-residential development, that:

Bicycle parking facilities and end of trip facilities are to be provided in addition to the calculated [car] parking requirement at the rate specified in the Bicycle Parking requirements Table. Bicycle parking is to be provided for employees/residents as well as visitors/shoppers in accordance with the specifications (p.3).

The Town of Vincent Parking and Access Policy

Provision of End of Trip Facilities

End of trip facilities are facilities which enable the cyclist to shower and change at the beginning or end of their journey to and from work. The facilities include separate male and female change rooms, showers and storage lockers. All new developments, and where appropriate, developments which involve a change of use and/or additions/enlargements to an existing building, that are required to provide 10 or more bicycle parking bays in accordance with the employee requirements of the above table, are required to provide end of trip facilities, as follows:

i) A minimum of one female shower and one male shower, located in separate change rooms.

ii) Additional shower facilities to be provided at a rate of one female shower and one male shower for every additional 10 bicycle parking bays, to a maximum of five female and five male showers per development.

iii) End of journey facilities should be located as close as possible to the bicycle parking facilities.

iv) The change rooms to be secure facilities capable of being locked.

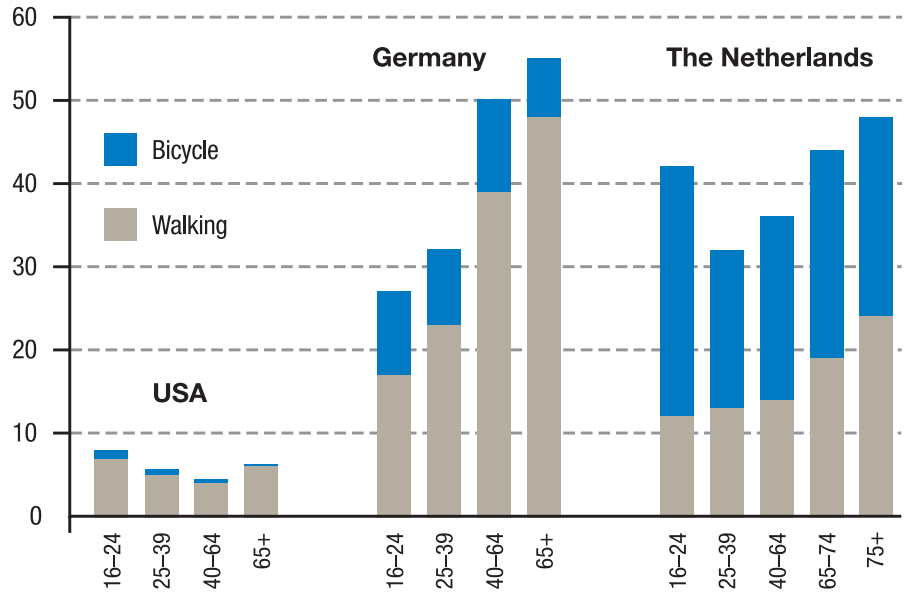
v) A locker to be provided for every bicycle parking bay provided.

In 2004, Victoria became the first state to amend their planning code to encourage the development of end of trip facilities in large new commercial and residential projects. Bicycle parking, showers, lockers and change rooms will be mandatory for all new buildings greater than 1000m2. Offices, retail, hospitals and apartments over 1000m2 will be required to include at least one bike parking space for every 300 square metres of floor space (TravelSmart, 2004).

In 2006, the Australian Capital Territory introduced Bicycle Parking Guidelines which requires commercial developments to provide one bicycle parking space per 250m2 and for each apartment. In addition, it is possible to replace one car space with four bicycle spaces to a maximum of 5% of the total number of mandatory car parking spots (Planning and Land Authority, 2006).

Appendix 13

Age group diversity in bicycle participation is possible



Source: Pucher & Dijkstra, 2003

Appendix 14

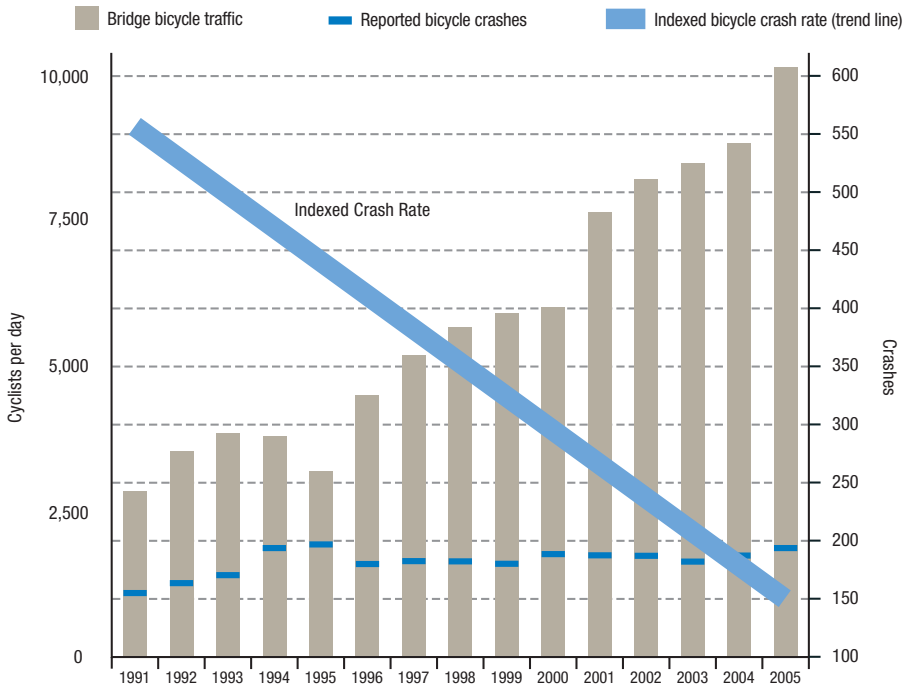
Poor behaviour on the road is a barrier to cycling

A Victorian Parliamentary inquiry into violence associated with motor vehicle use received a large number of submissions from the cycling community reporting instances of road violence. Several submissions suggested that the presence of cyclists on the road was a trigger for road violence against cyclists (Drugs and Crime Prevention Committee, 2005).

Driver knowledge of the road rules as they relate to people on bicycles has been found to be generally poor. Only one in five (19%) of drivers knew that it was legal for cyclists to ride two abreast, 44% that cyclists were allowed to ride along a clearway, and 63% that cyclists were allowed to occupy a whole lane (Rissel et al, 2002). Importantly, this lack of knowledge regarding vital aspects of the road rules has been found to be associated with a negative attitude amongst motorists towards people on bicycles (Rissel et al, 2002). The hostile reception reported by bicyclists from motorists is a consistent theme when surveying people who ride bicycles. Daley et al (2007) found that many occasional and regular riders perceived the average Sydney driver as impatient and intolerant. Some thought drivers were more likely to respect cyclist's safety and rights if bicycles were more frequently encountered on the roads and this is supported by Robinson (2005) who found that the more cyclists there are, the safer it becomes. Riders described altercations where motorists took out frustrations on them, often triggered by the motorist's view that their journey was delayed by the rider. Riders felt there was a skewed driver perception that a cyclist held up traffic, rather than seeing them as a legitimate part of the traffic system. It is this lack of acknowledgement towards people on bicycles that has been found by Greig (2001) to be a significant deterrent towards regular cycling.

Appendix 15

More bikes improves safety for everyone



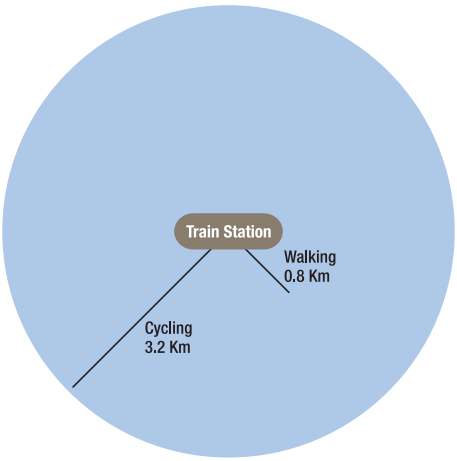
The long blue line left represents the proportion of cycle crashes relative to actual number of cyclists. It clearly illustrates that as the number of cyclists increases, the safer it becomes.

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	200	2001	2002	2003	2004	2005
Bridge Bicycle Traffic	2850	3555	3885	3830	3207	4520	5225	5690	5910	6015	7686	8250	8562	8875	10192
Reported Bicycle Crashes	155	163	171	189	195	160	167	166	161	179	175	173	164	174	188
Indexed Bicycle Crash Rate	544	459	440	493	514	354	320	292	272	298	230	210	192	196	184
Bicycle Fatalities	2	0	4	3	2	1	5	1	0	0	5	0	4	1	4

Source: Birk & Geller, 2007, data collected from Portland, US

Appendix 16

Encouraging cycling to the station can increase its catchment area by a factor of 15



	Average Speed	Distance Covered	Catchment Area
Walking	5 Km/h	0.8 Km	2 Km^2
Cycling	20 Km/h	3.2 Km	32 Km^2

Source: Elliot Fishman, adapted from Hudson, 1978

Appendix 17

Carrying bicycles on public transport

Bicycles on the front of a bus, Canberra

Source: Cycling Promotion Fund

The United States has a very successful federally funded program to allow passengers to carry bikes on buses (Federal Transit Administration, 2005).The United States Federal Government provides the capital costs to install racks on the front of the bus. Despite initial apprehension from bus companies, the experience has been overwhelmingly positive and it has grown to include over 30 cities. A key learning from this program is the importance of installing racks on all buses in the company's fleet (Federal Transit Administration, 2005). Two small pilot projects in Brisbane and Canberra have shown only limited success due to the fact that only a small number of buses were fitted with the racks and only on limited routes.

The following pictures offer a good overview of the diverse range of options provided in the United States by the Federal Government to encourage the combination of bicycles and public transport.

Bicycles on the inside of trams in Maryland, United States

Source: Michael Jackson, Department of Transportation, Maryland, US

A bicycle on Portland's light rail

Source: Elliot Fishman

Bicycles on Trains, California, United States

Source: Altamont Commuter Express, California

References 6

Access Economics, 2006 The economic costs of obesity, Access Economics, Canberra.

Andersen R.E., Crespo C.J., Bartlett S.J., Cheskin L.J., Pratt M., 1998 *Relationship pf physical activity and television watching with body weight and level of fatness among children: Results from the third National Health and Nutrition Examination Survey*, Journal of the American Medical Association, Vol. 279, p. 938 – 942.

Atkinson J.L., 2005 *The association of neighbourhood design and recreational environments with physical activity*, American Journal of Health Promotion, Vol. 19, p. 188 -199.

Aultman-Hall L., Hall F.L., Baetz B.B., 1997 *Analysis of bicycle commuter routes using geographic information systems: implications for bicycle planning*, Transportation Research Record, Vol. 1578, p. 102-110.

Australian Bicycle Council, 2004 *Benefits of cycling*. Australian Bicycle Council, Canberra. http://www.austroads.com.au/abc/index.php?type=sep&id=33

Australian Bureau of Statistics, 2006a *Environmental Issues: People's Views and Practices*, Catalogue Number 4602.0, March, Australian Government, Canberra.

Australian Bureau of Statistics, 2006b *Motor Vehicle Census*, Catalogue Number 9309.0, March, Australian Government, Canberra.

Australian Bureau of Statistics, 2007a 2001 *Census of Population and Housing, Journey to Work Files*, Canberra, Australia. http://www.abs.gov.au/websitedbs/d3310114.nsf/Home/census

Australian Bureau of Statistics, 2007 *Participation in Sports and Physical Activity 2005 - 06*, Australian Government, Canberra. www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/A36EC2C4EAD3937BCA257281001ADA51/$File/41770_2005-06.pdf

Australian Chronic Disease Prevention Alliance, 2004 *Chronic Illness: Australia's Health Challenge. The Economic Case for Physical Activity and Nutrition in the Prevention of Chronic Disease*, Australian Chronic Disease Prevention Alliance.

Australian Institute of Health and Welfare, 2002 *Australia's Health 2002*, Australian Government, Canberra.

Australian Institute of Health and Welfare, 2006 *Australia's Health 2006*, Australian Government, Canberra. http://www.aihw.gov.au/publications/aus/ah06/ah06.pdf

Australian Sports Commission, 2002 *Interventions to increase participation in physical activity in specific settings*, Australian Sports Commission, Canberra. http://www.ausport.gov.au/fulltext/2002/nphp/chapter2.6.asp

Australian Sports Commission, 2006 *Participation in Exercise, Recreation and Sport Survey*, Department of Communications, Information Technology and the Arts, Australian Government, Canberra. http://www.ausport.gov.au/scorsresearch/ERASS2006/ERASS_2006_annual_report_T16.pdf

Australian Transport Council, 2001 *National Road Safety Strategy 2001 to 2010*, Australian Government, Canberra. http://www.atcouncil.gov.au/documents/atcnrss.aspx

Austroads, 2005 *The Australian National Cycling Strategy 2005-2010*, Sydney. www.austroads.com.au/documents/

Bandura A., 1997 *Self-efficacy: The Exercise of Control*, W.H. Freeman & Company, New York.

Barengo N., Hu G., Lakka T.A., Pekkarinen H., Nissinen A., Tuomilehto J., 2004 *Low physical activity as a predictor for total and cardiovascular disease mortality in middle-aged men and women in Finland*, European Heart Journal, Vol. 25 No. 24, p. 2204 - 2011.

Basford L., Reid S., Lester T., Thomson J., Tolmie A., 2002 *Drivers perceptions of cyclists*, Department for Transport, University of Strathclyde, Scotland, TRL Report TRL549.

Bauman A., 2004 *The health benefits of physical activity in the older adults–epidemiological approaches to the evidence*, Chapter 1, p. 1 –24, in Morris M., Schoo A., *Exercise and physical activity in older people*, Heinmann Butterworth , Melbourne.

Beggs S., Vis T., Barker B., Stevenson C., Stanley L., Lopez A.B., 2003 *The Burden of Disease and Injury in Australia*, Australian Institute of Health and Welfare, Canberra.

Berrigan D., Troiano R.P., McNeel T., Disogra C., Ballard-Barbash R., 2006 *Active transportation increases adherence to activity recommendations*, American Journal of Preventative Medicine, Vol. 31, No. 3, p. 210 - 216.

Bicycle Federation of Australia, 2006, *Best-practice in adult cycling proficiency training, Report to the Australian Greenhouse Office*, Bicycle Federation of Australia, Canberra.

Bicycle Industries Australia, 2005, *The Bicycle Industries Report 2005*, Melbourne

Bicycle Industries Australia, 2006 *Bicycle Sales in Australia*, cited by the Cycling Promotion Fund. www.cyclingpromotion.com.au/images/stories/factsheets/Bike_Sales_in_Australia_July_06.pdf

Bicycle Queensland, 2004 *Ride to Work Day 2004: Survey Findings*, Bicycle Queensland, Brisbane.

Bicycle Victoria, 2007 *Backgrounder – National Ride to Work Day 2007*, Bicycle Victoria, Melbourne. http://www.bv.com.au/file/file/RTW/NRTWD07/Fact%20sheet%20for%20website.pdf

Bicycle Victoria, 2007 *Cycle-Friendly Workplace*, Bicycle Victoria, Melbourne. http://www.bv.com.au/file/file/RTW/BICY%20-%20Cycle-Fndly%20Workplaces_v12.pdf?phpMyAdmin=DhLMKS7n7oG8nIonGyRgo-K1uw6

Bicycle Victoria, 2006 *Ride to Work Day Post-event Report*, Bicycle Victoria, Melbourne. http://www.bv.com.au/file/file/RTW/RTWD%202006%20final%20Report%20.pdf?phpMyAdmin=DhLMKS7n7oG8nIonGyRgo-K1uw6

Biesma R., Schouten L., et al, 2006 *Physical activity and risk of ovarian cancer: results from the Netherlands Cohort Study (The Netherlands)*, Cancer Causes and Control, Vol. 17, No. 1, p. 109 - 115.

Birk M., Geller R., 2007 *On-Street Bikeways and Off-Street Trails: An Integrated Approach: Overview*, State of Oregon, United States. http://www.ibpi. usp.pdx.edu/ traildesign.php

Bloemkolk M., undated Groningen: *Integrated town planning and traffic policy*, City of Groningen, The Netherlands. http://www.eaue.de/winuwd/95.htm

Bowles H.R., Rissel C., Bauman A.E., 2006 *Mass cycling events: Who participates and is their post-event behaviour influenced by participation?*, International Journal of Behavioral Nutrition and Physical Activity, Vol. 3.

Brisco M., 2006 *How safe is cycling in metropolitan Adelaide?* Draft Report, Bicycle Institute of South Australia, Adelaide.

British Medical Association, 1992 *Cycling towards health and safety*, Oxford University Press, United Kingdom.

Bucksch J., 2005 *Physical activity of moderate intensity in leisure time and the risk of all cause mortality*, British Journal of Sports Medicine, Vol. 39, No. 9, p. 632 - 638.

Bunn F., Roberts I., Kwan I., 2003 *Area-wide traffic calming for preventing traffic related injuries*, Cochrane Database of Systemic Reviews, Issue 1. http://www.cochrane.org/reviews/en/ab003110.html

Bureau of Transport and Regional Economics, 2000 *Report 102: Road Crash Costs in Australia*, Department of Transport and Regional Services, Australian Government, Canberra. http://www.btre.gov.au/info.aspx?ResourceId=47&NodeId=58

Bureau of Transport and Regional Economics, 2005 *Health impacts of transport emissions in Australia: economic costs*, Department of Transport and Regional Services, Australian Government, Canberra. http://www.btre.gov.au/docs/workingpapers/wp63/wp63.pdf

Calvert S., Ross J., Hamlin M., 2001 *Levels of physical activity of a sample of 10-13 year old New Zealand children*, New Zealand Medical Journal, Vol. 114, No. 1143, p. 496-498.

Cavil N., 2006 *Promotion of physical activity among adults: Evidence into practice briefing*, National Institute for Health and Clinical Excellence, London, United Kingdom.

Centers for Disease Control and Prevention, 2002 *Barriers to children walking and biking to school--United States, 1999*, Morbidity and Mortality Weekly Report, Vol. 51, No. 32, p. 701 - 704.

Chertok M., Sheppeard V., Voukelatos A., Rissel C., 2004 *Comparison of air pollution exposure for five commuting modes in Sydney – car, train, bus, bicycle and walking*, Health Promotion Journal of Australia, Vol. 15, p. 63 - 67.

Cilliers J., Senekal M., Kunneke E., 2006 *The association between the body mass index of first-year female university students and their weight-related perceptions and practices, psychological health, physical activity and other physical health indicators*, Public Health Nutrition, Vol. 9, No. 2, p. 234 - 243.

Coggins A., Swanton D., Crombie H., 1999 *Physical activity and inequalities: A briefing paper,* Health Education Authority, London, United Kingdom.

Cornwell D., Barker B., 2007 *Monitoring of the Perth Bicycle Network 2006*, ARRB Consulting for Department for Planning and Infrastructure, Government of Western Australia, Perth.

Cycle Council of the Netherlands, 2007 *Strong growth of cycle use in pre train journeys*, Cycle Council of the Netherlands, Rotterdam. http://www.fietsberaad.nl/library/fietsverkeer/Fietsverkeer_15.pdf

Cycling Promotion Fund, 2005, *Be Active Tour Evaluation*, Melbourne.

Daley M., Rissel C., Lloyd B., 2007 *All dressed up and no-where to go? A qualitative research study of the barriers and enablers to cycling in inner Sydney*, Road and Transport Research, Vol. 16, p. 42-52.

Danish Ministry of Transport, 2007 *Danish National Travel Surveys*, Danish Institute of Transport Research, Copenhagen, Denmark.

Davidson K., Birch L.L., 2001 *Childhood overweight: a contextual model and recommendations for future research*, Obesity Review, Vol. 2, p. 159-171.

Dekoster J., Schollaert U., 2000 *Cycling: The Way Ahead for Towns and Cities*, European Commission, Directorate-General for the Environment. http://ec.europa.eu/environment/cycling/cycling_en.pdf

Department for Education and Skills/Department for Transport, 2003 *Travelling to School: An Action Plan*, Department for Education and Skills/Department for Transport, United Kingdom Government, London. http://www.dft.gov.uk/pgr/sustainable/schooltravel/travelling/

Department for Transport, 2003 *Attitudes to Walking and Cycling*, Department for Transport, United Kingdom.

Department for Transport, 2007 *National Travel Statistics*,United Kingdom Government, London. http://www.dft.gov.uk/

Department of Health 2004 *Accessibility Planning: An Introduction for the NHS*, Health Inequalities Unit, Department of Health, United Kingdom Government, London. http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4090977

Department of Health and Aged Care, 1999 *National Physical Activity Guidelines for Australians*, Department of Health and Aged Care, Australian Government, Canberra. http://www.ausport.gov.au/fulltext/1999/feddep/physguide.pdf

Department of Infrastructure, 2006 *Department of infrastructure Annual Report 2005 – 06*, Victorian Government, Melbourne.

Department of the Environment and Water Resources, 2007 *How to set up a successful bike fleet: A Toolkit*, Department of the Environment and Water Resources, Australian Government, Canberra. http://www.travelsmart.gov.au/toolkits/bikefleets/pubs/bikefleets.pdf

Department of the Environment, Transport and the Regions, 2000 *Guidance on the Methodology for Multi-Modal Studies*, United Kingdom Government, London.

Dettori N. J., Norvell D. C., 2006 *Non-traumatic bicycle injuries - A review of the literature*, Sports Medicine, Vol. 36, No. 1, p. 7-18.

Di Peitro G., Hughes I., 2003 *TravelSmart Schools: there really is a better way to go!* Dynamic Outcomes Pty Ltd, 26th Australasian Transport Research Forum, Wellington, New Zealand, 1 – 3 October.

Di Pietro L., Dziura J., Blair S.N., 2004, *Estimated change in physical activity level (PAL) and prediction of 5-year weight change in men: the Aerobics Center Longitudinal Study*, International Journal of Obesity, Vol. 28, No. 12, p. 1541-1547.

DiPietro L., Williamson D., Caspersen C.S., Eaker E., 1993 *The descriptive epidemiology of selected physical activities and body weight among adults trying to lose weight: the Behavioural Risk Factor Surveillance System survey*, 1989, International Journal of Obesity, Vol. 7, No. 2, p. 69 - 76.

Dora C., 1999 *A different route to health: implications of transport policies*, British Medical Journal, Vol. 318, p. 1686 – 1689. http://www.bmj.com/cgi/reprint/318/7199/1686

Dowler E., 2001 *Inequalities in diet and physical activity in Europe*, Public Health and Nutrition, Vol. 4, p. 701 – 709.

Drugs and Crime Prevention Committee, 2005 *Inquiry into violence associated with motor vehicle use: final report*, Parliament of Victoria, Melbourne.

Ebbeling C.B., Pawlak D.B., Ludwig D.S., 2002 *Childhood obesity: public health crisis, common sense cure*, The Lancet, Vol. 360, August 10th. http://www.allhealth.org/briefingmaterials/LancetObesityRev-393.pdf

Econtech, 2007 *Economic modelling of the net costs associated with non-participation in sport and physical activity*, Prepared by Econtech Pty. Ltd.for Medibank Private.

Estabrooks P.A., Lee R.E., Gyurcsik N.C., 2003 *Resources for physical activity participation: does availability and accessibility differ by neighbourhood socioeconomic status?* Annals of Behavioural Medicine, Vol. 25, p. 100 – 104.

European Commission, undated webpage http://www.ec.europa.eu/environment/climat/campaign/walk_en.htm

European Commission, 2003 *Panorama of transport: Statistical overview of transport in the European Union Part 2: Data 1970 – 2001*, European Commission, Brussels, Belgium.

Ewing R., McCann B., 2003 *Measuring the health effects of sprawl: A national analysis of physical activity, obesity and chronic disease*, Surface Transportation Policy Project, Smart Growth America, Washington D.C., United States of America.

Ewing R., Pendall R., Chen D., 2002 *Measuring sprawl and its impacts,* Smart Growth America, Washington D.C., United States of America.

Federal Transit Administration, 2005 *Integration of Bicycles and Transit*, Transit Cooperative Research Program, Synthesis 62, Transportation Research Board of the National Academies, Washington D.C. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_syn_62.pdf

Fisher F., 2006 *Response Ability: Environment, Health and Everyday Transcendence*, Vista Publications, Melbourne.

Flood L, Harrison J.E., 2006 *Hospitalised sports injury, Australia 2002-03*, Injury Research and Statistics Series Number 27, AIHW cat no. INJCAT 79, Adelaide: AIHW

Frank L.D., Andresen M.A., Schmid T.L., 2004 *Obesity relationships with community design, physical activity, and time spent in cars*, American Journal of Preventative Medicine, Vol. 2, p. 87 – 96.

Frank L.D., Saelens B.E., Powell K.E., Chapman J.E., 2007 *Stepping towards causation: Do built environments or neighborhood and travel preferences explain physical activity, driving and obesity?*, Social Science and Medicine.

French S.A., Story M., Jeffery R.W., 2001 *Environmental influences on eating and physical activity*, Annual Review of Public Health, Vol. 22, p. 309 – 335.

Galbraith J., Keegan O.P., 2005 *Attitudes of Cyclists and Car Commuters to Cycling in Dublin*, Velocity Conference, Dublin. http://home.connect.ie/dcc/docs/DublinCity/Attitudes.pdf

Garrard J., 2003 *Healthy revolutions: promoting cycling among women*. Health Promotion Journal of Australia, Vol. 14, No. 3, p. 213 - 215.

Garrard J., Crawford S., Hakman N., 2006 *Revolutions for women: increasing women's participation in cycling for recreation and transport, Final Report*, Deakin University, Melbourne, p. 1 - 77.

Garrard J., Rose G., Sing K.L., 2008 *Promoting transportation cycling for women: the role of bicycle infrastructure*, Preventive Medicine, 46(1):55–59.

German Federal Ministry of Transport, 2003 *German Federal Travel Survey 2002* (MiD). Berlin, Germany.

Giles-Corti B., Donovan R.J., 2003 *Relative influences of individual, social environmental, and physical correlates of walking*, American Journal of Public Health, Vol. 93, p. 1583 – 1689.

Giles-Corti B., Shannon T., Pikora T., Bulsara M., Shilton T., Bull F., 2005 *Active commuting in a university setting: Assessing commuting habits and potential for modal change*, Transport Policy.

Godbold T. I., 2005, *Exploring the self-reported impacts of participation in the 2004 Great Victorian Bike Ride*, School of Health and Social Development, Deakin University, Burwood.

Goldsmith S., Lagerway P., 2000 *Jump-staring bicycle transportation in the US: the carrot or the stick?*, Proceedings of the Velomondial International Cycling Conference, Amsterdam.

Greater London Authority, 2007 *The Mayor announces huge rise in cycling in London*, Media Release, 1st May. http://www.london.gov.uk/view_press_release.jsp?releaseid=11791

Greig R., 2001 *Cycling promotion in Western Australia*, Health Promotion Journal of Australia, Vol. 12, p. 250 – 253.

Greig R., 2007 *Cycling Promotion and Social Marketing*, Prepared for the Cycling Promotion Fund, September.

Hahn A., Craythorn E., 1994 *Inactivity and physical activity in two regional centres*, Health Promotion Journal of Australia, Vol. 4, p. 43 – 45.

Hamer M., Chida Y., 2007 *Active commuting and cardiovascular risk: A meta-analytic review*, Preventative Medicine.

Handy S., 2004 *Critical Assessment of the Literature on the Relationship among Transportation, Land Use and Physical Activity*. Prepared for the Transportation Research Board and the Institute of Medicine Committee on Physical Activity, Health, Transportation, and Land Use, Washington DC, USA. http://trb.org/downloads/sr282papers/sr282Handy.pdf

Heart Foundation, 2007 *Walking Fact Sheet*, Heart Foundation. http://www.heartfoundation.org.au/document/NHF/HL_walking_factsheet_final_16%2008%2007.pdf

Hill J.O., Peters J.C., 1998 *Environmental contributions to the obesity epidemic*, Science, Vol. 280, p. 1371 – 1374.

Hillman M., 1997, *Cycling offers important health benefits and should be encouraged* {Letter}, British Medical Journal, Vol. 315, No. 490.

Hillman M., Adams J., Whitelegg J., 1991 *One False Move... a study of children's independent mobility*, Policy Studies Institute, London, United Kingdom.

Hu G., Jousilahti P., Borodulin N.C., Barengo T.A., 2007, *Occupational, commuting and leisure-time physical activity in relation to coronary heart disease among middle-aged Finnish men and women*, Atherosclerosis, Vol. 194, No. 2, p. 490 – 497.

Hu G., Pekkarinen H., Hanninen O., Yu Z., Tian H., Guo Z., Nissinen A., 2002 *Physical activity during leisure and commuting in Tianjin, China*, Bulletin of the World Health Organisation, Vol. 80, No, 12, p. 933 - 938.

Hu G., Qiao Q., Silventoinen K,. Eriksson J.G., Jousilahti P., Lindstrom J., Valle T.T., Nissinen A., Tuomilehto J., 2003. *Occupational, commuting, and leisure-time physical activity in relation to risk for Type 2 diabetes in middle-aged Finnish men and women*, Diabetologia, Vol. 46, No. 3, p. 322 - 329.

Hudson M., 1978 T*he Bicycle Planning Book*, Open Source Publishing, United Kingdom.

Hume C., 2007 *Are children's perceptions of the neighbourhood environments associated with their physical activity?*, Presentation at the Sixth National Physical Activity Conference, Adelaide 13 – 16 October.

Jacobsen P.L., 2003 *Safety in numbers: more walkers and bicyclists, safer walking and bicycling*, Injury Prevention, Vol. 9, p. 205 – 209.

Kafatos A., 1999 *Regional, demographic and national influences on attitudes and beliefs with regard to physical activity, body weight and health in a nationally representative sample in the European Union*, Public Health Nutrition, Vol. 2, p. 260 – 275.

Kelley G.A., Kelley K.S., Tran Z.V., 2001 *Walking and resting blood pressure in adults: a meta-analysis*, Preventative Medicine, August, Vol. 33, p. 120 – 127.

Kelley G.A., Kelley K.S., *Aerobic exercise and resting blood pressure in older adults: meta-analytic review of randomized controlled trials*, Journals of Gerontology: Series A: Biological Science and Medical Science, May, Vol. 56, p. 298 – 303.

Kelley G.A., Kelley K.A., Tran Z.V., 2001 *Aerobic exercise and resting blood pressure: a meta-analytic* review of randomized, control trials, Preventative Cardiology, Vol. 4, p. 73 – 80.

Kavanagh A., Thornton L., Tattam A., Thomas L., Jolley D., Turrell G., 2007 *Place does matter for your health: A report of the Victorian Lifestyle and Neighbourhood Environment Study*, University of Melbourne, Australia.

Kennedy A., 1997 *Exercise and heart disease: cardiac findings in fatal cycle accidents,* British Journal of Sports Medicine, Vol. 31, No. 4, p. 328-331.

Ker I.R., 2003 *External Costs of Transport: Guide for Project Evaluators*. ARRB Transport Research for Department for Planning and Infrastructure, Western Australian Government, Perth.

Ker I.R., 2003 *Impact of Incentive and Disincentive Programs on Passenger Transport and Efficient Vehicle Use: Stage 1*, ARRB Transport Research for National Transport Secretariat.

Ker I.R., 2007 *North Brisbane TravelSmart Peer Review and Evaluation: Part 1 Context, Methodology and Values*, CATALYST Consulting for Brisbane City Council (unpublished).

Ker I.R., 2004 *Perth Bicycle Network Stage 3: Evaluation*, ARRB Transport Research for Bikewest, Department of Planning and Infrastructure, Western Australian Government, Perth.

Ker I. R., 2002 *Preliminary Evaluation of the Financial Impacts and Outcomes of the TravelSmart Individualised Marketing Program – Update (Appendix A)*. ARRB Transport Research for the Department for Planning and Infrastructure, Western Australian Government, Perth.

Killoran A., Doyle N., Waller S., Wohlgemuth C., Crombie H., 2006 *Transport interventions: Evidence briefing*, National Institute for Health and Clinical Excellence, National Health Service, UK. http://www.nice.org.uk/page.aspx?o=346196

King R., 2005 *A cycle trip from Warrington UK to Hilden, Germany to compare cycle facilities*, Proceedings of the fifteenth Velo-city cycling conference, Dublin, 31 May- 3 June.

Phernambucq A.P., 2000 *The campaign "cycle to work" scores a lot of points*, Proceedings of the Velomondial International Cycling Conference, Amsterdam.

Lehner-Lierz U., 1997 *The role of cycling for women*. In R Tolley (ed) *The greening of urban transport: Planning for walking and cycling in Western cities*, 2nd ed., John Wiley & Sons, Chichester, United Kingdom.

Leibovitch I., Mor Y., 2005. *The vicious cycling: Bicycling related urogenital disorders*, European Urology, Vol. 47, No. 3, p. 277-287.

Litman T., 2007 *Win-Win Emission Reduction Strategies*, Victoria Transport Policy Institute, Canada. http://www.vtpi.org/wwclimate.pdf

Litman T., Fitzroy S., 2005 *Safe Travels: Evaluating Mobility Management Traffic Safety Impacts*, Victoria Transport Policy Institute, Victoria, Canada. http://www.vtpi.org.au/saftrav.pd

Maller C., Townsend M., Brown P., 2002 *Healthy Parks Healthy People*, Report to Parks Victoria and the International Park Strategic Partners Group, Deakin University, Melbourne.

Mathers C., Vos T., Stevenson C., 1999 *The burden of disease and injury in Australia*, Australian Institute of Health and Welfare, Canberra.

McCormack G., Giles-Corti B., Lange A., 2004 *An update of recent evidence of the relationship between objective and self-report measures of the physical environment and physical activity behaviours*, Journal of Science and Medicine in Sport, Vol. 7, p. 81 – 92.

Mellifont D., 2001 *Results of Bike Week Ride to Work Survey*, Queensland Department of Transport, Queensland Government, Brisbane.

Mellifont D., 2002 *2002 Ride to Work Survey Report*, Queensland Department of Transport, Queensland Government, Brisbane.

Merom D., Bauman A., Vita P., Close G., 2003 *An environmental intervention to promote walking and cycling-the impact of a newly constructed Rail Trail in Western Sydney*, Preventive Medicine, Vol. 26, p. 235 - 242.

Milligan R., 2005 *Stay On Your Feet WA: The Falls Risk Factor Survey*, Western Australian Government, Perth.

Milligan R., McCormack G.R., Rosenberg M., 2007 *Physical Activity Levels of Western Australian Adults 2006 Results from the Adult Physical Activity Study, Perth, Western Australia*, Western Australian Government. www.beactive.wa.gov.au/PDF%20ADULT%20SURVEY%202006%20Full%Report.PDF

Ministry of Transport, Public Works and Water Management, 2007 *Cycling in the Netherlands*, Ministry of Transport, Public Works and Water Management, The Netherlands Government, The Hague. http://www.fietsberaad.nl/library/repository/bestanden/Cycling%20in%20the%20Netherlands%20VenW.pdf

Mobilität in der Schweiz, 2001 *Ergebnisse des Mikrozensus 2000 vum Verehrsverhalten*, Bundesamt für Statistik.

Morris J., 2007 *What's driving policy: Government's response to a new wave of older drivers?*, Transport Policy Branch, Policy and Intergovernmental Relations Division, Department of Infrastructure, Victorian Government, Melbourne. www.monash.edu.au/cmo/Transport2007/JennyMorris.ppt

Morris J.N., Clayton D.G., et al, 1990, *Exercise in leisure time: coronary attack and death rates*, British Heart Journal; Vol. 63, No. 6, p. 325 - 334.

Morris J.N., 1994 *Exercise in the prevention of coronary heart disease: today's best buy in public health*, Medicine and Science in Sports and Exercise, Vol. 26, p. 807 – 814.

National Institute of Public Health, 2006 *Risk factors and public health in Denmark*, National Institute of Public Health, University of Southern Denmark, Copenhagen, Denmark.

National Public Health Partnership, 2001 *Promoting Active Transport: An Intervention Portfolio to Increase Physical Activity as a Means of Transport,* National Public Health Partnership, Melbourne. http://www.nphp.gov.au/publications/phpractice/activetransport.pdf\

Nelson A.C., Allen D., 1997 *If you build them, commuters will use them: association between bicycle facilities and bicycle commuting*, Transportation Research Record, Vol. 1578, Paper No. 970132, p. 79 - 83.

New South Wales Environment Protection Authority, 2000 *State of the Environment*, Government of New South Wales, Sydney.

Newman P., Kenworthy J., 1999 *Sustainability and Cities: Overcoming Automobile Dependence*, Island Press, Washington D.C.

Ogilvie D., Egan M., Hamilton V., 2004 *Promoting walking and cycling as an alternative to using cars: systematic review*, British Medical Journal Vsol. 329, p. 763 – 766.

Parker A., 2000 *The Dutch model for making walking and cycling safer*, Paper for Safe Cycling Conference, Brisbane. www.rsconference.com/roadsafety/detail/227

Pate R.R., 1995 *Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine*, Journal of the American Medical Association, Vol. 273, p. 402 – 407.

Peacock J., Hine R., Pretty J., 2007 *Got the blues, then find some greenspace: The mental health benefits of green exercise activities and green care*, Mind week report February 2007, University of Essex, United Kingdom. http://www.mind.org.uk/mindweek

Planning and Land Authority, 2006 *Bicycle Parking Guidelines*, Australian Capital Territory, Canberra. http://apps.actpla.act.gov.au/tplan/planning_register/register_docs/bike_guidelines.pdf

Popkin B.M., Duffey K., Gordon-Larsen P., 2005 *Environmental influences on food choice, physical activity and energy balance*, Physiology and Behaviour, Vol. 86, p. 603 – 613.

Powell K.E., 2005 *Land use, the built environment, and physical activity: a public health mixture; a public health solution*, American Journal of Preventative Medicine, Vol. 2, p. 216 – 217.

Pretty J., Griffin M., Sellens M., Pretty C., 2003 *Green Exercise: Complementary roles of nature, exercise and diet in physical and emotional well-being and implications for public health policy*, CES Occasional Paper 2003-1, University of Essex, United Kingdom.

Pucher J., 2006 *Public Health and Urban Transport*, Presentation at the Sustainable Living Festival, Federation Square Melbourne, 18th February.

Pucher J., Buehler R., 2008 *Making Cycling Irresistible: Lessons from the Netherlands, Denmark and Germany*, Paper accepted for publication in Transport Reviews, Vol. 28, July.

Pucher J., Dijkstra L., 2003 *Promoting Safe Walking and Cycling to Improve Public Health: Lessons from the Netherlands and Germany*, American Journal of Public Health, Vol. 93, No. 9.

Racioppi F., Dora C., Rutter H., 2005 *Urban settings and opportunities for healthy lifestyles: rediscovering walking and cycling and understanding their health benefits*, Built Environment, Vol. 13, p. 302 – 314.

Research Australia, 2007 *Healthy Planet, Places and People*, Research Australia, Sydney, Australia. http://www.thankyouday.org/content/documents/web_EnviroReportRA.pdf

Rissel C., Campbell F., Ashley B., Jackson L., 2002 *Driver road rule knowledge and attitudes towards cyclists*, Australian Journal of Primary Health, Vol. 8, No. 2, p. 66 - 69.

Rissel C., Garrard J., 2006 *Cycling for active transport and recreation in Australia: status review and future directions*, World Transport Policy and Practice, Vol. 1, p. 49 – 63.

Rissel C., Merom D., Wen L.M., Bauman A., Garrard J., New C., 2007 *Cycling Connecting Communities –Baseline survey results, August 2007*. Liverpool: Sydney South West Area Health Service.

Rissel C, New C., Pham S., Bindon J., *Cycling Connecting communities – a cycling promotion research project in south west Sydney*. Paper presented at the Bicycle Research Interest Group Muster, January 2008, University of South Australia

Robinson D.L., 2005 *Safety in numbers in Australia: more walkers and bicyclists, safer walking and bicycling*, Heath Promotion Journal of Australia, Vol. 16, Issue 1, pp. 47-51.

Robinson T.N., Hammer L.D., Killen J.D., 1993 *Does television viewing increase obesity and reduce physical activity? Cross-sectional and longitudinal analyses among adolescent girls*, Pediatrics, Vol. 93, p. 273-280.

Rose G., 2003 *Event Based Behaviour Change: A Literature Review Focussing on Transport Applications*, Institute of Transport Studies, Monash University, Melbourne. http://www.bv.com.au/file/file/RTW/Event%20Based%20Behaviour%20Change%20Lit%20Review%20Final%20Report.pdf?phpMyAdmin=DhLMKS7n7oG8nlonGyRgo-K1uw6

Royal Melbourne Institute of Technology, 1999 *Victorian Activity and Travel Survey, 1994 – 1999*, Melbourne.

Russell M., 2007 *Don't speed and swear, drivers warned*, The Age, September 16th.

Saelens B., Sallis J., Frank L., 2003 *Environmental correlates of walking and cycling: findings from the transportation, urban design and planning literatures*, Annals of Behavioral Medicine, Vol. 25, p. 80 – 91.

Sallis J., Bauman A., Pratt M., 1998 *Environmental and policy interventions to promote physical activity*, American Journal of Preventative Medicine.

Sallis J. F., Frank L. D., Saelens B.E., Kraft M.K., 2004, Active transportation and physical activity: opportunities for collaboration on transportation and public opportunities health research, Transportation Research Part a-Policy and Practice, Vol. 38, No. 4, p. 249-268.

Sanigorski A.M., Bell A.C., Kremer P.J., Swinburn B., 2007 *Can community-based childhood obesity prevention programs reduce the socioeconomic status (SES) gradient with body mass index (BMI)?*, International Journal of Obesity, Vol. 31: suppl 1, pS38.

Saris W.H.M., Blair S.N., van Baak, M.A.., Eaton S.B., Davies P.S.W., Di Pietro L., Fogelholm M., 2003 How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1st Stock Conference and consensus statement. Obesity Reviews, 4, 101.

Sentence A., 2006 *Are we there yet? A comparison of transport in Europe* United Kingdom Commission for Integrated Transport, London http://www.cfit.gov.uk/docs/2007/ebp/pdf/ebp.pdf

Sevick M.A., Dunn A.L., Morrow M.S., Marcus B.H., Chen G.J., Blair S.N., 2000 *Cost-effectiveness of lifestyle and structural interventions in sedentary adults: results of Project ACTIVE,* American Journal of Preventive Medicine, Vol. 19, No. 1. p. 1 - 8.

Sobal J., Stunkard A.J., 1989 *Socioeconomic status and obesity: a review of the literature*, Psychological Bulletin, Vol. 105, p. 260 – 275.

Social Exclusion Unit, 2003 *Making the Connections: Final Report on Transport and Social Exclusion*, The Stationery Office, Norwich, United Kingdom. ttp://www.cabinetoffice.gov.uk/social_exclusion_task_force/documents/publications_1997_to_2006/making_transport_summary_2003.pdf

Statistics Netherlands, *2005 Transportation Statistics*. Amsterdam, Netherlands.

Steel K., 2007 *Bicycling and Walking in the US: Benchmarking Report 2007*, Thunderhead Alliance, United States of America. http://www.thunderheadalliance.org/benchmarking.htm

Sully A., 2005 *Invisible infrastructure, Proceedings of the fifteenth Velo-city cycling conference*, Dublin, 31 May.

Swinburn B., Egger G., 1996 *An "Ecological" Approach to the Obesity Pandemic*, British Medical Journal, Vol. 315, p. 477 – 480.

Swinburn B., Egger G., Raza F., 1999 *Dissecting obesogenic environments: the development and application of a framework for identifying and prioritising environmental interventions for obesity*, Preventative Medicine, Vol. 29, p. 563 – 570.

Telfer B., Rissel C., Bindon J., Bosch T., 2006 *Encouraging cycling through a pilot cycling proficiency training program among adults in Sydney*, Journal of Science and Medicine in Sport, Vol. 9, p. 151 – 156.

The Royal Society for the Prevention of Accidents, 2001 *The Effectiveness of Cyclist Training*. September. http://www.rospa.org.uk/pdfs/road/cyclisttraining.pdf

Timperio A., Ball K., Salmon J., Roberts R., Giles-Corti B., Simmons D., Baur L.A., Crawford D., 2006 *Personal, family, social, and environmental correlates of active commuting to school*, American Journal of Preventive Medicine, Vol. 30, No. 1, p. 45-51.

Town of Vincent, 2004 *Policy 3.7.1: Parking and Access*, Planning and Building Policy Manual, Town of Vincent, Western Australia. http://www.vincent.wa.gov.au/cproot/420/6586/3.7.1 Parking and Access.pdf

Transport for London, 2007 *Impacts monitoring*, Fifth Annual Report, July. http://www.tfl.gov.uk/corporate/projectsandschemes/roadsandpublicspaces/2287.aspx#reports

Transport Western Australia, 1996 *Bike Ahead: Bicycle Strategy for the 21st Century*, Western Australian Government, Perth.

Tranter P.J., 1996 *Children's independent mobility and urban form in Australasian, English and German cities*, In D. Hensher, J. King & T. Oum (Eds.), *World Transport Research: Proceedings of the Seventh World Conference on Transport Research, Volume 3*: Transport Policy, p. 31 – 44, Sydney: World Conference on Transport Research.

Tranter P., 2004 *Effective Speeds: Car Costs are slowing us down*, Australian Greenhouse Office, Department of the Environment and Heritage, Australian Government, Canberra. http://www.greenhouse.gov.au/tdm/publications/pubs/effectivespeeds.pdf

TravelSmart, 2003 *Packaging the travel choices: schools*, TravelSmart Australia, Australian Greenhouse Office, Australian Government, Canberra.

TravelSmart, 2004 *TravelSmart News November*, Department of Infrastructure, Victorian Government, Melbourne. http://www.travelsmart.vic.gov.au/doi/doielect.nsf/2a6bd98dee287482ca256915001cff0c/161c08f44e7ec7e9ca256f470011eb9f/$FILE/TravelSmart%20November%202004.pdf

Trost S. G., Owen N., Bauman A. E., Sallis J., Brown W., 2002 *Correlates of adults' participation in physical activity: review and update*, Medicine and Science in Sports and Exercise, Vol 34.

Tudor-Locke C., Ainsworth B., Adair L.S., Du S., Popkin B.M., 2003 *Physical activity and inactivity in Chinese school-aged youth: the China Health and Nutrition Survey*, International Journal of Obesity, Vol. 27, No. 9, p. 1093 - 1099.

U.S. Department of Transportation, 2003 *National Household Travel Survey, 2001*. Federal Highway Administration, Washington, DC:

VicHealth, 2006 *School Pedal Pod Guide*, VicHealth, Victorian Government, Melbourne. http://www.vichealth.vic.gov.au/assets/contentFiles/PedalPod_Guide.pdf

Voelcker J., 2007 *A critical review of the legal penalties for drivers who kill cyclists or pedestrians*. http://www.jake-v.co.uk/resources/documents/cycling/summary_of_findings.pdf

Wagner A., Simon C., Evans A., Ferrieres J., Montaye M., Ducimetiere P., Arveiler D., 2002 *Physical activity and coronary event incidence in Northern Ireland and France - The Prospective Epidemiological Study of Myocardial Infarction (PRIME)*, Circulation, Vol. 105, No. 19, p. 2247 - 2252.

Wardlaw M.J., 2000 *Three lessons for a better cycling future*, British Medical Journal, Vol. 321, p. 1582 - 1585.

Welleman T., 2000 *Dutch experience with government bicycle policy*, Proceedings of the Velomondial International Cycling Conference, Amsterdam.

Wennberg P., Lindahl B., Hallmans G., Messner T., Weinehall L., Johansson L., Boman K., Jansson J.H., 2006 *The effects of commuting activity and occupational and leisure time physical activity on risk of myocardial infarction*, European Journal of Cardiovascular Prevention & Rehabilitation, Vol. 13, No. 6, p. 924 - 930.

Whitaker E., 2005 *The bicycle makes the eyes smile: exercise, aging, and psychophysical well-being in older Italian cyclists*, Medical Anthropology, Vol. 24, No. 1, p. 1 - 43.

Whitelegg J., 2006 *Presentation to the City of Greater Dandenong*, Dandenong Town Hall, October 20th.

Winters, M., Friesen M., et al, 2007 *Utilitarian bicycling: a multilevel analysis of climate and personal influences*, American Journal of Preventative Medicine, Vol. 32, No. 1. p. 52 - 58.

Wood L., Moynihan S., 2007 *The curious case of a cyclist's life destroyed*, The Age, September 12th.

Wooldridge C., 2005 *Cycling, the re-emerging transport mode*, Proceedings of the *'Transit Oriented Development-Making it Happen'* Conference, Fremantle, 5 - 8 July, Perth, WA: Planning and Transport Research Centre. www.patrec.org.conferences/todJuly2005/papers/wooldridge.cpdf

World Health Organisation, 2000 *Air Quality Guidelines for Europe, 2nd ed*, WHO Regional Office for Europe, Publications European Series No.: 91, Copenhagen.

World Health Organisation, 2006 *Promoting physical activity for health: A framework for action in the WHO European Region*, WHO European Conference on Counteracting Obesity: Diet and physical activity for health, Istanbul, Turkey, 15 – 17 November. http://www.euro.who.int/Document/NUT/Instanbul_conf_edoc10.pdf

World Health Organisation, 2004 *Young people's health in context: Health behaviour in school aged children study: international report from the 2001/2002 survey*, World Health Organisation Regional Office for Europe, Copenhagen, Denmark.

Cycling offers an effective form of physical activity, providing significant contributions to public health. When used as an alternative to motorised transport, cycling is an effective method of reducing greenhouse gas emissions, congestion and increasingly expensive fuel costs

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PO Box 3052 Auburn VIC 3123
T 03 9818 5400 **F** 03 9818 4535
E office@cyclingpromotion.com.au
W www.rideabike.com.au