

PEDALLING HEALTH

—HEALTH BENEFITS OF A MODAL TRANSPORT SHIFT

Ian Roberts, Harry Owen, Peter Lumb, Colin MacDougall

'Excess eating of sweet and fatty foods, lack of exercise and excess of sleep causes obesity. There is impaired tissue metabolism leading to weakness and degeneration of tissues. There is a coating and obstruction of different channels in the body resulting in decreased supply of nutrients to tissues leading to death. [...] —exercise may be protective.'

Sushruta Samhita 600 BC

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1. SUMMARY

The aim of this report is to present medical research on the benefits accruing from incorporating exercise into daily living patterns and particularly why cycling for transport has been identified as a sustainable and health-promoting mode of transport to be encouraged over car use wherever possible.

Technology has all but replaced adult human effort in the home and workplace. The journey to work or school which until quite recently involved a walk to public transport or a cycle ride is now mostly by motor vehicle and the walk to the local shop is now a drive to a shopping centre. The population has become sedentary and health agencies in Australia are now grappling with the illness burden arising from this rapid reduction in physical activity. The cost of treating the adverse consequences using drugs and surgery is threatening to overwhelm our health-care systems unless major change occurs.

One scenario is to increase health-care funding for treatment of illness through additional taxation and another is to increase exercise in the community again. The former is politically unacceptable but campaigns to encourage individuals to undertake physical activity have been relatively ineffective. There appears to be no reliable innate drive to exercise and there is a prevention paradox; for individuals exercising produces no immediate gain but it is the community that benefits. Structural changes in the built environment and community attitudes are necessary so that exercise becomes integrated into every day life.

The physical activities that are most health promoting are moderate, habitual and not seasonal. Surveys reveal that the only activities that meet these requirements and are maintained throughout life are walking, gardening and cycling. Government promotion of cycling would not only increase exercise throughout the community it would reduce the impact of transport on the environment and reduce the need for expensive road construction. The transport system has become wholly centred on the car to fulfil the majority of personal transport needs. Current planning regulations and taxation policy assure this situation will continue even though giving people the facilities that would make cycling a transport option would provide an ideal opportunity for increased healthy physical activity.

Physical activity not only protects against disease it can promote health. It is a myth that exercise must make you sweaty and breathless to be good for you. In fact all exercise is beneficial improved cardiovascular health can be obtained from a summation of activity equivalent to approximately 2000 kCal/week—equivalent to approximately six hours cycling per week. The ‘No pain - No gain’ mentality has a negative public health message; by suggesting the need for high intensity exercise many are put off and those that participate expose themselves to unnecessary risks. There is a similar danger in concentrating on sport and recreation promotion rather than increased healthy activity in the community. There is also a disturbing trend towards packaging exercise as a commodity for sale or prescribed as treatment by health-care professionals.

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Among Australians perceived obstacles to physical activity are lack of time, being tired and not wanting to be involved in sporting or competitive activities. Cycling for transport is not a sport nor is it competitive. It can be undertaken by most members of society who wish to build exercise into their normal activities. The moderate, frequent exercise required to cycle to work, school, shops, friends, etc, is 'preventative maintenance' of a healthy body.

There is a strong negative association between fitness and death rates from all causes. Attempts have been made to isolate the effects of physical activity from the physiological risk factors for cardiovascular disease including high blood pressure, obesity and unhealthy blood lipid profiles however exercise has a beneficial corrective action on all these risk factors. It appears that in men the relative risk of a heart attack from being sedentary is similar to smoking 20/day, having a systolic blood pressure over 150 mm Hg or having a blood cholesterol over 6.9 mmol/L.

The significance of physical inactivity is its prevalence amongst Australians, 27% are sedentary, at least 55% have insufficient exercise to have any appreciable benefit and only 15-20% have enough exercise for optimal protection. The cost of cardiovascular disease in Australia was almost \$4 billion in 1989-90. The proportion of this cost attributable to lack of exercise as an independent risk factor was \$1.2-1.6 billion in that year. A commitment to cycling would not only improve community health significantly it would dramatically reduce health-care costs.

Overseas experience indicates that regular cycling can be undertaken by people with a wide range of age and fitness levels and that campaigns and supportive policies to encourage cycling can increase the amount of physical activity in the population. In these studies women more often than men reported that physically active commuting was their main form of physical activity. Cyclists more than walkers emphasised fitness and ease of transport as the main reason for choice of transport mode. The exertion of commuter cyclists was in the middle of the range required for aerobic stimulus whilst walking was in the lower range and below that for a 'training response'. In addition the level of exertion among cyclists was ideal for protection against maturity-onset diabetes whilst that of walkers was again sub-optimal. The health benefits of work- and leisure-based physical activity has been the subject of epidemiological research, incidental exercise derived from transport has received relatively little attention.

A sedentary lifestyle takes its toll through:

- coronary heart disease (CHD),
- stroke,
- obesity and
- maturity-onset diabetes.

Regular exercise not only reduces total cholesterol in blood it increases the high density lipoprotein:cholesterol ratio, ie it results in a healthier blood lipid profile. Exercise also has a beneficial effect on blood clotting making strokes and heart

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attacks less likely. It also reduces these devastating and expensive illnesses through an effect on blood pressure. Regular exercise reduces the prevalence of blood pressure and the relative risk of death from high blood pressure is 34% higher than the general population. Australian research revealed that in people with high blood pressure regular cycling reduced the blood pressure as much as drugs.

Physically active people are rarely obese. Obesity leads to increased blood pressure and abdominal obesity (the typical Australian male pattern) is a risk factor for CHD. The prevalence of maturity-onset diabetes in South Australia is 5% and expected to double in the next 20-30 years. A serious disease itself, it is a risk factor for cardiovascular disease and compounds the effect of other risk factors. The disease and its complications (including vascular disease leading to gangrene and kidney failure), are costly to treat and have a major effect on quality of life. Maturity-onset diabetes is strongly related to a sedentary lifestyle and increased physical activity has a protective effect. This is through the effect of exercise on the action of insulin and the utilisation of glucose by the body.

Increased cycling does incur costs. It requires additional facilities and services and cyclists occasionally are involved in accidents. Cycling is widely perceived to be an unsafe activity but very few people consider the consequences of their sedentary lifestyle on health. The risk of injury requiring hospital treatment as a result of cycling is around 0.005 per 100 hours; this compares with 0.19 for football, 0.13 for squash, 0.11 for basketball and netball and 0.06 for soccer. Hospitalisation figures reveal that whilst the rate of all accidents is too high cyclists typically bear less severe injuries than other classes of road users. The data on cyclist involvement in collisions is incomplete but it appears that young males are most at risk of being injured. However, almost 90% of critical injuries to cyclists (including fatalities) occur as result of collision with motor vehicles and the major determinant of the injury is the speed of that vehicle. The 'windscreen-shaped' view of road planning has created a road network that is often hostile to cyclists and road safety has concentrated on the occupants of motor vehicles. A major international road safety conference called pedestrians and cyclists 'vulnerable road users' but concluded because of their low cost, negligible energy consumption and environmental compatibility they should be encouraged and promoted by appropriate planning of the transport system.

A comparison of all the benefits accruing with injuries arising from the activity is beyond the scope of this report. However, conclusions can be drawn from the death rate of non-cyclists from CHD which is far higher than that of cyclists from CHD and cycling accidents. Whilst the health benefits of cycling outweigh the risks the situation now can be described as 'if you live long enough you'll live longer'. This is unacceptable and urgent attention to road safety for cyclists is required. Overseas and interstate experience is that as the number of cyclists increases, more drivers have recent experience of cycling (as occasional cyclists) and drivers become more experienced among cyclists, so cycling becomes safer. Perhaps the best road safety measure is to increase cyclist numbers.

The shift to more active transport has some obstacles, traffic fumes, congestion, noise and safety. Environmental change to allow for, or even encourage increased

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physical activity has received scant attention. Strong coordinated action is required. In Adelaide the weather, terrain and distances between destinations make cycling a viable transport option. With appropriate action by road planners and road safety professionals the road network can be made safer for cyclists. Planning regulations could be modified to improve provision of end-of-trip facilities for cyclists in new developments. Lower speed limits would both make cycling safer and reduce the severity of cyclist injuries following collision with a motor vehicle. Subtle changes to tax laws could make commuting by bicycle desirable. High profile role-models using bicycles instead of cars for short journeys would begin to shift community attitudes.

Health agencies world-wide are calling for increased cycling, from the British Medical Association, which recently called on doctors to set an example like they did with smoking and get on their bikes to the Commonwealth Department of Health which recommended strategies be developed to encourage cycling and walking over car use. The message for South Australia is clear. A commitment to cycling will result in a far healthier community.

2. RECOMMENDATIONS

The health benefits of a modal shift to cycling are so overwhelming that the investigators recommend that:

1. Strategies be developed and implemented to realise the South Australia Government's Cycling Policy.
2. Recommendations from the Commonwealth Department of Human Services and Health in favour of walking and cycling over car use be endorsed and implemented in South Australia.
3. An appropriate person be appointed to the Road Safety Advisory Council to represent and advocate the interests of pedestrians and cyclists.
4. The South Australian Office of Road Safety become actively involved in improving the safety of cycling in South Australia.
 - a) The South Australian Office of Road Safety develop road safety expertise relevant to cyclists.
 - b) Research be undertaken to develop strategies to reduce the risk projected onto cyclists by motor vehicles.
 - c) Research be undertaken to identify particularly risky cyclist behaviour and reduce the risks of that behaviour.
 - d) Strategies be developed to improve the safety of young cyclists including footpath cycling and alternatives to arterial roads.
 - e) Bicycle travel demand management be discarded as inappropriate and inequitable.
5. Research be undertaken to identify modifiable obstacles to incipient cyclists including but not limited to road safety and end-of-trip facilities.
 - a) Strategies be developed to remove obstacles to cycling.
6. Strategic education campaigns be developed to create a climate of opinion receptive to lower vehicle travel speeds.
 - a) Motor vehicle travel speeds be reduced to 40 km/h on arterial roads in urban areas.
 - b) Streets in residential and commercial precincts be treated to reduce vehicle speeds below 40 km/h.
7. Strategies be developed to provide incentives to replace motor vehicle trips with cycling and walking wherever possible. These might include road pricing, taxation rebates, hypothecation.

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3. OVERVIEW

An increase in cycling for transport will reduce the:

- **incidence** of coronary heart disease, diabetes and associated complications, obesity and osteoporosis and
- **expenditure** on drug treatment of hypertension and coronary heart disease.

To maximise these benefits a refocussing of road safety and transport planning is needed to make roads safer and more attractive for cyclists and to provide off-road alternatives where feasible.

Physical activity has been largely excluded from modern lifestyles and exercise is relegated to a leisure activity for many people. Cycling for transport has been identified as a sustainable and health-promoting mode of transport to be encouraged over car use wherever possible (DHS 1994; Houghton 1994; BMA 1992).

The structural factors affecting people's lifestyles must be changed if health is to be promoted. Improved sanitation, protection of air quality and provision of better housing are examples of structural changes that have enabled healthier lifestyles.

While people have a right and responsibility to participate in the protection and development of their own health, good health in the community is a major resource for social, economic and personal development and therefore becomes an appropriate public issue (WHO 1986).

There appears to be a lack of genuine political commitment to sustainability and our social, economic and political systems favour private consumption and are technologically oriented. Champions of environmentally sustainable policies in health, transport and other sectors are confronting these aspects of industrial capitalism. Cycling for transport is a 'no regrets' sustainable transport option that brings many benefits.

With a reduction in work based physical activity and increasingly stressful lives, Australians need be provided with opportunities to incorporate physical activity into their lives. Allowing people to choose cycling for transport provides an ideal opportunity for increased healthy physical activity.

The developing consensus amongst researchers investigating physical activity as a key attribute of healthy lifestyles is that physical activity should be moderate, frequent and maintained for a large proportion of people's lives.

From a health promotion perspective, a key determinant for feasibility is the intensity of the exercise, because strenuous exercise, like jogging, exceeds the abilities and motivations of many inactive, middle-aged, older and sick people and increases the risk of exercise induced cardiovascular complications (Vuori 1991).

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The integration of physical activity incidental to other lifestyle choices presents an opportunity for improved health. Worryingly, physical exercise and fitness are being commodified—identified as products to be packaged, promoted and sold to the public by commercial operators and therapies to be prescribed and supervised by medical or health care professionals (BMA 1992).

It is essential to realise that exercise has a ‘preventative maintenance’ effect on the body that may be its most vital function rather than as a remedy to be prescribed to cure a disease (Paffenbarger and Hyde 1984).

With only 15% of the Australian population exercising at a level that provides optimum protection and twice that number who can be described as sedentary there is a huge possibility for increased physical activity (DASET 1992).

Since exercise for prevention of coronary heart disease, cardiovascular disease and other lifestyle-related diseases is the best prospect for improved public health, (Morris 1994) the decision to opt for cycling as a mode of transport could contribute significantly to a dramatic improvement in community health and a reduction in health costs.

To date, ‘exercise’ and activities associated with sport have been promoted. These are attractive to *coqs sportif* in the community but they are the people who are already sufficiently active. Cycling for transport is not a ‘sport’ and may be an attractive form of exercise for many not so-inclined.

While the health benefits of work and leisure based physical activity have been the focus of epidemiological study, incidental exercise derived from other categories of activity such as transport has received little attention.

The spectrum of the health benefits from physical activity is broad. Interventions to increase physical activity address the root cause of many modern lifestyle related diseases and do so without many damaging side effects. The multiple benefits and limited side effects mean that exercise may be the preferred treatment in many cases (Vuori 1991).

The potential benefits of increased physical activity in the community by an increased use of bicycles for transport is clearly indicated by overseas studies.

Increased physical activity addresses the root cause of many lifestyle related diseases and therefore should be the preferred intervention. Increases in physical activity produce benefits in the main physiological *risk factors* for cardiovascular disease and diabetes:

- high blood pressure
- obesity
- blood lipid profiles

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Increased physical activity also produces additional benefits independent of these rewards.

Because of the difficulty of identifying groups at elevated risk and because deaths in these undetected high-risk categories constitute a large proportion of deaths, broad population-based structural changes are likely to reap major benefits (Rose 1981). Policies to increase physical activity in the population through increased use of cycling and walking for transport are well suited to this approach.

Cycling for transport can provide a large proportion of the moderate exercise needed for optimum protection against cardiovascular disease and diabetes and can be integrated into lifestyles so that little extra time is required. Cycling for transport provides a valuable alternative physical activity to sport.

As with any form of physical activity a significant health cost of cycling is the risk of injury but the rate of injury is lower than other popular forms of exercise. However, the risk of serious injury following collision with a motor vehicles must be addressed. It must be recognised that this risk is a cost of both cycling and motor vehicle travel and strategies to reduce this risk must not only focus on the victim.

There is a developing climate of opinion that environmentally sustainable and health-promoting modes of transport should be encouraged and the principles outlined in the Delhi Declaration should be adopted in South Australia to guide road safety policy. Even under current conditions, the health benefits of cycling outweigh the health costs.

Cyclists have been disadvantaged and prospective cyclists discouraged because there has been a general:

- failure to recognise the private automobile as a vector for various lifestyle-related diseases because of the sedentary lifestyle it engenders
- characterisation of cycling as dangerous and car driving as safe
- reluctance to recognise the important structural influences on human behaviour and health
- tendency to adopt simplistic models of public health intervention.

There is a developing climate of opinion around the world that cycling and walking should be promoted as environmentally sustainable and health promoting modes of transport. Strategies are needed that reduce the hazards projected by motor vehicles onto other road users. The most significant improvements could be achieved by lowering vehicle travel speeds in urban areas especially on arterial roads.

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Cyclists need road safety professionals to:

- accept that cycling and walking are not just legitimate but desirable forms of transport
- identify accurately the source of risk on our roads
- develop professional skills in and understanding of the safety needs of cyclists
- develop and introduce programs to reduce risk for cyclists and pedestrians
- become actively involved in securing a safe and pleasant environment for cycling.

Planning for cycling needs to be integrated into broader transport and urban planning. As a beginning, the *Delhi Declaration* could be widely adopted as a set of guiding principles for road safety. Discouragement of cycling as a road safety measure needs to be identified as inequitable and replaced with policies that improve cyclist safety by addressing the source of the hazard and reducing the hazard that motor vehicles project onto cyclists and pedestrians. Research is needed to identify strategies to improve the safety of cyclists rather than to discourage cycling.

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4. INTRODUCTION

‘All parts of the body which have a function, if used in moderation and exercised in labours in which each is accustomed, become thereby healthy, well-developed and age more slowly, but if unused and left idle they become liable to disease, defective in growth and age quickly.’

Hippocrates circa 460-377 BC (Jones 1967)

From the time of Hippocrates, there has been, and continues to be, general consensus that exercise is essential to good health. Scientific evidence in support of this understanding has only become available in the last 50 years (Leon 1984). Sharing the wisdom of antiquity, Dr Nicholas DiNubile, a Special Adviser to the US President’s Council on Physical Fitness and Sports has said that:

‘The human body is the only machine that breaks down when it is not used.’ (DiNubile 1993)

It has also been said that, ‘if exercise could be packed into a pill, it would be the single most widely prescribed and beneficial medicine available.’ Unfortunately, this pharmacological model will never be applicable, so policies are needed to promote exercise that is feasible, attractive and safe for the population at large (Vuori 1991).

4.1 Physical activity and modern life

Technological developments provide labour-saving devices that reduce human energy expenditure and encourage a sedentary lifestyle (Leon 1984). Indeed, many household appliances are actually promoted by highlighting how much effort they can ‘save’! Saving energy in the form of human effort appears to have become a cultural norm.

The facts that cardiovascular disease is the leading cause of death in Australia and responsible for higher hospital costs than any other disease category has led the Commonwealth Department of Human Services and Health to develop goals and targets and to seek strategies to alleviate this problem (Nutbeam, Wise et al. 1993).

One of the major strategies of the Commonwealth Department of Human Services and Health to reduce cardiovascular disease is to increase participation in regular physical activity (Wise and Graham-Clarke 1994). As the most widespread contributor to heart disease, physical inactivity has been the ‘Cinderella’ of illness prevention in recent times. Difficulties in measurement and the development of intervention strategies have seen this area under-emphasised or even over-looked in recent surveys of the health of Australians (Wise and Graham-Clarke 1994).

However, recognising the urgent need to encourage and enable Australians to incorporate more physical activity in their lives, the Commonwealth Department of Human Services and Health now recommends that cycling as a form of transport

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be encouraged in favour of car travel wherever possible and that governments at all levels should develop strategies to achieve this transport modal shift (DHS 1994, p56).

4.2 Different roles for physical activity

Physical activity is undertaken for a number of different reasons. Analyses of physical activity and lifestyle usually focus on activity involved in employment and leisure-time activity. However, this dichotomy overlooks physical activity that is integrated with other life activities—especially when policies for change are being considered.

A successful campaign to increase physical activity through cycling for transport is likely to have a very different focus and concentrate on different facilities and attitudes than campaigns promoting leisure activities. The obstacles preventing Australians from integrating physical activity in their lives, and cycling for transport is a good example, are not likely to be the same as the obstacles preventing them from pursuing physically active recreation.

4.3 Intersectoral health policies

In the *Ottawa Charter for Health Promotion*¹, the *World Health Organisation*, *WHO*, has observed that:

‘the pre-requisites and prospects for health cannot be ensured by the health sector alone’

The Charter went on to commit health promoters to advocate for healthy policies in all sectors (WHO 1986, para 8).

Stating that, ‘a strictly health sectoral approach is not enough’, the *Australian National Health Strategy* proposes changes to:

- promote intersectoral action
- enhance the nation’s capacity to achieve health gains and
- improve access to opportunities for health improvement (NHS 1993, Chapter 6).

¹ As a seminal document defining and informing current health promotion philosophy and policy, the full text of the *Ottawa Charter for Health Promotion* has been included in an appendix to this report.

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4.4 Environmental health benefits

Examining transport from an environmental health perspective, the UK Royal Commission on Environmental Pollution stated in its Eighteenth Report released last year that:

- the environmental health costs of motor traffic in the form of air and noise pollution, lost social amenity and road trauma are unsustainable
- continued reliance on motor traffic can not be maintained
- a modal shift to cycling as an environmentally benign and health promoting form of transport is needed (Houghton 1994).

There is an urgent need for the links between public and environmental health to be identified and for that information to inform the public debate on ecological sustainability (Camkin 1994).

4.5 Health promoting transport

In the past, intersectoral action has provided a reliable sewerage system, potable water and a better stock of housing. Since continued car-dominance is not sustainable and contributes to a vicious cycle that discourages more sustainable transport options, the time has come to apply these intersectoral precedents to the transport system (Houghton 1994).

Options need to be considered and priorities set for transport modes that are health promoting (BMA 1992; DSHS 1994). Public and environmental health issues must be seen as intimately linked to the issue of ecological sustainability (Camkin 1994).

Transport and accessibility is vital to urban life and yet motorised travel has major environmental impacts especially in terms of local air quality, noise and injury.(Horton-Stephens, Ray et al. 1994) The bicycle provides an efficient, healthy and economical form of transport for a large section of the population and has the capacity to:

- increase the accessibility of Australian cities
- aid the mobility of residents
- provide significant health benefits (Horton-Stephens, Ray et al. 1994).

5. PREREQUISITES FOR HEALTH

'The doctor of the future will give no medicines. Instead he [sic] will interest the patient in the care of the human frame, in diet and in the cause and prevention of disease.'

Thomas Edison

In the *Ottawa Charter for Health Promotion*, developed and adopted at the first *International Conference on Health Promotion*, meeting in Ottawa in 1986, the World Health Organisation (WHO) identified the social structure and environment in which people live as the most crucial factor that needs to be changed in order to achieve improved and more equitably distributed public health (WHO 1986). Programs attempting to urge people to make healthy life decisions are doomed to failure if they are mounted within an environment that encourages unhealthy options.

5.1 Intersectoral health

It is well accepted that interventions to improve health can be made at a number of levels:

- medical—treats an existing problem
- public health—prevents the onset of a problem by education and encouragement
- socio-environmental—creates social and physical environments that nurture individual health and well-being (Labonte 1989; Labonte 1992).

Recognising the inequalities of health in general and the uneven distribution of risk factors in particular, interventions need to be developed that cut across socioeconomic divisions. Medical interventions and health education target identified high risk groups and frequently offer little benefit to undiagnosed or socially disadvantaged groups (Rose 1981). Structural changes aimed at socio-environmental development to empower the community to lead more healthy lifestyles and pre-empt the development of disease are more equitable.

Australian public health professionals agree that:

'many of the great public health and health promotion achievements have come from individuals working outside the medical and hospital systems.' (NHS 1993, p14-5)

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5.2 Structural change

Alternatively, interventions designed to promote health can be classified as being directed to encourage the individual to make alternative choices or to remove social, environmental and structural obstacles to those choices.

In a book published by the WHO, Beaglehole argues that the importance, recent neglect and intersectoral characteristics of these structural issues justify the adoption of the term ‘primordial health care’ to focus attention on this area. Beaglehole believes that:

‘developments in primordial health care have the most to contribute to the health and well-being of the whole population [...] The aim of primordial prevention is to avoid the emergence and establishment of the social, economic and cultural patterns of living that are known to contribute to an elevated risk of disease.’ (Beaglehole, Bonita et al. 1993, Chapter 6)

5.3 Illness prevention

Health promotion for illness prevention is often overlooked and under-resourced because the long-term nature of the benefits make assessment difficult. An added problem is that the costs are likely to be incurred in the life of current administrations and the benefits accrued during future administrations (NHS 1993, p15). These problems are even more acute for socio-environmental measures. The under-resourcing of the health promotion sector renders it less powerful than sectors responsible for more conventional medical interventions and less influential than other interests groups closely related to transport and transport-related manufacturing industries.

Epidemiological research has focussed on four key personal behaviours: smoking, alcohol consumption, diet and exercise with little attention being paid to the context in which these behaviours develop. Healthy behaviours can only be effectively encouraged by providing a supportive context (Martin and McQueen 1989).

5.4 Measures of health

Discussing the health benefits of regular cycling requires consideration of appropriate measures of health. For example, simply looking at deaths ignores illness and quality of life issues which are clear benefits of regular cycling. Quality of life includes: age at death, severity of physical disabilities in later years and number of years of disabilities prior to death (Labonte 1992).

Unfortunately, little quantitative data is available on the amount of illness caused by physical inactivity in Australia nor is there reliable information on the extent of cycling in Australia. The rate of accidents to cyclists as a function of time or distance cycled is therefore difficult to assess. Notwithstanding these gaps in our knowledge, policies are needed that simultaneously increase the use of bicycles in

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the community and make cycling safer. Strategies that improve the safety and perceived safety of cycling in the community are likely to be the most effective at increasing the use of bicycles for transport.

5.5 Limits of health promotion

It is accepted that, because the need to be physically active to stay alive (in the short term) has largely been removed in the developed world by modern technology and changing work practices, levels of physical activity in the general population is now at an historical low.

There appears to be no dependable innate drive for humans to be physically active and voluntary decisions to be active appear to be unreliable (Durnin 1992). There may be an evolutionary basis for an apparent desire to minimise effort. For example, an advantage would be enjoyed by hunters and gatherers who could conserve energy when a regular food supply was not assured while the work involved in food collection and other critical activities would involve a great deal of moderate and limited strenuous exercise.

The circumstances of modern life in developed countries supplies ample food for most people and requires a limited amount of physical activity. The dangers of this sedentary life are clear and are generally not lessened by health promotion campaigns that encourage people to be more active in their recreational activities (Durnin 1992). It is structural changes that are needed that encourage people to incorporate adequate physical activity in their daily lives.

Studies of interventions seeking to increase physical activity in populations indicate them to be of limited success (Dishman and Sallis 1994, p226). It should also be noted that those who do respond to public campaigns exhorting a more physically active lifestyle are those members of the population who are generally well-educated, single, young, male and of above average socioeconomic status (Heinonen, Oja et al. 1994; Shephard 1994). Fundamental changes are needed to the environment in which people live to make the healthy choice the easy choice. Cycling can be made a feasible alternative form of transport that is health-promoting.

5.6 Healthy transport

The *National Health Strategy* identifies the need to review and amend legislation and regulations in other non-health sectors to provide a framework that enhance the national health (NHS 1993, Chapter 5). Transport policy certainly has an influence on public health and this is acknowledged by the Commonwealth Department of Human Services and Health and by the Eighteenth Report from the UK Royal Commission on Environmental Pollution (DHS 1994; Houghton 1994). Both of these organisations have urged governments to adopt policies to discourage car use and encourage cycling as an environmentally benign and health promoting mode of transport.

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5.7 Sustainable Policies

In the developed world, the sustainability of transport policies is seen to be a crucial test for the commitment to sustainable development. To ensure sustainability, transport policies need to:

- strike a balance between transport and environmental protection
- provide for the economic and social needs for access rather than transport
- take measures to reduce the environmental impact of transport and influence the rate of traffic growth
- ensure that users pay the full social and environmental costs of their transport decisions (HMG 1994).²

5.8 Conclusion

Physical activity has been largely excluded from modern lifestyles and exercise is relegated to a leisure activity for many people. Cycling for transport has been identified as a sustainable and health-promoting mode of transport to be encouraged over car use wherever possible (DHS 1994; Houghton 1994; BMA 1992).

The structural factors affecting people's lifestyles must be changed if health is to be promoted. Improved sanitation, protection of air quality and provision of better housing are examples of structural changes that have enabled healthier lifestyles.

While people have a right and responsibility to participate in the protection and development of their own health, good health in the community is a major resource for social, economic and personal development and therefore becomes an appropriate public issue (WHO 1986).

There appears to be a lack of genuine political commitment to sustainability and our social, economic and political systems favour private consumption and are technologically oriented. Champions of environmentally sustainable policies in health, transport and other sectors are confronting these aspects of industrial capitalism. Cycling for transport is a 'no regrets' sustainable transport option that brings many benefits.

² A case may be made for subsidisation of some modes of transport but such decisions should be explicit, transparent and rational.

6. HEALTH BENEFITS OF PHYSICAL ACTIVITY

'Every time I see an adult on a bicycle I no longer despair for the human race.' **HG Wells**

Researchers in the field of lifestyle and health have considered two classes of physical activity: work-related and leisure-time activity. Cycling for transport is a class of activity that transcends these classifications and the characteristics of this type of activity are worthy of further investigation.

6.1 Exercise from transport

Over the last century structural changes have resulted in dramatic reductions in work-related physical activity and this trend is unlikely to be halted or reversed. At the same time a bicycle ride or long walk to work, or to public transport has largely been replaced by driving, ie structural change in urban transport have meant that most passenger trips are now completed with minimal physical exertion and people now seem unwilling to walk far to a train station or bus stop. Planning regulations ensure that subsidised car parking is provided adjacent to shopping centres and work sites but there is no requirement for access by public transport or end-of trip facilities by cyclists. Yet cycling for transport involves a form of exercise ideally suited to improved public health because of its physiological and social attributes (Vuori, Oja et al. 1994).

6.2 Cycling in Australian cities

Even in low-density Australian cities one third of all car trips are less than 3 km long (DTC 1993). Trips of this length are feasible even for inexperienced cyclists. Fifty percent of Australian households own at least one bicycle and yet most of these bicycles are left unused much of the time. (Horton-Stephens, Ray et al. 1994, p 423)

The health benefits from increased use of cycling will accrue to the cycling individual and to the broader community. The benefits to the individual are largely those of regular moderate exercise. The benefits to the community flowing from a modal shift from motorised to non-motorised transport come as a result of:

- reduced health care costs associated with lifestyle generated disease (Houghton 1994; NH&MRC 1992; DSHS 1994)
- reduced motorised traffic and therefore congestion (Horton-Stephens, Ray et al. 1994)
- reduced transport-related construction costs (Horton-Stephens, Ray et al. 1994)
- reduced air pollution (Houghton 1994; NH&MRC 1992)
- reduced noise (Houghton 1994; NH&MRC 1992).

The British Medical Association has determined that a modal shift from car to bicycle travel should be pursued in the same manner that other important public

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health issues have been pursued successfully in the past including: anti-smoking and seat-belt wearing (BMA 1992).

6.3 Physical activity and health

Improved cardiovascular fitness improves the way people handle stress and participation in moderate exercise involving rhythmical large-muscle activities is recommended by the American College of Sports Medicine for protection against cardiovascular disease (Leith 1994; Traunmuller, Weinstabl et al. 1994).

In the past health was described in terms of vigour and stamina and the ability to do work. More recently there has been a belief that ‘healthy people choose to do exercise’ rather than ‘exercise makes people healthy’. Evidence now exists that the inverse relationship between physical activity and cardiovascular disease indicates a causal relationship rather than simply a correlation due to self-selection. The Centers for Disease Control in the USA has recognised that regular physical activity:

- increases a person’s ability to perform daily activities more efficiently
- reduces the risk of specific chronic diseases, including cardiovascular disease
- lowers death rates in general (Heinonen, Oja et al. 1994).

6.4 Limitations of promoting exercise

While there is general agreement that physical activity is good for health, campaigns directed at increasing recreational physical activity have been largely unsuccessful. A comparative study of successive surveys of cardiovascular risk factors carried out by the National Heart Foundation indicates that, while there is heightened awareness of the benefits of exercise and there is a small drop in the proportion of Australians described as sedentary, there has been no significant rise in the prevalence of physical activity in the Australian population at a level providing optimum protection (NHF 1980; NHF 1989).

6.5 Conclusion

With a reduction in work based physical activity and increasingly stressful lives, Australians need be provided with opportunities to incorporate physical activity into their lives. Allowing people to choose cycling for transport provides an ideal opportunity for increased healthy physical activity.

7. HEALTHY EXERCISE

It is no longer debated whether or not exercise is beneficial, rather the debate has now shifted to the type of exercise that is most beneficial. Current emphases on poorly defined terms like ‘fitness’ should be replaced by a focus on lifetime physical activity as a more accurate measure of protection (Bauman, Owen et al. 1990).

Our understanding of the attributes of the most beneficial forms of physical activity is still developing. It has recently become apparent that quite moderate exercise can be beneficial provided it is performed sufficiently frequently and for sufficient duration. Optimal protection appears to be obtained at an exertion of approximately 2000 kCal/week (8400kJ/week) while appreciable protection may be detected at approximately 800 kCal/week. This energy expenditure corresponds to the exertion involved in commuter cycling for approximately 2.5–6 hours per week (Vuori, Oja et al. 1994).

It has been shown that, to provide protection against disease, exercise should be:

- moderate
- habitual
- not marked by seasonal variation (Magnus, Matroos et al. 1979).

That study identified cycling, walking and gardening as suitable activities providing significant protection (Magnus, Matroos et al. 1979). The 1985 Zutphen study demonstrated that both the percentage of the population participating in physical activity and the total weekly time spent in physical activity diminishes as age increases. However, for cycling, the decrease is less pronounced than it is for sports, hobbies and work-related physical activity. Within a supportive culture, cycling for transport has been shown to be an activity particularly acceptable to older men who demonstrate significant improvements in risk factors for cardiovascular disease including blood lipid profiles and high blood pressure due to their involvement in this activity (Caspersen, Bloemberg et al. 1990).

Marking the recent change in understanding about the ideal intensity of exercise required for protection from cardiovascular disease, an editorial in the New England Journal of Medicine makes the case clearly:

‘Exercise performed at frequent intervals and over a long time span provides protection against both the development of coronary artery disease and the triggering of myocardial infarction by strenuous exertion.’ (Curfman 1993)

7.1 Optimal physical activity

Physical activity can protect against cardiovascular disease, diabetes and other lifestyle related diseases but what exercise regimens are required? In past decades it has been considered necessary to exercise to a ‘sweaty and breathless’ state for 20-

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30 minutes three times per week in order to develop significant protection against these diseases. However our understanding is now changing.

A recurring theme in recent literature indicates that a summation of the total energy expenditure is the most important measure with approximately 2000 kCal/week providing optimum protection (Berlin and Colditz 1990).

This ‘optimum protection’ development has positive and negative consequences:

- On the one hand, the public health message is a much more palatable one. No longer is it necessary to tell sedentary people that they need to exercise at a discouragingly high level of intensity to achieve benefits. Inactive people can be reassured that gentle, frequent, habitual exercise is ideal and that it avoids the increased risk of exercise-induced severe discomfort and sudden death that accompanies unaccustomed intense exercise.
- On the other hand, methods of assessing the amount of energy expenditure need to be much more sophisticated to determine the *relative risk* to which people are exposed as a result of their particular lifestyle.

7.2 Intensity and quantity of exercise

The changing understanding of the desirable quantity and intensity of physical activity has generated new opportunities for health promotion. It is becoming clear that marked health improvements can be achieved from relatively mild exercise.

The ‘no pain no gain’ aphorism is therefore not only discouraging as a public health message it is also misleading and dangerous. While conferring significant health benefits exercise can also induce sudden coronary events including death. For protection, exercise needs to be moderate, habitual and maintained for a long period of one’s life. Campaigns to encourage one-off or infrequent activities may actually increase the overall risks (Eichner 1983; Curfman 1993).

Physical activity must be maintained throughout life. Current, continuing, adequate exercise, rather than a history of youthful or hereditary vigour and athleticism is protective against coronary heart disease in all age ranges. Lapsed athletes may be exposed to higher risks of heart attack than the general population (Paffenbarger and Hyde 1984). Here lies the danger in concentrating on sport and recreation promotion rather than increased healthy physical activity in the community.

Only by promoting activities that can form an integral part of people’s lifestyles can we expect to:

- increase the amount of regular, moderate and habitual activity in the community
- ensure that those sections of the community who are not interested or able to participate in sport-style recreation can enjoy the benefits.

7.3 Lifelong involvement

Studies from the United Kingdom indicate that there is a strong correlation between childhood and adult activity levels (Riddoch, Savage et al. 1991). Inactive children

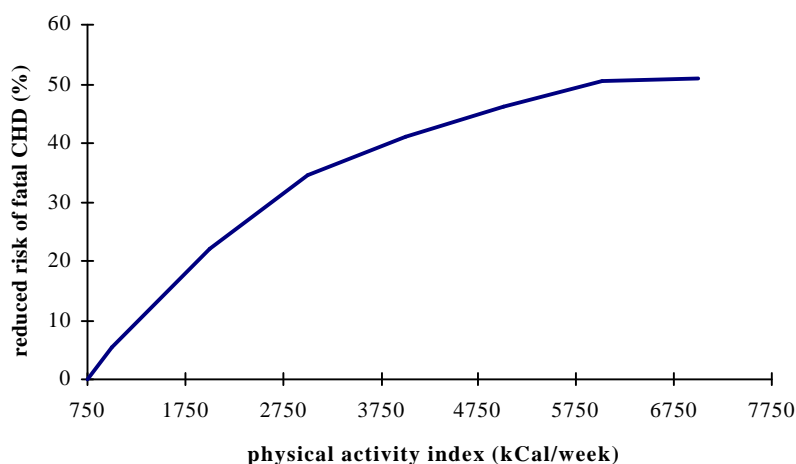
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and adolescents grow into sedentary adults. While most pre-pubertal children appear to enjoy physical activity, activity levels diminish considerably during adolescence, especially amongst girls. It appears that ‘sport’ is not universally attractive and that other forms of physical activity need to be promoted (Saul 1994).

7.4 Energy expenditure

Studies of men involved in heavy physical work have shown that the risks of fatal and non-fatal coronary heart disease are related to their total habitual and current energy expenditure (Paffenbarger and Hyde 1984). (Figure 1)

Figure 1 Risk reduction of heart attack deaths with total energy expenditure³



(Paffenbarger and Hyde 1984, Fig. 2)

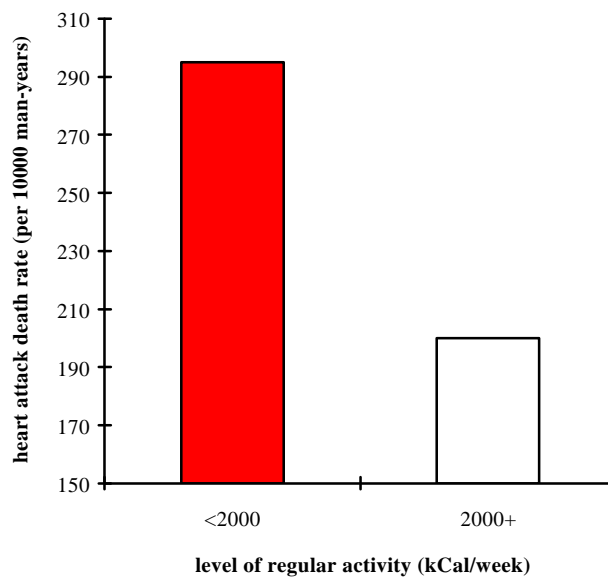
The proportion of the population that is physically active as a result of their occupation has been steadily decreasing for the past 40 years (Durnin 1992). The decline of heavy and dangerous manual labour is to be welcomed but there has been an unintended cost due to the widespread reduction in physical activity. With technological change reducing the opportunity and necessity to labour in this manner other reasons to exercise are needed and must be explored.

Until recently, the only alternative to work-based physical activity that has been considered was leisure activity. A cohort study of Harvard college alumni shows clearly the reduction in the number of deaths due to heart attack in men expending more than 2000 kilocalories of energy each week in identified physical activity (Paffenbarger and Hyde 1984). (Figure 2)

³ Physical activity data in this study has been converted and interpolated to match the Harvard leisure-time physical activity index.

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Figure 2 Heart attack death rates by leisure time physical activity



(Paffenbarger and Hyde 1984, Fig. 6)

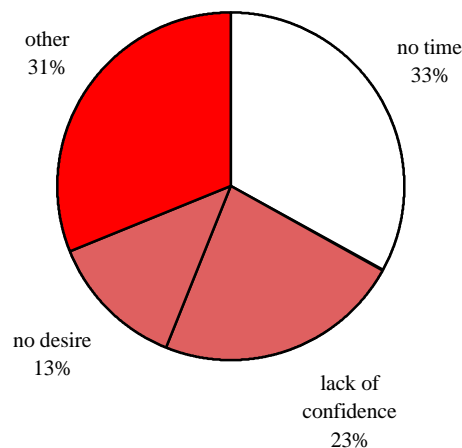
7.5 Obstacles to physical activity

Television and motorised transport are two factors that are closely linked to changing levels of physical activity (Durnin 1992). A recent survey of the fitness of Australians indicated a number of perceived obstacles to physical activity amongst sedentary Australians. (Figure 3) Lack of time available for active recreational activities was the most commonly reported obstacle while others indicate a resistance to become involved in sporting and competitive activities.

Cycling for transport or leisure is not sport nor is it a competitive activity and therefore it may appeal to many people who lack interest in sport or reject competitive activities. It may also appeal to those who wish to build exercise into their normal daily activities (ie those who state that they have 'no time' for exercise as a separate pursuit).

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Figure 3 Reasons given by sedentary Australians for not exercising



(Owen and Bauman 1992)

7.6 Leisure time and integral activities

Although of limited benefit to the health of the population as a whole, the promotion of physical activity in an attempt to acquire physical fitness through leisure activities has grown recently but fails to address the structural obstacles to integrate physical activity (Durnin 1992).

Such forms of physical activity, bolted on to people's lives, are unlikely to be adopted sufficiently broadly or maintained over a sufficient time span for population-wide benefits to be realised (BMA 1992, Chapter 2). Also, activities that are associated with sports 'training' are unlikely to be attractive to inactive people and are associated with low adherence and a high incidence of injury (Hardman 1992).

7.7 Conclusion

The developing consensus amongst researchers investigating physical activity as a key attribute of healthy lifestyles is that physical activity should be moderate, frequent and maintained for a large proportion of people's lives.

From a health promotion perspective, a key determinant for feasibility is the intensity of the exercise, because strenuous exercise, like jogging, exceeds the abilities and motivations of many inactive, middle-aged, older and sick people and increases the risk of exercise induced cardiovascular complications (Vuori 1991).

The integration of physical activity incidental to other lifestyle choices presents an opportunity for improved health. Worryingly, physical exercise and fitness are being commodified—identified as products to be packaged, promoted and sold to the public by commercial operators and therapies to be prescribed and supervised by medical or health care professionals (BMA 1992).

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It is essential to realise that exercise has a ‘preventative maintenance’ effect on the body that may be its most vital function rather than as a remedy to be prescribed to cure a disease (Paffenbarger and Hyde 1984).

8. SIGNIFICANCE OF INACTIVITY

Physical activity is unlike many important lifestyle attributes and risk factors (eg smoking, family history, etc) in that it has total *prevalence*. Everybody does some activity but the issues of importance are the:

- quantity
- intensity and
- longevity of the exercise.

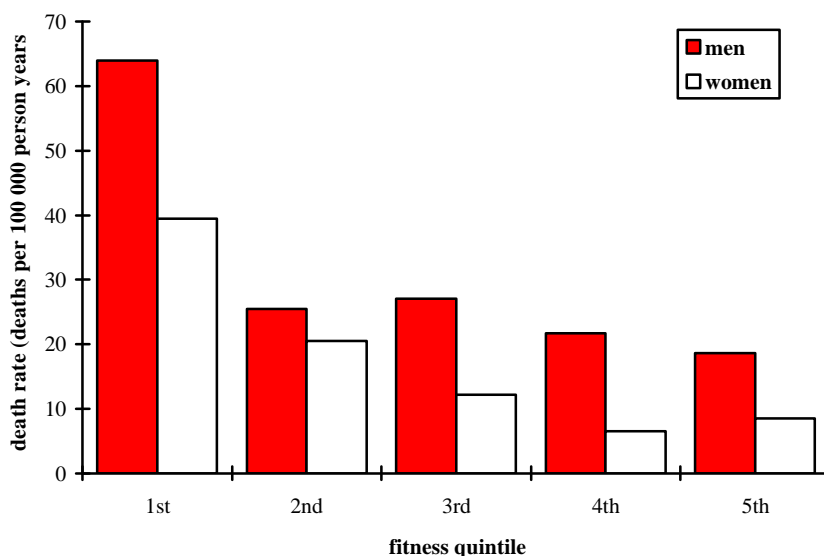
No straightforward dose-response relationship can be expected over the entire range of conceivable measures of physical activity. At both extremely low and extremely high levels of intensity and durations of exercise the benefits are likely to be attenuated.

The public health burdens of sedentary living habits are very high and it has been estimated that approximately one third of deaths due to coronary heart disease, colon cancer and diabetes are attributable due to physical inactivity (Powell and Blair 1994).

8.1 Physical fitness and death rates

There is a strong negative association between fitness and the death rate from all causes with the least fit quintile (20% of the age-adjusted population) experiencing the greatest relative disadvantage. (Figure 4) The second fitness quintile in the population enjoys approximately half the death rate of the least fit. For women there are further incremental gains by achieving higher fitness quintiles but for men the advantages are marginal (Blair, Kohl et al. 1989).

Figure 4 Age-adjusted death rates as a function of fitness



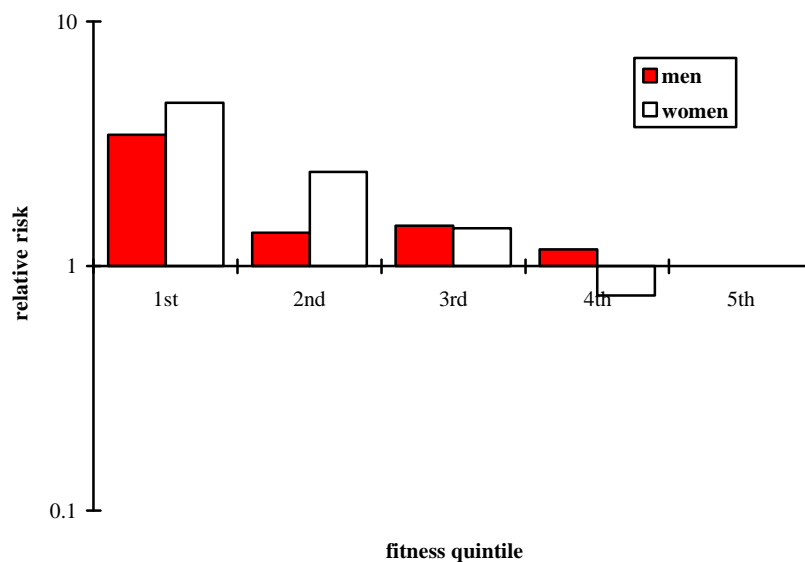
(Blair, Kohl et al. 1989)

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All causes of death including accidental death have been considered in the calculation of death rates in Figure 4. To date, fitness has been closely related to physical activity occurring out-of-doors and in spite of the risk of injury associated with these activities, the benefits are clear.

Using a logarithmic scale, Figure 5 represents the benefits of increased physical fitness as measured using the *relative risk* of death by all causes. The risk of death of the most fit quintile is the reference for this graph. Once again the most dramatic benefits are achieved between the first and second quintiles for men but the benefits for women are shown to be more progressive. The difference between the fourth and fifth quintile (especially the anomalous result for women) are unlikely to be significant.

Figure 5 *Relative risk* of death as a function of physical fitness



(Blair, Kohl et al. 1989)

8.2 Independent and interdependent risk factors

Attempts have been made to isolate the effects of physical activity from those of other physiological risk factors for cardiovascular disease including:

- hypertension
- unhealthy blood lipid profiles
- obesity.

It must be remembered that physical inactivity increases the *prevalence* of these physiological risks factors and so the *relative risk* isolated for physical inactivity as a pseudo-independent risk factor underestimates the benefit from physical activity.

It is not well understood why physical inactivity remains an independent risk factor for cardiovascular disease even after the secondary effects of physical activity on the other, physiological, risk factors have been controlled for. Since experimental

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controls for high blood pressure and other physiological risk factors are tantamount to controls for physical activity itself, it is extraordinary that a residual independent effect can be measured.

8.3 Population significance of physical activity

The significance of physical inactivity as a cause of chronic disease in the community is a function of the:

- **relative risk of inactivity** —the degree to which one's risk for developing a particular disease is increased as a result of being insufficiently active compared to active people
- **prevalence of inactivity** —the large proportion of the Australian population that is either sedentary or insufficiently active for protection against lifestyle-related diseases

One estimate of the significance of physical inactivity to our population is the fraction of a particular disease (coronary heart disease, etc) that can be attributed to that particular risk factor. This attributable fraction is a function of both the relative risk experienced by those exposed to the particular risk factor and also the prevalence of that risk factor in the community (Last 1983).

8.4 Relative risk in perspective

The relative risk of cardiovascular disease amongst physically active men has been shown to vary inversely with increased physical activity (Paffenbarger, Hyde et al. 1993). A meta-analysis of published research indicates that the better designed studies show a stronger relationship between physical inactivity and cardiovascular disease with a limit of the relative risk indicated as 3.1 (Berlin and Colditz 1990).

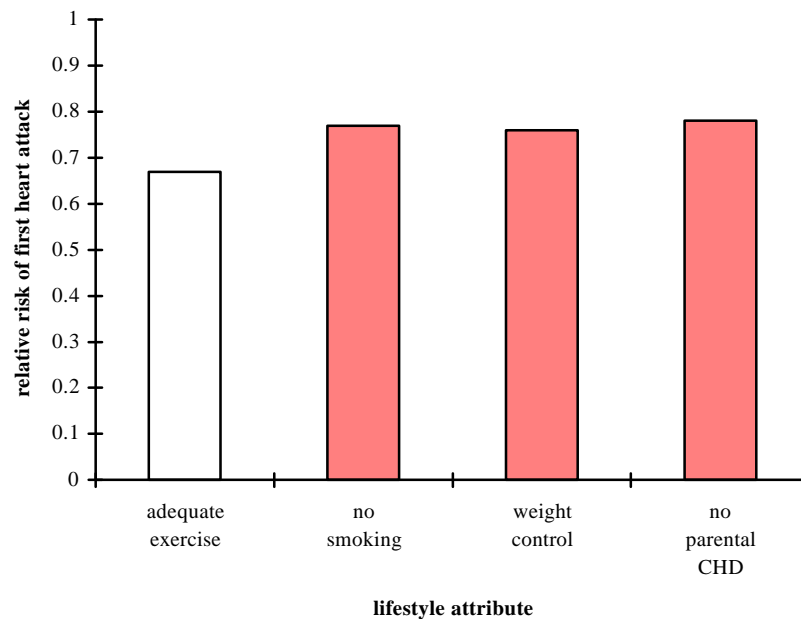
A conservative estimate for the *relative risk* of heart attack in sedentary men relative to active men is accepted to vary between 1.7-2.4 which is similar to the increased risk due to:

- smoking more than 20 cigarettes per day
- having a systolic blood pressure in excess of 150 mm Hg or
- blood cholesterol concentration over 6.9 mmol/L (Hardman 1992, p149).

By incorporating sufficient physical activity in one's life the relative risk of heart attack is reduced by a margin at least comparable to the benefits of not smoking, avoiding obesity and not having a family history of heart disease (Paffenbarger and Hyde 1984, Tab. 1). (Figure 6)

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Figure 6 *Relative risk of first heart attack by lifestyle and family characteristics*



(Paffenbarger and Hyde 1984, Tab. 1)

8.5 Prevalence of physical activity

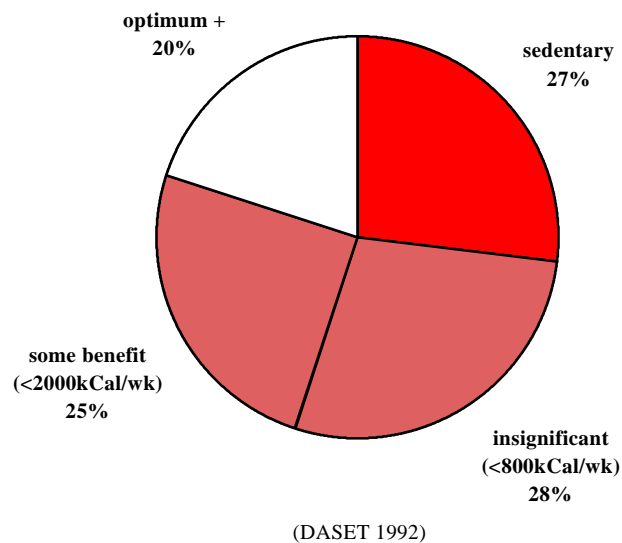
In order to estimate the benefits to the community of this increase in physical activity it is necessary to know the prevalence of inactivity in the population:

One difficulty in assessing the *prevalence* of inactivity in the population is that our understanding of the level and type of exercise that confer protection has changed in recent years. Therefore survey questions designed twenty years ago to determine how many people exercised to a ‘sweaty and breathless’ state and how often they did so are no longer valid questions and the data derived from those surveys are not directly comparable to current data.

The *Pilot survey of the fitness of Australians* (DASET 1992, p24) contained a number of questions relating to physical activity and lifestyle. This survey measures the proportion of the Australian population that can be described as sedentary but also identifies a majority of the population that is insufficiently physically active for optimal or even significant protection against common lifestyle-related diseases (DASET 1992, p24). (Figure 7)

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Figure 7 Physical activity amongst Australians



The large contribution of physical inactivity to lifestyle-related diseases and mortality in general can be understood when the high *prevalence* of this inactivity is considered.

- Almost 30% of Australians are classified as sedentary (NHF 1980; NHF 1989).⁴
- At least 55% of the population is failing to do sufficient exercise to have any significant benefit (DASET 1992).
- 80-85% of the population are failing to meet the 2000 kCal/week criterion for optimum protection and therefore fall into the high risk group as described in the Berlin and Colditz paper (Berlin and Colditz 1990).

Cycling for transport offers a form of physical activity that is available to a large proportion of the population. Already it is a feasible option for those in the community unable or unwilling to drive motor cars. Currently, about half the Australian population do not have a motor vehicle licence and there are approximately half a million Australian households which own no car. (Newman, Kenworthy et al. 1994, p60) For others, perceived road traffic dangers and inadequate end of trip facilities for secure bicycle parking, changing rooms etc, make the bicycle an unattractive or inconvenient option.

The level of physical activity identified as ‘sedentary’ is at the extreme end of the scale. The level identified as high corresponds to exercise resulting in becoming sweaty and breathless at least three times per week. Unfortunately, the question design in such surveys lags behind the developing understanding of the most beneficial types of exercise but it has been estimated that the prevalence of physical inactivity producing an elevated risk of the identified lifestyle related illness can plausibly be set between 50–80% for the whole population (DASET 1992). The

⁴There was a small decrease in this section of the population during the 1980s.

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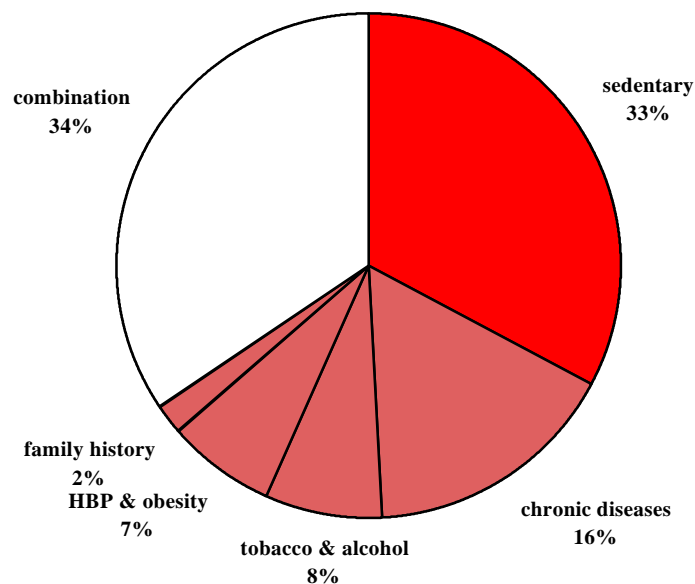
dramatic conclusion is that more than half the Australian population are sufficiently inactive to significantly increase their risk of various lifestyle-related illness.

8.6 Disease attributable to physical inactivity

Attempts have been made to estimate the amount of coronary heart disease in a population that is attributable to physical inactivity. Taking the current best estimates for *relative risk* of coronary heart disease due to inactivity of 1.7 and the prevalence of inactivity produces an estimate for the *PAF* between 30-40% (Berlin and Colditz 1990; Waters 1995).

A study of major risk factors and death rates in the United States indicates that insufficient physical activity contributes massively to the death rate. There is no reason to believe the situation in Australia is dramatically different. (Figure 8)

Figure 8 Population attributable risk of mortality by major risk factors



(Paffenbarger, Kampert et al. 1994)

8.7 Cardiovascular disease and physical activity

Many Australians do very little exercise and this risk is born heavily by those who are less well educated and have lower incomes (Owen and Bauman 1992).

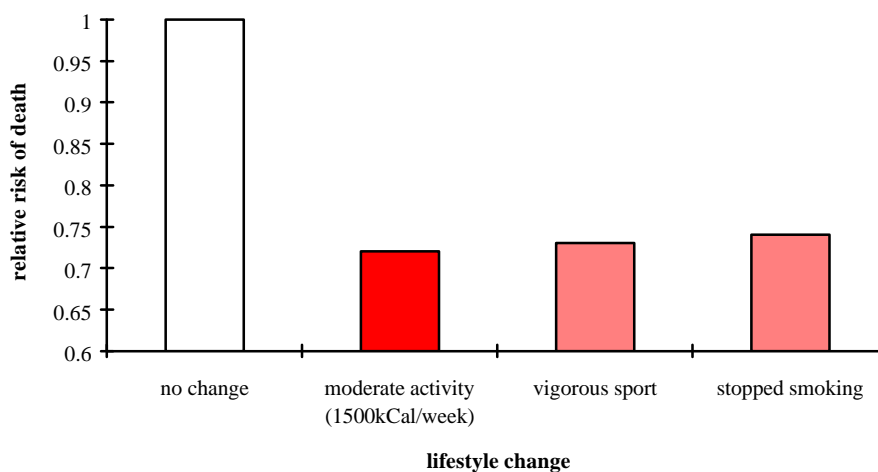
Increases in physical activity could achieve reductions in heart attacks of between 35%-55% (Manson, Tosteson et al. 1992).

Setting aside the human costs, figures from the Australian Institute of Health and Welfare estimate the financial cost of cardiovascular disease in Australia to have been almost \$A4 billion dollars in 1989-90 (Waters 1995). The proportion of this cost attributable to inadequate physical activity as an independent risk factor (30-40% PAF) was \$A1.2-1.6 billion in that year.

8.8 Exercise for change

Follow up studies of people who had changed their lifestyles indicated that incorporating moderate physical activity corresponding to the expenditure of 1500 kCal of energy each week decreased their risk of death from all causes comparable to stopping smoking—strong evidence that adopting a physically active lifestyle will delay all-cause mortality and extend longevity. (Figure 9)

Figure 9 *Relative risk following changes in lifestyle*



(Paffenbarger, Kampert et al. 1994)

Not only does this data support the proposition that there is a causal link between physical inactivity and disease, it also indicates that risks can be lowered by adoption of more physical activity in later life (Paffenbarger, Kampert et al. 1994). However, the difficulty in changing attitudes makes it essential that healthy habits are established in youth.

Margaret Bermingham writes in a recent article:

‘that lifestyle components which influence cardiovascular disease are better treated in adolescence than in later life.’
(Bermingham 1995)

8.9 Conclusion

With only 15% of the Australian population exercising at a level that provides optimum protection and twice that number who can be described as sedentary there is a huge possibility for increased physical activity (DASET 1992).

Since exercise for prevention of coronary heart disease, cardiovascular disease and other lifestyle-related diseases is the best prospect for improved public health, (Morris 1994) the decision to opt for cycling as a mode of transport could contribute significantly to a dramatic improvement in community health and a reduction in health costs.

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To date, ‘exercise’ and activities associated with sport have been promoted. These are attractive to *coqs sportif* in the community but they are the people who are already sufficiently active. Cycling for transport is not a ‘sport’ and may be an attractive form of exercise for many not so-inclined.

9. HEALTHY TRANSPORT

The best prospects for improved community health from increased exercise are feasible, simple activities like walking and cycling (BMA 1992). This type of activity is also the most beneficial with one study indicating that men expending more than 1000 kCal of energy per week in this type of incidental activity have less than half (42%) the risk of developing coronary heart disease than their inactive colleagues (Paffenbarger and Hyde 1984).

9.1 Cycling for transport

Regular cycling can be undertaken by people with a wide age range and fitness levels with substantial health benefits especially for the least fit. Furthermore it can be done without the provision of special recreational facilities nor the need to pay fees and can be incorporated into every day life (BMA 1992). Bicycles have been designed and are available for people with many types of disability (BCQ 1994).

Where a supportive and encouraging environment is provided, cycling for transport is seen as a desirable option for healthy exercise amongst sections of the community that eschew sport-oriented recreational activities, especially women (Welleman ; Vuori 1991).

9.2 Feasibility of cycling for transport and health

Few studies have been performed to investigate the physiology and psychology of physically active transport in general and cycling for transport in particular nor has the role it could play in improving public health been thoroughly explored. Finnish studies indicate that cycling is a feasible option for health-promoting transport and that campaigns and supportive policies to encourage cycling can increase the amount of physical activity in a population (Vuori 1991; Vuori, Oja et al 1994).

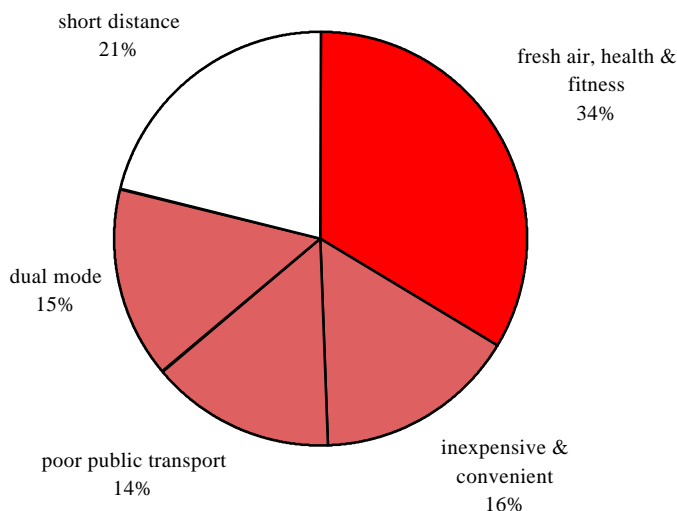
In spite of perceptions of risk amongst many non-cycling Australians, the wide support for cycling in Australia is indicated by the high level of bicycle ownership and the rate of increase of bicycle sales in this country (DTC 1993). The willingness to purchase a bicycle is an indication of some form of predisposition to ride a bicycle and this would indicate a climate of receptiveness as a basis on which to build policies for increased bicycle use.

9.3 Perceived benefits of commuter cycling

One third of those Finns in the research sample who chose cycling or walking for work commuting did so to enjoy 'fresh air' and to derive health and fitness benefits while another 30% did so for convenience and economic reasons or to increase access to public transport. (**Figure 10**)

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Figure 10 Reason for physically active commuting in Finland



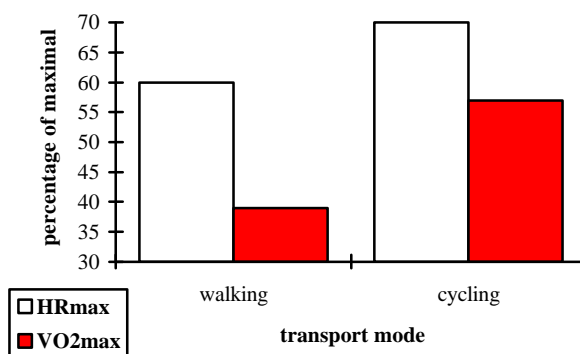
(Vuori, Oja et al. 1994)

Finnish women reported more often than men that physically active commuting was their main form of physical activity and ‘substituted for other physical activity during leisure’. The cyclists more than the walkers emphasised fitness and ease of transport as the main reasons for their choice of commuting mode (Vuori, Oja et al. 1994).

9.4 Physiology of cycling for transport

Commuter cyclists appear to voluntarily exert themselves more than walkers. (Figure 11) In doing so, they provide themselves with the best possible form of exercise for protection against many lifestyle related diseases. The Finnish study measured the level of exertion typically adopted by moderately fit male and female cycling and walking commuters (Vuori, Oja et al. 1994).

Figure 11 Exertion of cycling and walking for transport



(Vuori, Oja et al. 1994)

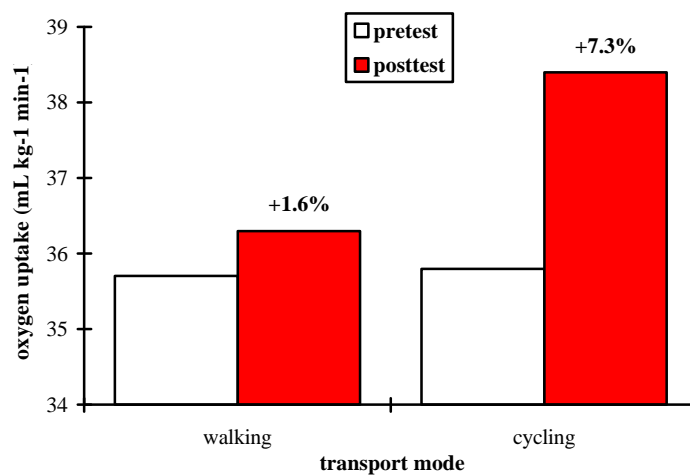
The results of that study indicated that the self-selected exertion of commuter cyclists was in the middle of the range required for aerobic stimulus while that for

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walking was in the lower range. The exertion level of walkers falls below that which is considered adequate for a ‘training response’ while the level for cyclists falls comfortably within the range considered to provide optimum benefit (Vuori, Oja et al. 1994). The level of exertion amongst the cyclists is also ideal for protection against maturity-onset diabetes, while that of the walkers was sub-optimal (Chisolm, Ashwell et al. 1993).

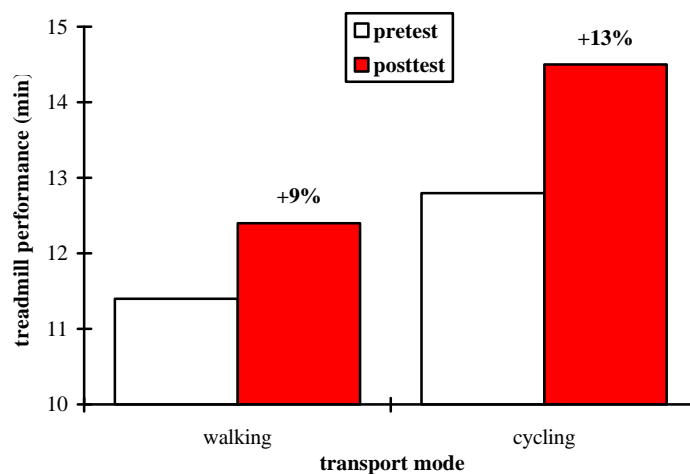
In a controlled intervention follow-up study, regular cycling and walking to and from work for only ten weeks produced small but consistent improvements in standard fitness tests amongst previously passive commuters (**Figure 12** and **Figure 13**). The benefits were higher amongst the cyclists (Oja, Paronen et al. 1991).

Figure 12 Fitness benefits from walking and cycling to work—maximal oxygen uptake



(Vuori, Oja et al. 1994)

Figure 13 Fitness benefits from walking and cycling to work—standard treadmill test performance



(Vuori, Oja et al. 1994)

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9.5 Prospects for increased cycling

The Finnish study also indicated a substantial willingness to increase the use of walking and cycling for transport (34% of study population) and this was spread evenly amongst those who were already cycling and walking and those who were not (Vuori 1991).

9.6 Conclusion

While the health benefits of work-based and leisure-based physical activity have been the focus of epidemiological study, incidental exercise derived from other categories of activity such as transport has received little attention.

The spectrum of the health benefits from physical activity is broad. Interventions to increase physical activity address the root cause of many modern lifestyle related diseases and do so without many damaging side effects. The multiple benefits and limited side effects mean that exercise may be the preferred treatment in many cases (Vuori 1991).

The potential benefits of increased physical activity in the community by an increased use of bicycles for transport is clearly indicated by the Finnish studies.

10. CYCLING AND HEALTH

‘The conventional dichotomy in health promotion and the prevention of disease between individual high-risk and population strategies seldom applies to exercise. In developed societies, the big majority may be presumed to be at raised risk because of their habitual inactivity. Equally the “prevention paradox” is irrelevant: people encouraged to take up exercise can be assured that they are not merely contributing to public good but themselves will feel, function (and look!) better, and soon, from its many benefits.’ (Morris 1994)

10.1 Heart health

The relationship between the incidence of cardiovascular disease and physical inactivity is well documented. Studies of population-based samples of predominantly middle aged men indicate that physical inactivity is a potentially causal risk factor with strong links to total cholesterol, high density lipoprotein cholesterol and systolic blood pressure (Caspersen, Bloemberg et al. 1990). While the data is clearer for men, benefits also exist for women. A recent study of adolescent women indicated that both vigorous and non-vigorous physical activity were associated with healthy blood lipid profiles. (Birmingham 1995)

10.1.1 Sedentary lifestyles

A sedentary lifestyle takes its toll largely through heart disease, stroke and, as is becoming more apparent, mature-onset diabetes. It appears that the level of energy expenditure is a critical factor in determining an individual’s risk of developing these diseases (Paffenbarger, Brand et al. 1978). Cardiovascular disease is a largely preventable disease and recent studies provide compelling evidence that physical activity is an important independent risk factor for cardiovascular disease (Rose 1981; Berlin and Colditz 1990). For maximum benefit exercise must be maintained throughout life (Eichner 1983).

10.1.2 Cardiovascular disease—a leading cause of death

Although remaining the leading cause of death in South Australia, there has been a reduction in mortality due to cardiovascular disease (NHS 1993). A substantial proportion of this improvement has been achieved by increasing the survival rate following heart attacks. Medical interventions following heart attacks are extremely costly and patients often carry on-going disability.

10.2 Blood lipids

Figures from the Australian Institute of Health and Welfare estimate the cost of coronary heart disease attributable to unhealthy blood lipid profiles to have been \$A333 million in 1989-90 (Waters 1995).

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For a long time physical activity as a health measure has been overshadowed by diet and drugs in the management of cardiovascular complications of unhealthy blood lipid profiles. However, cross-sectional studies have consistently shown that physically active people exhibit healthier blood lipid profiles than sedentary people. Recent controlled intervention trials have demonstrated the positive effects of increased physical activity. Weight supported activities like cycling are ideal as they avoid overuse injuries of the joints (Heyden, Schneider et al. 1991).

10.2.1 Benefits from increased physical activity

Table 1 list the many benefits for people with unhealthy blood lipid profiles that derive from increased physical activity (Heyden, Schneider et al. 1991). These benefits go well beyond simply lowering cholesterol levels. By addressing the root cause of the problem, increased exercise re-tunes many aspects of blood chemistry.

Table 1 Benefits of exercise for people with unhealthy blood lipid profiles

	Benefit	
Blood lipid profile	Total cholesterol	↓
	Triglyceride level	↑
	High density lipoprotein level	↑
Blood coagulation	Clotting problems	↓
Insulin-glucose relationship	Excessive insulin levels	↓
	Insulin sensitivity	↑
Associated risk factors	Overweight	↓
	Hypertension	↓
	Smoking habits	↓
Life-style	Improved health awareness	↑
	Adherence to diet	↑

(Heyden, Schneider et al. 1991)

Men and women who participate in regular exercise generally have blood lipid and lipoprotein profiles that are consistent with lower risk for coronary heart disease. There appears to be a threshold of moderate exercise involving energy expenditure of approximately 1000 kCal/week to achieve improvement.⁵ Beyond this threshold, a dose-response relationship exists up to an expenditure of 4500 kCal/week.⁶ (Haskell 1984) These energy expenditure figures are within the same range as those required for protection from coronary heart disease.

⁵ Cycling for 2-4 hours per week

⁶ Cycling for 10-20 hours per week

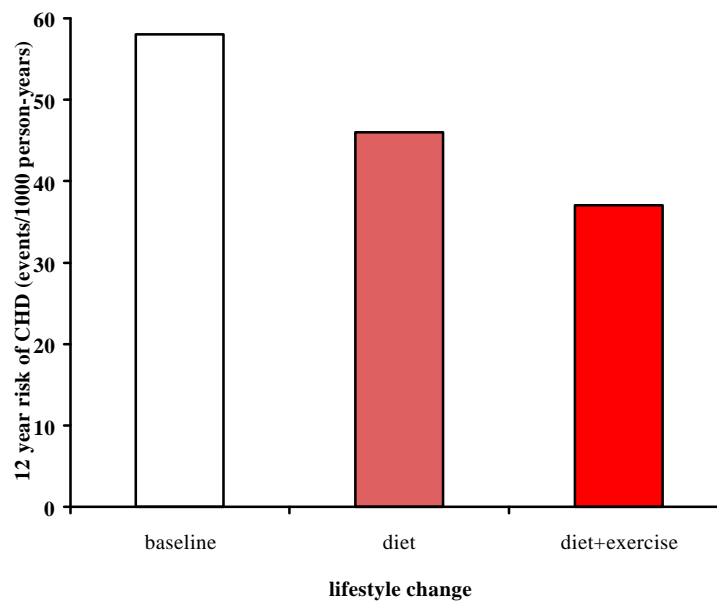
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The link between exercise and unhealthy blood lipid concentrations is so strong that it is recognised that lifestyle factors, including exercise, should be addressed prior to the administration of drug treatment (Barter 1994; Barter 1994a).

10.2.2 Physical activity and diet synergies

Increased physical activity is a valuable adjunct to dietary controls for the improvement of blood lipid profiles in both men and women—more than doubling the benefit derived from dietary controls alone. (Figure 14 and Figure 15) Diet and physical activity have independent and interactive beneficial health effects (Wood 1994).

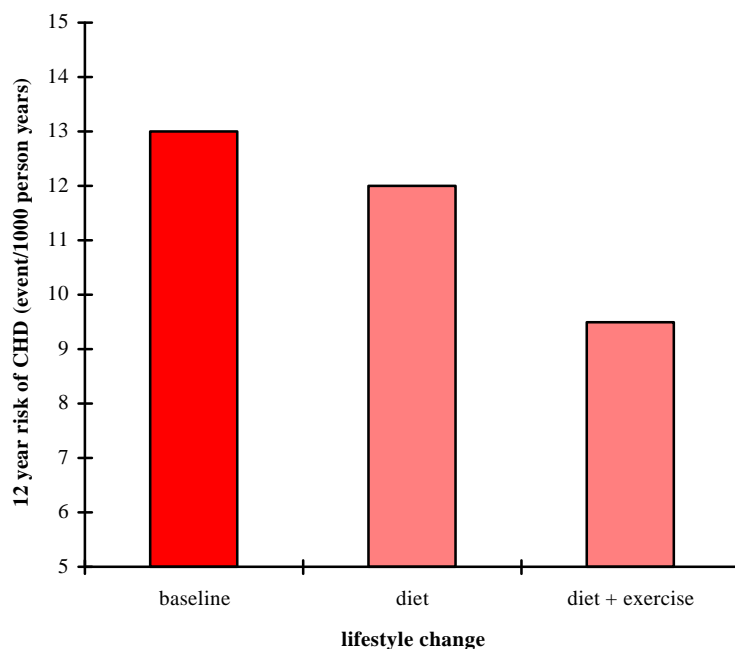
Figure 14 Physical activity and dietary interventions for men



(Wood 1994)

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Figure 15 Physical activity and dietary interventions for women



(Wood 1994)

10.2.3 Physical activity and high blood pressure

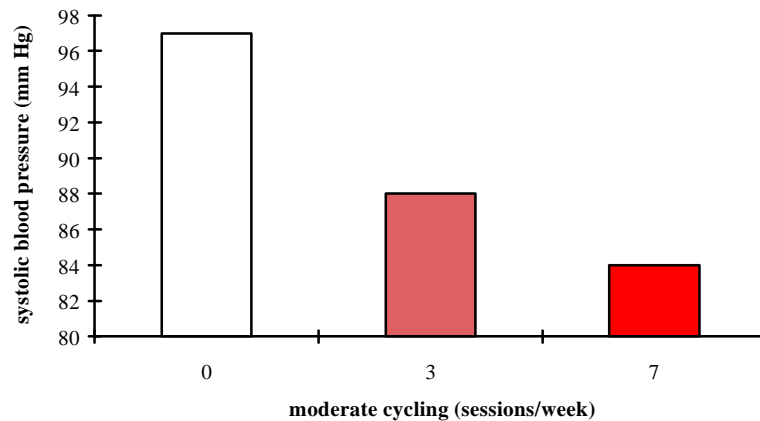
Studies of hypertension have shown that potentially modifiable lifestyle behaviours are closely related to the manifestation of high blood pressure (Carmelli, Robinette et al. 1994). Moderate regular exercise has been shown to lower blood pressure and is an important non-pharmacological method of treating hypertension (Jennings, Nelson et al. 1986). Unfortunately, surveys report infrequent use of this non-pharmacological means of control of hypertension with or without other treatments (Joffres, Hamet et al. 1992).

10.2.3.1 Cycling reduces high blood pressure

In a randomised study of the effects of physical activity on otherwise healthy sedentary volunteers with high blood pressure, blood pressure fell significantly (10/7 mm Hg) after just one month of cycling (Jennings, Nelson et al. 1986). In another study, regular moderate cycling (60-70% of maximal effort) for 3 and 7 sessions per week has been shown to lower high blood pressure significantly after only four weeks (Nelson, Esler et al. 1986). (Figure 16)

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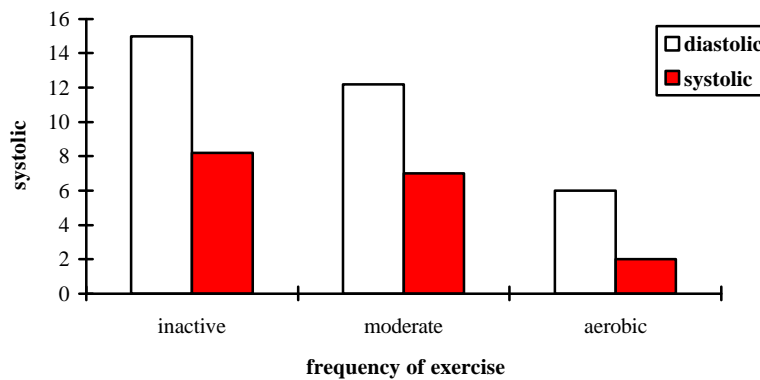
Figure 16 Effect of moderate cycling on high blood pressure



(Nelson, Esler et al. 1986)

Regular exercise dramatically reduces the prevalence of high blood pressure dramatically. Even moderate exercise produces significant benefits while regular aerobic exercise halves the amount of high blood pressure present. The effect is present in both men and women in spite of the lower baseline level of hypertension in women (Bauman and Owen 1991). (Figure 17)

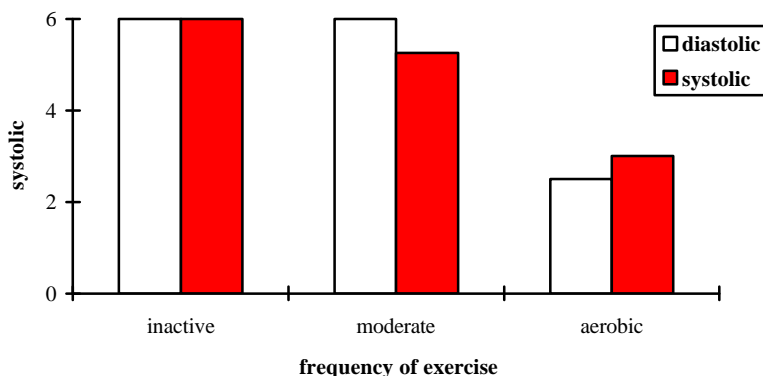
Figure 17 Effect of exercise on the prevalence of hypertension in men



(Bauman and Owen 1991)

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Figure 18 Effect of exercise on the prevalence of hypertension in women



(Bauman and Owen 1991)

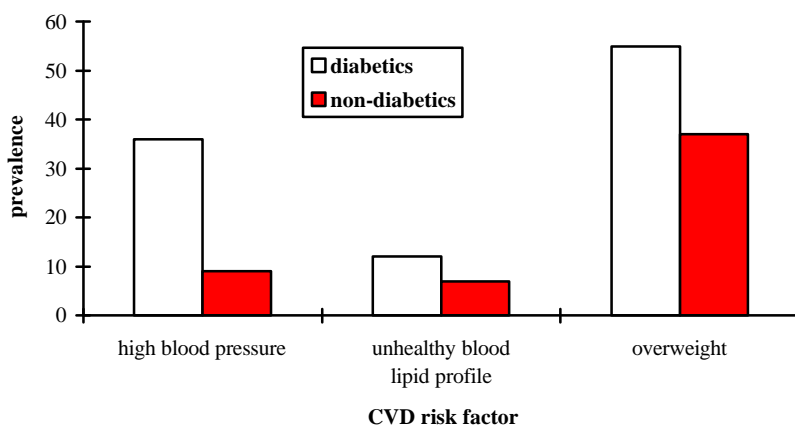
For people classified as hypertensive, the *relative risk* of death is 34% higher than the general population (Paffenbarger, Kampert et al. 1994).

10.3 Diabetes

Mature onset diabetes is a relatively common condition in South Australia with a prevalence of 5% and this may double in the next 20-30 years (Phillips 1995). It is likely that statistics on this disease underestimate its prevalence (Whittall, Glatthaar et al. 1990).

A serious disease in itself, mature onset diabetes is also a major risk factor for cardiovascular disease and can co-exist with and compound the effects of other risk factors. Cardiovascular disease risk factors are much more prevalent amongst diabetic South Australians than in the general population. (Figure 19) Overall death rates for people with mature onset diabetes are much higher than for those without. (Phillips 1995)

Figure 19 Prevalence of CVD risk factors amongst South Australians with mature onset diabetes



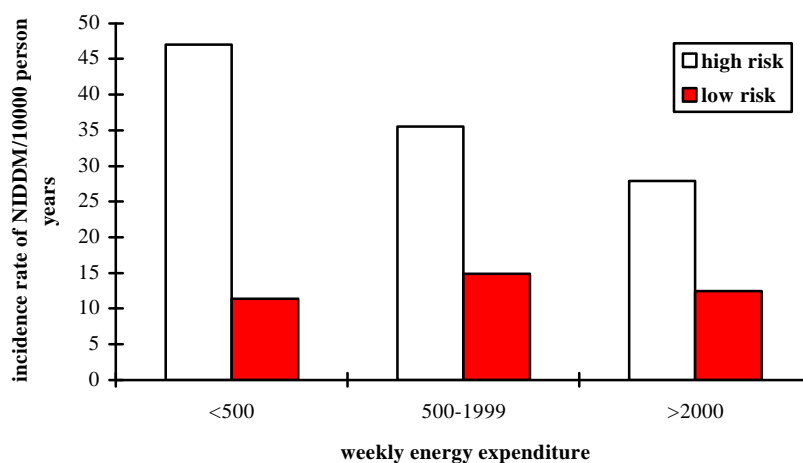
(Phillips 1995)

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Mature onset diabetes is a disease strongly related to sedentary lifestyles. Increased physical activity is effective in preventing this disease and the protective effect is strongest for those at highest risk—including those with a high body mass index, a history of hypertension or a parental history of diabetes (Helmrich, Ragland et al. 1991; Helmrich, Ragland et al. 1994). Moderate regular exercise provides substantial protection (Chisolm, Ashwell et al. 1993).

Representing data on the incidence of mature onset diabetes, Figure 20 demonstrates the dramatic reduction in the incidence of this disease amongst high risk people as a result of regular moderate exercise—the excess incidence almost halves with a weekly energy expenditure of 2000 kCal (6 hours of cycling per week).

Figure 20 Influence of physical activity on incidence of mature onset diabetes



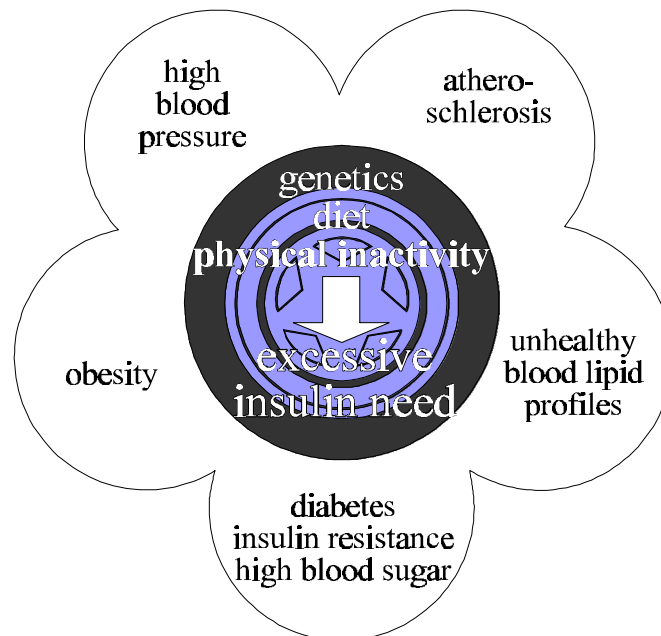
(Helmrich, Ragland et al. 1994)

10.3.1 Insulin, exercise and health

Insulin plays a key role in the conversion of fuel to work in the body and exercise dramatically alters the efficiency with which insulin is used. There is a developing understanding of a metabolic syndrome that combines high blood pressure, obesity, unhealthy blood lipid profiles and diabetes and links them with lack of physical exercise (Heyden, Schneider et al. 1991). (Figure 21) The existence of these links may result in the estimates of the *relative risk* of physical inactivity to be underestimated in controlled studies. While the best estimates of the benefits of increased physical activity are compelling, the benefits of physical activity may be seriously underestimated (Morris 1994).

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Figure 21 Physical inactivity, insulin and disease



(Heyden, Schneider et al. 1991)

10.3.2 Physical activity and glucose metabolism

Physical activity is a powerful stimulus for glucose uptake and utilisation by exercising muscles. Repeated aerobic exercise has been shown to increase insulin sensitivity throughout the body, even those not particularly involved in the exercise. The role of exercise in the control of obesity and hypertension is of great importance in improving insulin sensitivity and glycaemic control (Chisolm, Ashwell et al. 1993).

10.4 Osteoporosis

With diet, physical inactivity is an important risk factor for osteoporosis (Anderson and Metz 1993). Increased physical activity has been shown to increase bone density. Cycling has been shown to be beneficial (Henderson, Graham et al, 1989).

10.5 Conclusion

Increased physical activity addresses the root cause of many lifestyle related diseases and therefore should be the preferred intervention. Increases in physical activity produce benefits in the main physiological *risk factors* for cardiovascular disease and diabetes:

- high blood pressure
- obesity
- blood lipid profiles

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Increased physical activity also produces additional benefits independent of these rewards.

Because of the difficulty of identifying groups at elevated risk and because deaths in these undetected high-risk categories constitute a large proportion of deaths, broad population-based structural changes are likely to reap major benefits (Rose 1981). Policies to increase physical activity in the population through increased use of cycling and walking for transport are well suited to this approach.

Cycling for transport can provide a large proportion of the moderate exercise needed for optimum protection against cardiovascular disease and diabetes and can be integrated into lifestyles so that little extra time is required. Cycling for transport provides a valuable alternative physical activity to sport.

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11. HEALTH COSTS OF CYCLING

The costs of increased bicycle use include the costs of:

- provision of facilities and services required by cyclists
- possible adverse health outcomes.

However, all forms of intervention incur costs. In addition to their astronomical financial costs, medical interventions have undesirable side-effects of treatment and these can be severe (Rose 1981). For example, drugs used to lower cholesterol, and therefore the risk of cardiovascular disease, are associated with increases in risk for other diseases including depression and sudden death (WHO 1978; MaLAM 1994).

Because it addresses the root cause of many contemporary health problems, increasing physical activity, carries fewer risks and more incidental benefits than drug or other medical interventions. However, an increase in physical activity will result in an increase in injury unless changes occur to reduce the exposure-adjusted risk.

The main risks of increased exercise come from overuse and traumas. High intensity and competitive sports are particularly dangerous for these types of injury while cycling is a particularly safe activity (Vuori 1991).

11.1 Risk of injury

As with all forms of physical activity, cycling carries a risk of injury. It is essential to assess the risks involved in cycling and to allow for them in policies developed to encourage cycling in the community. The risk of injury and death is the most well-recognised cost of cycling and one of the most widespread perceived obstacles to cycling. Although accurate measures of cycling are unavailable, it appears that cyclists are over-represented in road accident statistics compared to motor vehicle occupants (Dolinis, O'Connor et al. 1995).

The reputation of cycling as a safe activity suffers from:

- a failure to identify the magnitude and real source of the risks to cyclists
- unfair comparison between other activities
- incomplete assessment of the health impacts of various transport modes.

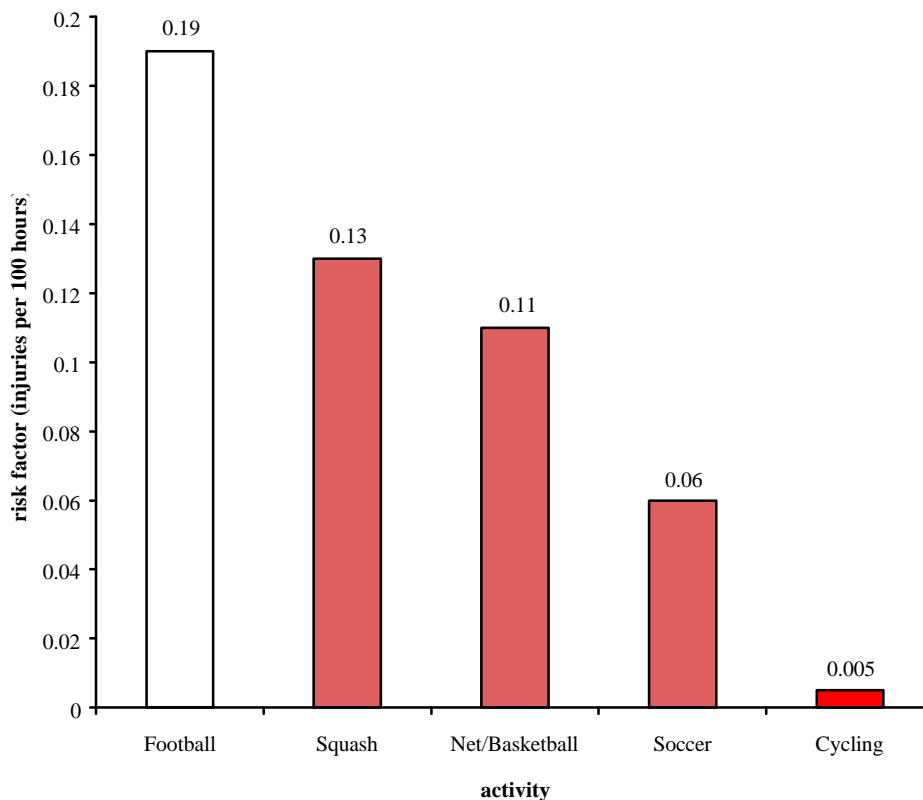
11.1.1 Injury rates for cycling

It is difficult to compare the exposure-corrected risk of injury to cyclists because of the difficulties involved in measuring the amount of cycling that occurs. Cordon counts are performed infrequently and are biased towards certain types of cyclists—CBD-based work commuters using major arterial roads. The vast majority of cycling occurs in residential areas and is rarely measured (Drummond and Jee 1988). These difficulties ensure that the amount of cycling is underestimated and therefore the accident rate of cyclists is overestimated.

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One of the few studies that has attempted to measure the time-exposure of cycling in Australia was performed by the Monash University Accident Research Centre in 1988 (Drummond and Jee 1988). A comparison of data from this study with a pilot survey that used hospital figures to assess the risk of sporting accidents indicates the risk of injury is substantially lower for cyclists than for common sporting activities (Routley and Ozanne-Smith 1991). (Figure 22)

Figure 22 Comparison of injury rate for cycling with sporting activities



(Drummond and Jee 1988; Routley and Ozanne-Smith 1991)

If increased physical activity is to be adopted for improved public health, then cycling is ideal because of this low rate of injury.

11.1.2 Motor vehicle collisions

Figure 22 fails to reveal the impact that collisions with motor vehicles has on the safety and reputation of cycling. Cycling suffers from a widespread failure to identify the real source of risk. Hospitalisation figures indicate that almost 90% of serious injuries to cyclists (including fatalities) occur as a result of collisions with motor vehicles (Dolinis, O'Connor et al. 1995). Whatever the circumstances of particular collisions, resulting injuries are a cost of both cycling and motor vehicle transport.

Cycling is safer where cycling is more common (Ker and Evans 1994). Cycling is safer on residential streets and on the weekend although at these locations and times more cyclists and more inexperienced cyclists are present. Cycling is more

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dangerous where cars are more common (Drummond and Jee 1988). The real source of risk of serious injury to cyclists comes from motor traffic so interventions need to be implemented that reduce the danger projected by motor vehicles onto other road users (DHS 1994; NH&MRC 1992).

11.1.3 Severity of cyclist injury

Most cycling injuries are minor. Less than 0.5% of injuries to cyclists are critical compared to almost 3% for pedestrians. While the rate of injury for cyclists is too high, cyclists typically bear much less severe injuries following road accidents than other classes of road users (Dolinis, O'Connor et al. 1995).

11.2 Identification of risk

A serious problem for cyclists (shared by pedestrians) is that the source of risk has not been accurately identified and has been associated with the victim. The most significant source of risk of serious injury for all road users are motor vehicles and that risk is not just experienced by their occupants although it receives the major emphasis in road safety interventions. (Dolinis, O'Connor et al. 1995) Motor vehicles project a real risk to other road users. They also pose a creeping risk to their occupants due to the sedentary life they engender.

11.2.1 Cars are dangerous

The National Injury Surveillance Unit identifies injuries to car drivers and passengers as the most significant public health issue in road safety but also points out that this preoccupation of road safety with the protection of motor vehicle occupants has been at the expense of cyclists (Dolinis, O'Connor et al. 1995).

In spite of efforts over recent years, cars:

- are hazardous to their occupants
- project a serious, acute threat onto other road users
- pose a creeping threat to their drivers and passengers from the sedentary lifestyle they engender.

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The most extreme injuries occur to cyclists and pedestrians as the result of collisions with heavier and faster vehicles and steps should be taken to reduce the risk posed by these vehicles by:

- reductions in travelling speeds of motor vehicles in metropolitan areas (McLean 1994)
- improvements in the design of vehicle exteriors, especially front and upper surfaces (Dolinis, O'Connor et al. 1995)
- enforced removal of unnecessary and dangerous accessories attached to the front of motor vehicles that circumvent the recent developments in Australian design rules.
- Changes in the allocation of road space and the design of lanes, crossings and intersections are also needed to allow cyclists to operate safely.

11.3 Road safety planning ignores cyclists

The majority of road fatalities in Australia, as with other developed countries, are motor vehicle occupants and, as a result, the preoccupation of road safety research and development in recent times has been towards their protection, often at the expense of cyclists (Dolinis, O'Connor et al. 1995). Consequently, it should not be surprising that cyclists using our roads are over-represented in road casualty statistics when they are forced to cycle in an environment designed with an overwhelming focus on car travel.

Although it is generally accepted that cyclists are over-represented in road casualty statistics, fatalities amongst cyclists constitute a very small component of the road toll (2-3% fatalities). Instead, proposals likely to further discourage cycling appear as hidden and not-so-hidden agenda from safety planners. Few road safety planners have professional or personal experience of cycling and a 'windscreen shaped' view of the road system is an inadequate perspective for effective policy development for the safety of all road users.

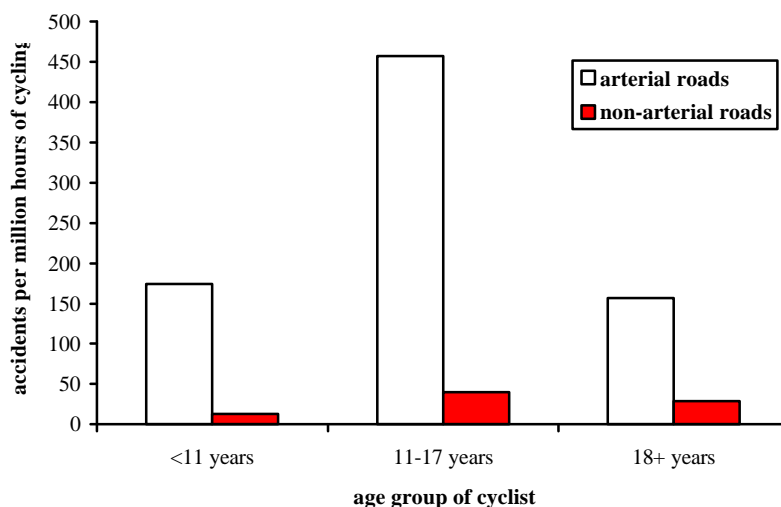
Cycling is caught on the horns of the dilemma of being too dangerous and not being dangerous enough. The safety of cyclists is rarely afforded a high priority in road safety planning and inadequate resources are provided for improved safety. Cyclists and pedestrians need appropriate representation on road safety advisory committees at commonwealth and state levels.

11.4 Cyclist involvement in accidents

The risk of accident involvement is unevenly distributed across the population of cyclists. The age and sex of the cyclist and the location of the accident are important features that affect the probability of an accident occurring (ORS 1993). The risk of collision with a motor vehicle also varies with the age and sex of the motor vehicle driver (Drummond and Jee 1988). (Figure 23)

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Figure 23 Risk of cyclist accident involvement by road type and age group

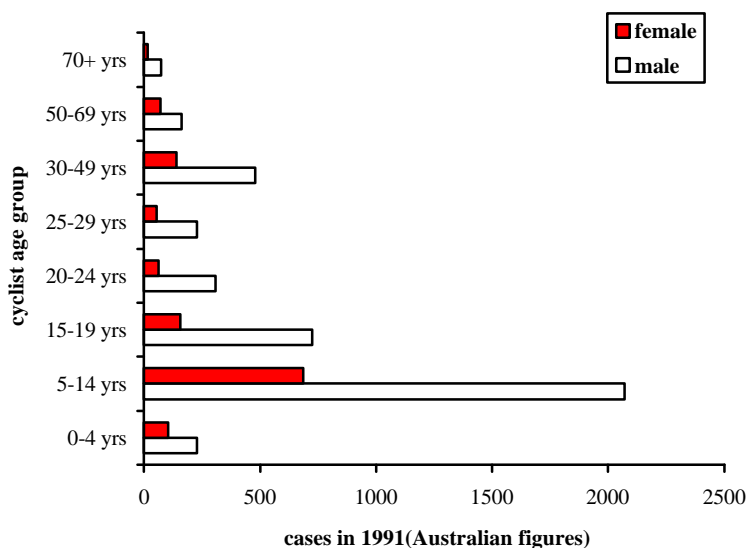


(Drummond and Jee 1988)

11.5 Hospitalisation

Hospitalisation data (Figure 24) reveals an over-representation of male cyclists relative to female cyclists across all age groups (but especially amongst males under twenty) and this reflects the aggregated data for all road users (O'Connor and Trembath 1994). However, these raw data take no account of the increased exposure of certain categories of cyclists.

Figure 24 Hospitalisations of cyclists by age and sex

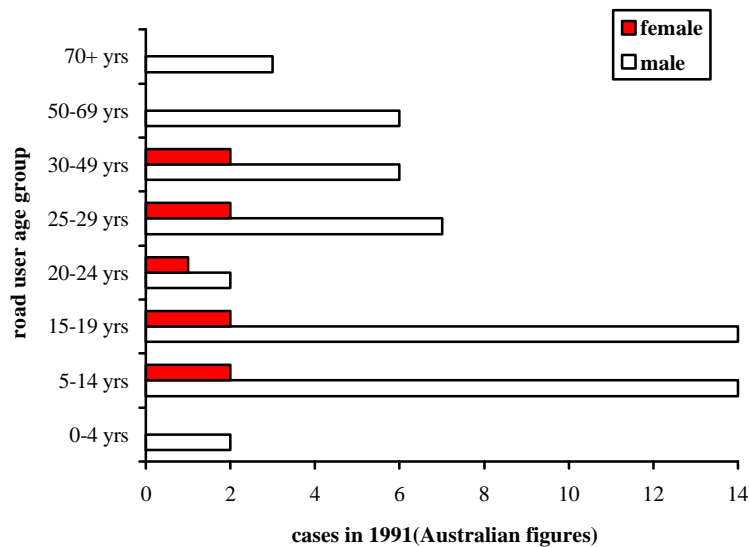


(O'Connor and Trembath 1994)

11.6 Fatalities

As in other activities, road fatalities of cyclists, mainly due to collision with motor vehicles, occur predominantly amongst young male cyclists. (Figure 25) Once again this follows, but exaggerates, the experience of all road users (O'Connor and Trembath 1994).

Figure 25 Road fatalities of cyclists by age and sex



(O'Connor and Trembath 1994)

11.7 Exposure measurements

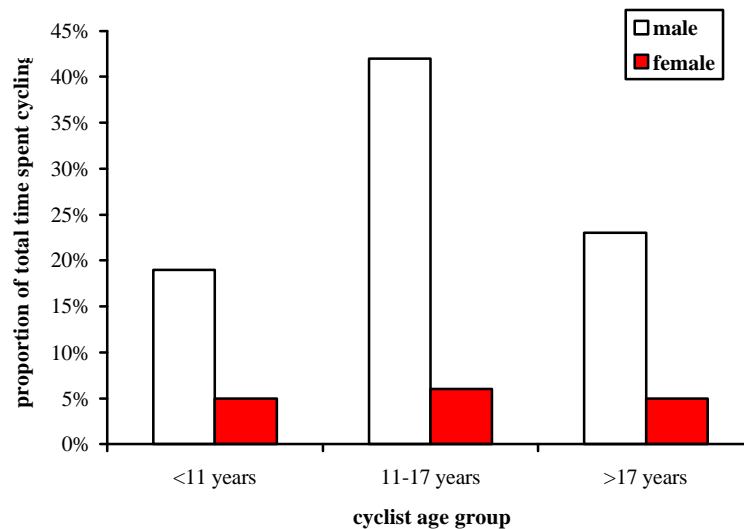
Although little hard evidence is available on the extent of bicycle use, and therefore the exposure to risk, a great deal of attention is focussed on the risks of cycling. Unfortunately, this attention has produced few positive results for cyclists.

Crude hospitalisation data cannot be readily interpreted without considering the exposure to risk that has produced those results. Without accurate and directly comparable measures of exposure to risk it is impossible to determine the proportion of over-representation due to increased exposure and the degree to which young males are inherently at higher risk.

The best data available indicates that in Australia cycling is currently done predominantly by young men and boys. (Figure 26) The preceding data demonstrating the large representation of men and boys in road casualty figures must be read in conjunction with the data that indicates that they do most of the cycling.

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Figure 26 Time spent cycling by age and sex



(Drummond and Jee 1988)

11.8 Road Safety Expertise

So clear are the health benefits of cycling that the British Medical Association has editorialised in the *British Medical Journal* that doctors should be setting an example and, as they did with smoking, quitting car driving for life and getting on their bikes. The British Medical Association praises cyclists as ‘modern day heroes who would expose themselves to the risks of injury and pollution from road traffic rather than add to them’ (Godlee 1992; Godlee 1992a).

Unfortunately, as a result of decades of neglect of cycling safety too many cyclists are injured or killed and many others are discouraged from cycling and add to the traffic problems by relying solely on their cars. The experience and attitudes of road users has become more polarised. Focus group research performed on behalf of the South Australian Department of Transport in 1994 indicated that the most significant attribute that affected motorist attitudes to cyclists was their own cycling experience (Walker 1994).

Undue attention to the road toll has encouraged the concentration on vehicle occupant protection. Rather than relying on a single measure (road fatalities), better policies and strategies could be developed by examining a wider range of injury experience and other health impacts from various transport modes (Dolinis, O’Connor et al. 1995).

Cyclists need road safety professionals to:

- accept that cycling and walking are legitimate and desirable forms of transport

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- identify accurately the source of risk on our roads
- develop professional skills in and understanding of the safety needs of cyclists
- develop and introduce programs to reduce risk for cyclists and pedestrians
- become actively involved in securing a safe and pleasant environment for cycling.

11.9 Access, mobility and equity

Cycling is a legal and socially acceptable activity. Cyclists are tax payers and many own motor vehicles that they choose to leave at home in favour of their bicycles. In a recent survey of commuters to the Adelaide CBD, more than 70% of respondents could have opted to drive rather than cycle on that day (Dorrestyn 1995).

Our road authorities have the responsibility to provide a road system that can be used safely by pedestrians, cyclists, public transport patrons and motorists. Children, older people and people with low incomes or disabilities and others who are unable or choose not to drive motor vehicles have the right to move independently within the metropolitan area with reasonable safety (Roberts, Norton et al. 1994; Roberts, Keall et al. 1994).

Pedestrians and cyclists are at greater risk because they are not surrounded by a steel shield and are sometimes classed as ‘vulnerable’ or ‘un-protected’ road users. It might also be said that, lacking this metal shield and travelling at lower speeds, pedestrians and cyclists do not project significant hazards onto other road users. Nor do they damage roads, contribute to pollution or traffic congestion and by adopting a physically active transport mode, they are improving the health of the community. They could therefore be classed as:

- non-polluting
- non-congesting
- non-road damaging
- non-threatening
- health promoting
- environmentally sustainable.

Although sustainability is one of the corporate goals of the Department of Transport and although it is Government Policy to increase the use of bicycles in this state, that department and in particular the Office of Road Safety, has been slow to pursue the interests and rights of cyclists and other non-motorised road users. At the time of writing, the Office of Road Safety had not released its strategic plan but draft documents circulated for comment:

- continue the recent emphasis on the protection of motor vehicles
- fail to acknowledge their responsibilities towards cyclists and pedestrians
- fail to identify risk reduction for cyclists and pedestrians as a priority
- foreshadow demand management strategies to further discourage cyclists (ORS 1994; ORS 1994(sic)).

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11.10 International perspective

An international conference on Traffic Safety was held in January 1991 on the theme 'The Vulnerable Road User'. The conference was sponsored by the World Health Organisation; the Association for the Advancement of Automotive Medicine; the Indian Institute of Technology; the International Association for Accident and Traffic Medicine; the International Committee on Alcohol, Drugs and Traffic Safety; the International Federation of Pedestrians and the International Research Council on the Biokinetics of Impacts and adopted the *Delhi Declaration on the Safety of the 'Vulnerable Road User'* which states that:⁷

'The groups that are today the vulnerable road users are an important and desirable part of the entire transport system. Walking and bicycling in particular are to be encouraged and promoted by appropriate planning of the transport environment because of their low cost, negligible energy consumption, and environmental compatibility.' (ICTS 1992, Point 1)

In this recommendation, the *Delhi Declaration* provides strong support for the South Australian Government's current *Cycling Policy* to double the use of bicycles in this State by the year 2000 (Laidlaw 1993). The opinion that cycling is a worthwhile activity that should be supported is widely held and not just by cycling advocates.

11.11 Community support for cycling

Data on bicycle sales in Australia indicates that Australians wish to be able ride bicycles but require safer roads:

- total bicycle travel rose between 10% and 12% each year from 1986-9 (more than twice the rate of increase in car kilometres travelled)
- more bicycles are sold each year than new cars
- bicycle sales are increasing at 7% per annum (DTC 1993).

In a study of bicycle use at the University of Adelaide in 1991, 100% of respondents including cyclists and non-cyclists alike and representing students and staff believed that the University should encourage cycling (van Alphen, Darley et al. 1991). In a survey of candidates in the Adelaide City Council elections held in 1995, respondents supported the propositions that:

- Adelaide's environment would benefit from increased use of bicycles.
- Adelaide's roads were perceived to be too dangerous for cyclists.
- on-road improvements were needed to increase the safety of cyclists (BISA 1995).

⁷ vide Appendix

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These views are shared by Adelaide cyclists and it is clear that, in response to policies and campaigns to increase the use of bicycles, steps must be taken to improve the safety of cyclists in the community (Dorrestyn 1995). Since on-road safety issues are perceived as important barriers to cycling, steps to improve safety and perceptions of safety are necessary. However, steps to improve safety for cyclists will also benefit all other road users—especially pedestrians, children, many older Australians and people with disabilities.

11.12 Net Benefits

The benefits of cycling for transport could be assessed using a number of measures including:

- reduction in deaths or illness due to heart attacks
- reduction in deaths associated with high blood pressure
- improved cardiovascular and other lifestyle-related health
- reduced pollution.

In practice, data does not exist to make the necessary calculations for most of these measures and, at best, only estimates can be made.

11.12.1 Heart attack deaths versus road fatalities

As with most forms of health promotion and illness prevention the costs of increased cycling are incurred early in life while the benefits are enjoyed later in life. For example, scanning even high-risk populations for cancer is expensive and the benefits are only realised in lower cancer rates in future decades. This is also true for cycling.

The most serious health cost associated with cycling for transport is the risk of serious injury or death following a collision with a motor vehicle while the main benefit comes from better health and reduced illness in later life. It is not easy to develop a philosophically acceptable way of balancing reduced death rates or illness stemming from increased physical activity and deaths or illness due to trauma occurring during that activity. What is the exchange rate between broken legs and non-fatal heart attacks or strokes? How should a road fatality be compared with a heart attack death.

Risk of accident and risk of life-style related disease are distributed very differently in a population with the young apparently taking more risk and chronic disease developing in later life. Nevertheless, for optimum protection, physical activity must be maintained for most of one's life and that life habits established in youth are difficult to alter, (Morris and Froelicher 1993; Saul 1994) the option of discouraging young and possibly reckless cyclists while simultaneously encouraging older people to resume cycling is not feasible.

The choice of an appropriate measure for making a quantitative comparison is also difficult. Comparing *years of life lost* in accidents with *years of life gained* from illness prevention is one example. The *years of life lost* measure would indicate that

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the death of a 30 year old cyclist (life expectancy approximately 40 years) in a road crash was worth two heart attack deaths at age fifty (life expectancy approximately 20 years each) and the ethical basis of this calculation is far from secure.

Notwithstanding the preceding concerns, a direct comparison of fatal outcomes of cyclists accidents and heart attacks is possible. By restricting the assessment to one outcome and to equivalent age-standardised populations, the benefit will be demonstrated using *death rates* or *years of life lost* as measures. Such a straightforward approach cannot be made for more complicated scenarios.

The following simple comparison of deaths due to cyclists' collisions with motor vehicles and fatal heart attacks makes a clear case that on one lifestyle related illness alone cycling for transport is worthwhile (Table 2).

Table 2 Estimation of net benefit of cycling for Australian men

Parameter	Value	Units	Source/derivation
Hospitalisation rate for cycling	61	hospitalisations per million hours of cycling	(Drummond and Jee 1988; Dolinis, O'Connor et al. 1995)
Fatality rate for cycling	0.61	fatalities per million hours of cycling	⁸
Relative risk of death by heart attack active men ⁹	0.59	no units	(Berlin and Colditz 1990)
Prevalence of adequate exercise ¹⁰	55%	percentage	(DASET 1992)
Death rate due to heart attack in Australian men	155.04	deaths per 100 000 person-years	(Wise and Graham-Clarke 1994)
Death rate due to heart attack in Australian men who do insufficient exercise for optimum protection	206		
Death rate due to heart attack in Australian men who cycle sufficiently for optimum protection	121		
Death rate reduction for cycling group	85	deaths per 100 000 cyclist-years (for men cycling 6 hours per week)	(Drummond and Jee 1988; Dolinis, O'Connor et al. 1995)
Cyclist road fatality death rate	19		
Lives saved (net)	66		

⁸ Evidence indicates that fatalities equal approximately 1% of hospitalisations.

⁹ The relative risk of CHD experienced by the cyclist compared to the non-cyclists (While difficult to measure a relative risk of 0.59 for CHD death is widely accepted for active (>2000 kCal/week) compared to inactive people although this is likely to be conservative.)

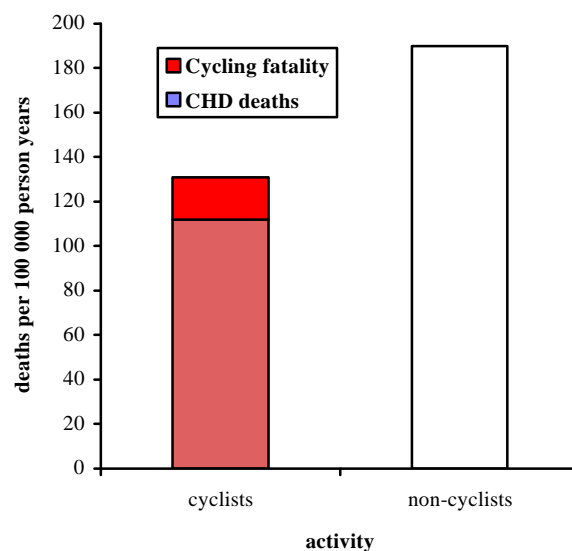
¹⁰ The prevalence of inactivity in the Australian population is known to be high and may reach 85% of the population. (DASET, 1992)

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This data represents the relative proportion of lives saved from reductions in coronary heart disease alone as a result of regular cycling. This calculation underestimates the benefits and overestimates the costs of cycling by failing to account for the following:

- a lower prevalence of diabetes and other cardiovascular disease risk factors will further reduce the amount of coronary heart disease amongst the cyclists
- benefits will also accrue from reductions in stroke due to lower prevalence of high blood pressure amongst the cyclists
- a modal shift from car travel to cycle travel reduces the exposure to the risk of injury as a car occupant
- improved road and traffic conditions as a result of a modal shift from car to bicycle travel.

Figure 27 CHD death and road trauma death rates for cycling and non-cycling men



A direct trade off between *years of life lost* and *years of life gained* is not appropriate as they are not independent but paradoxically linked because the cost of fatal accidents at any age is a function of the life expectancy at that age and is lower in a less healthy population. In a healthier population the life expectancy at any age will be higher and therefore the *years of life lost* in an accident will be higher—in promoting a healthier community the cost of accidents increases.

The only ethical course is to promote cycling for transport as part of a healthy sustainable lifestyles while at the same time ensuring the safest possible conditions for cyclists.

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11.13 Conclusion

As with any form of physical activity a significant health cost of cycling is the risk of injury but the rate of injury is lower than other popular forms of exercise. However, the risk of serious injury following collision with a motor vehicles must be addressed. It must be recognised that this risk is a cost of both cycling and motor vehicle travel and strategies to reduce this risk must not only focus on the victim.

There is developing climate of opinion that environmentally sustainable and health-promoting modes of transport should be encouraged and the principles outlined in the Delhi Declaration should be adopted in South Australia to guide road safety policy. Even under current conditions, the health benefits of cycling outweigh the health costs.

12. POLICIES FOR IMPROVEMENT

‘Curbing car traffic demands alternative modes of transport. In addition to public transport, the bicycle is a good alternative...—especially for short distances. We try to make cycling more attractive in order to persuade car drivers to use their bicycles more often.’ (Maij-Weggen, Dutch Minister for Transport)

Walking and cycling are natural and convenient forms of exercise but traffic fumes, congestion, noise and safety are major obstacles. Some of these obstacles are perceived obstacles but perception remains a major deterrent.

‘Nothing less is required than an epochal shift of behaviour to a more active style of living... So exercise becomes a major issue of social priorities, of the dominance accorded to the motor car, the capacity of different branches of government to work together and the stage reached in articulating national policy on quality of life.’ (Morris 1994)

Cycling is a legal and socially acceptable activity. Cyclists are tax payers and many own motor vehicles that they choose to leave at home in favour of their bicycles. In a recent survey of cyclist commuters to the Adelaide CBD, more than 70% of respondents could have opted to drive rather than cycle on that day (Dorrestyn 1995).

Our road authorities have the responsibility to provide a road system that can be used safely by pedestrians, cyclists, public transport patrons and motorists. Children, older people and people with low incomes or disabilities and others who are unable or choose not to drive motor vehicles have the right to move independently within the metropolitan area with reasonable safety (Roberts, Norton et al. 1994; Roberts, Keall et al. 1994).

Pedestrians and cyclists are at greater risk because they are not surrounded by a steel shield and are sometimes classed as ‘vulnerable’ or ‘un-protected’ road users. It might also be said that, lacking this metal shield and travelling at lower speeds, pedestrians and cyclists do not project significant hazards onto other road users nor do they damage roads, contribute to pollution or traffic congestion and by adopting a physically active transport mode, they are improving the health of the community.

12.1 Public health interventions

A more complete analysis of the factors influencing public health is needed. This analysis will need to go beyond the conventional health sector and include transport and road safety.

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Policy makers are failing to address the root cause of many health problems and remain locked into a system responding with expensive medical interventions and generating spiralling health costs (Evans and Stoddart 1990).

On the other hand, by accurately identifying those social and environmental obstacles to healthy choices and by acting to remove them, more effective public health policies could be developed. Encouragement of the use of bicycles for transport is one ideal opportunity. Steps to improve the urban and road environment would empower people to adopt lifestyles incorporating cycling as a health promoting form of transport that matches our biological needs (DHS 1994).

A survey conducted on behalf of the Department of Transport in South Australia into motorists' attitudes to cyclists and their on-road needs revealed that one of the most important determinants of motorists' attitudes was whether those motorists had recently ridden a bicycle (Walker 1994). If effective programs are implemented to encourage cycling then this aspect of motorist attitude will work to the benefit of cyclists and all road users—more cyclists will translate into more motorists sharing the experience of cycling. On the other hand, if cyclists are marginalised, then motorists' empathy for cyclists will continue to deteriorate.

12.2 International perspective

An international conference on Traffic Safety was held in January 1991 on the theme 'The Vulnerable Road User'. The conference was sponsored by the World Health Organisation; the Association for the Advancement of Automotive Medicine; the Indian Institute of Technology; the International Association for Accident and Traffic Medicine; the International Committee on Alcohol, Drugs and Traffic Safety; the International Federation of Pedestrians and the International Research Council on the Biokinetics of Impacts and adopted the *Delhi Declaration on the Safety of the 'Vulnerable Road User'* which states that:¹¹

'The groups that are today the vulnerable road users are an important and desirable part of the entire transport system. Walking and bicycling in particular are to be encouraged and promoted by appropriate planning of the transport environment because of their low cost, negligible energy consumption, and environmental compatibility.' (ICTS 1992, Point 1)

In this recommendation, the *Delhi Declaration* provides strong support for the South Australian Government's current *Cycling Policy* to double the use of bicycles in this State by the year 2000 (Laidlaw 1993). The opinion that cycling is a worthwhile activity that should be supported is widely held and not just by cycling advocates.

¹¹ vide Appendix

12.3 Community support for cycling

Data on bicycle sales in Australia indicates that Australians wish to be able ride bicycles but require safer roads. Bicycle sales are increasing at 7% per annum (DTC 1993) and surveys reveal community support for cycling for transport because of its minimal environmental impact (van Alphen, Darley et al. 1991).

On-road safety issues are perceived as important barriers to cycling (Dorrestyn 1995), steps to improve safety and perceptions of safety are necessary. However, steps to improve safety for cyclists will also benefit all other road users—especially pedestrians, children, many older Australians and people with disabilities.

12.4 Coordinated policy

Health promotion needs to involve educational and environmental strategies to encourage healthy decisions and to make them feasible. Notwithstanding marginal increases in physical activity as a result of public health campaigns, more than half the population in Australia, Canada, Finland, the United States and Germany remain insufficiently active for effective protection against many lifestyle related diseases. Because of continuing declines in work and transport related exercise, the total amount of physical activity has decreased.

12.5 Policies for a conducive environment

Environmental change to allow for, or encourage increased physical activity is an area that has received scant attention to date (Powell, Stephens et al. 1991). However, in Adelaide, no climatic change is needed! Fine weather predominates and days when commuter cyclists get wet are rare. By comparison, in the Netherlands where it rains 6% of the time cycling is still seen as a convenient transport mode (Maij-Weggen).

Cyclists need the current preoccupation of road safety researchers, planners and engineers with the protection of motor vehicle occupants to be broadened so that cyclists can benefit from changes in the road and traffic environment.

12.6 Work site based encouragement

Work site-based schemes for encouraging cycling for transport are feasible and the promotion of physically active commuting is a plausible alternative by which to promote exercise among the general, often inactive, working population (Leon 1991).

Evaluation of a commuting exercise program in Finland indicated that the awareness and practice of walking and cycling could be increased by relatively simple promotion methods and that, while safety issues emerged as the most important obstacle to walking and cycling, cooperation with traffic authorities to improve safety proved encouraging (Oja, Paronen et al. 1991).

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Identifying concerns about road safety held by incipient cyclists (and shared by cyclists) as major obstacles to bicycle use, effective strategies to increase the use of bicycles will, of necessity, address safety issues.

12.7 Road safety expertise

So clear are the health benefits of cycling that the British Medical Association has editorialised in the *British Medical Journal* that doctors should be setting an example and, as they did with smoking, quitting car driving for life and getting on their bikes. The British Medical Association praises cyclists as ‘modern day heroes who would expose themselves to the risks of injury and pollution from road traffic rather than add to them’ (Godlee 1992; Godlee 1992a).

Unfortunately, as a result of decades of neglect of cycling safety too many cyclists are injured or killed and many others are discouraged from cycling and add to the traffic problems by relying solely on their cars. The experience and attitudes of road users has become more polarised. Focus group research performed on behalf of the Department of Transport in 1994 indicated that the most significant attribute that affected motorist attitudes to cyclists was their own cycling experience (Walker 1994).

Undue attention to the road toll has encouraged the concentration on vehicle occupant protection. Rather than relying on a single measure (road fatalities), better policies and strategies could be developed by examining a wider range of injury experience and other health impacts from various transport modes (Dolinis, O’Connor et al. 1995).

In South Australia, reports on the safety of cyclists and road safety plans seem to be written from the perspective that cycling is dispensable and the deterrents are appropriate (Taylor 1995; ORS 1994). Instead, research is needed to characterise in detail the classes of cyclists or types of cycling activities at greatest risk with a view to making them safer. Interventions may be required to improve the road and traffic environment and alter motorist and cyclist behaviour.

12.8 Engineering for safety

The *Delhi Declaration* states that:

‘Road environments can be designed to control speeds; to separate road users of different sizes, weights, and velocities; to reduce the probability of road users making mistakes; and to minimise injuries if a crash does occur.’ (ICTS 1992, Point 4)

The overwhelming proportion of serious injuries to cyclists involve motor vehicles and attention has been previously drawn to the high contribution young cyclists make to road casualty statistics. Experience from New Zealand child pedestrian studies indicate that strategies to discourage car use and reduce car speeds are likely to be more successful at reducing child road trauma than education of children. (Roberts, Ashton, et al 1994; Roberts, Norton, et al 1994; Roberts,

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Norton, et al 1995) Furthermore, strategies to create a road environment that is a safe for cyclists and pedestrians also benefit other road users.

A well designed road system should aim to integrate bicycles and motor vehicles according to well-established principles of traffic law and engineering. It should always be a priority to find on-road solutions to traffic problems rather than to force cyclists onto footpaths for dubious safety reasons (Wachtel and Lewiston 1994).

Opponents to engineering and legal controls implemented to lower vehicle speeds focus on the costs associated with increased travel times. Rarely is the cost of parents ferrying children to school and other activities considered even though parents adopt this role because of the perceived danger of collision with motor vehicles (Roberts, Ashton et al. 1994). Paradoxically, much of the traffic in the vicinity of schools is generated by parents' concerns for the traffic hazards near schools.

Environmentally-based prevention strategies are likely to be more effective than skills education (Roberts 1993). While focussing on pedestrian accidents, recommendations from Roberts for changes to the urban traffic environment to reduce traffic flows and speeds will reduce injuries to all road users.

In New Zealand, government policies to reduce car use following the energy crisis in the 1970s were associated with a 46.4% reduction in the child pedestrian mortality rate (Roberts 1993). With this overwhelming link between car use and road casualties, it is hypocritical to encourage car use and then to blame the victims of the subsequent collisions (Roberts, Norton et al. 1994). There is a limit to the responsibility children and, in fact, any road user can bear for their own safety. It is unreasonable to expect road users to operate safely in a road environment that is intrinsically dangerous or to make safe decisions in an environment that encourages high vehicle speeds etc (McLean, Anderson et al. 1994; McLean 1995; Roberts, Norton et al. 1995).

While there are recognised shortcomings in currently accepted guidelines for cycling engineering, many existing facilities fail to meet even those (AUSTROADS 1993). Many existing intersections are difficult to negotiate safely and are impossible for novice cyclists to interpret.

Expertise must be developed to assess and improve the design of intersections, bicycle lanes, crossings and other aspects of engineering for cycling.

12.8.1 Segregated bicycle paths

In Australian cities the road network is the only widespread transportation network and it is unlikely that financial or political support will ever exist for the creation of segregated networks of bicycle paths. Therefore it is the road network that cyclists are obliged to use if they are to cycle for transport but changes are needed in this network in order to ensure that all road users can operate safely.

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12.8.2 Footpath cycling

In the absence of a strategic approach to cyclist safety, the issue of footpath cycling is often raised. The option of encouraging footpath cycling as a safe or safer alternative to road use is often considered, usually by non-cyclists.

A report from the Monash University Accident Research Centre appears to offer *prima facie* evidence that footpath cycling is safer than road cycling although this finding is contradicted by more recent work from the United States (Drummond and Jee 1988; Wachtel and Lewiston 1994). In grid-based cities such as Adelaide, footpath cycling involves a great many ride-out manoeuvres where cyclists must continually enter and cross carriageways. These are some of the most dangerous manoeuvres for cyclists (Cross and Fisher 1977; Wachtel and Lewiston 1994).

While currently illegal, there is a certain amount of cycling done on footpaths by novice and experienced cyclists. These trips, or sections of trips, are often short and are used to bridge particularly dangerous section of road. Shortcomings in the design and construction of roads and bicycle paths make footpath cycling a responsible, if currently illegal, decision under some circumstances. For young children taking short, local trips the footpath appears a safe alternative although there are indications that problems with sight lines at intersections and driveways increase the risk (Wachtel and Lewiston 1994).

However for regional and longer journeys footpath cycling is impractical and may be more dangerous than road cycling. The exposure measure used to compare road and footpath cycling in the Monash University Accident Research Centre study are time-based and, especially for transport cyclists, misrepresent the relative risks. No attempt has been made to measure, or allow for, the different mean cycling speeds practicable on footpaths and therefore the greater travel time involved for footpath cycling. Therefore, for a trip of a given distance, the time-based exposure to the risk of accident might be anything from 5 to 10 times longer for a footpath journey than a road journey. Except for short trips and certain locations, footpath and other off-road cycling is not a viable transport option in Adelaide and steps must be taken to make roads safer for cyclists.

12.8.3 Lower vehicle speeds

The *Delhi Declaration* states that:

'Inappropriate speeds by motor vehicles are a major cause of accidents, especially in urban situations. Lower speeds generally result in fewer crashes and less severe injuries, and therefore should be systematically fostered in urban areas.'
(ICTS 1992, Point 3)

While deviant speed (motor vehicles exceeding the speed limit) has been identified as a national road safety priority area, lower urban speed limits are still being investigated in an AUSTROADS project. This appears to be focussing on hierarchies of speed limits that may see further posting of high speed limits on arterial roads (Croft 1995). In answer to a question at the Department of

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Transport's Road Safety Research Workshop in June 1995, Peter Croft, Manager, Road Environment Safety, Roads and Traffic Authority of New South Wales stated that lower motor vehicle speeds would be the single most effective intervention for improving bicycle safety.

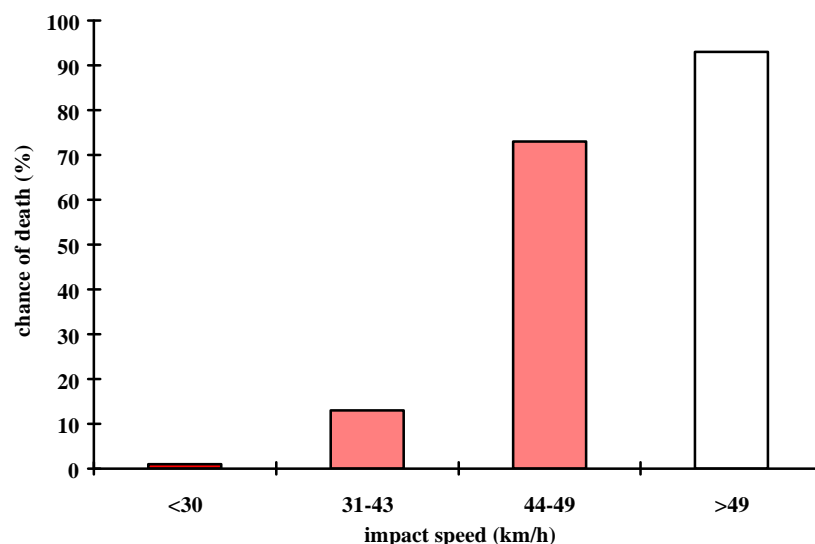
In its recent publication, *Killing Speed Saving Lives*, the UK Department of Transport recommends lower speed limits for improved road safety (DTp 1992). The single most effective (and cost effective) change that could be made to reduce road casualties in the metropolitan area would be to lower motor vehicle travel speeds. By following international examples and lowering vehicle travel speeds many lives could be saved but these lower limits would need to be applied to arterial roads as well as residential streets (McLean, Anderson et al. 1994; McLean 1995).

The National Health and Medical Research Council's Road Accident Research Unit at the University of Adelaide has studied the likely impact on pedestrian fatalities for a number of speed reduction scenarios. Reduction in vehicle speeds carries two benefits:

- reduction in the impact speed of collisions and therefore the severity of injury sustained
- increased opportunity for both parties to avoid the accident altogether (McLean, Anderson et al. 1994).

Figure 28 demonstrates the increasing likelihood of pedestrian death following collision with a motor vehicle as the impact speed of the vehicle rises. Likelihood of serious injury will also increase.

Figure 28 Chance of death as a function of impact speed

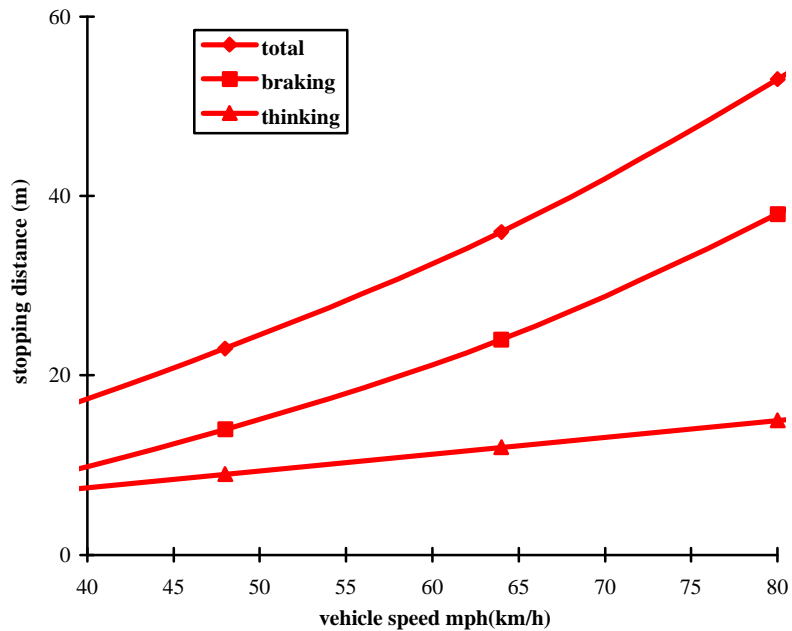


(McLean, Anderson et al. 1994)

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Figure 29 indicates the increase of stopping distance with increasing vehicle speeds. By reducing the stopping distance many accidents will be totally avoided (McLean, Anderson et al. 1994).

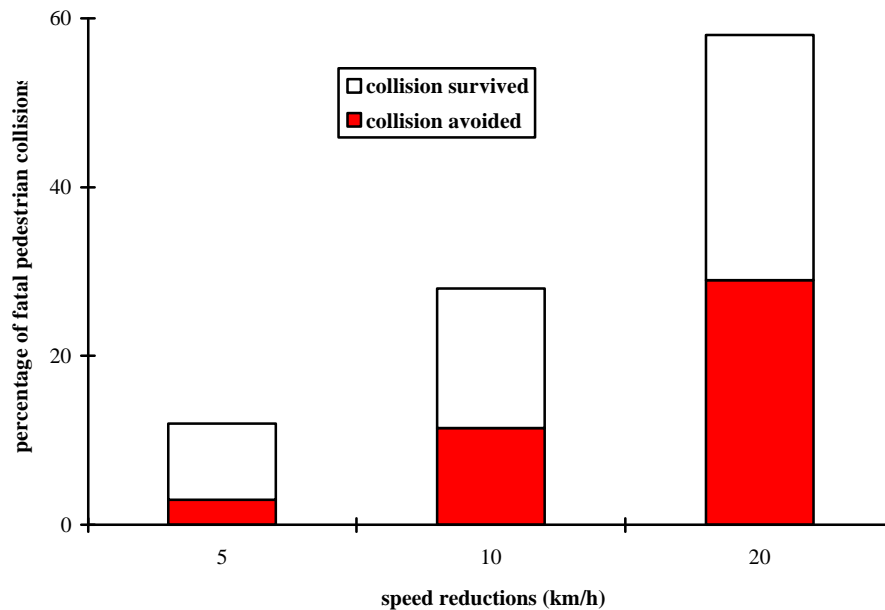
Figure 29 Stopping distance as a function of impact speed



(McLean, Anderson et al. 1994)

Accident analysis shows that the impact speeds of crash vehicles and the survivability of collisions between pedestrians and motor vehicles are very sensitive to vehicle travel speeds and reductions in travel speeds translate into dramatic and valuable reductions in impact speeds and pedestrian fatalities. Often the accident is avoided altogether. (Figure 30) demonstrates the reduction in overall pedestrian fatalities as a result of lowering vehicle travel speeds to by 5, 10 and 20 km/h. Current levels of compliance to speed limits were assumed (McLean, Anderson et al. 1994).

Figure 30 Reduced pedestrian fatalities following vehicle speed reductions



(McLean, Anderson et al. 1994)

While the McLean study concentrated on pedestrians it is certain that cyclists would derive similar benefits from lower motor vehicle speeds.

Recent community debate managed by the Urban Speed Limit Advisory Group urged lower urban speed limits in South Australia and identified 40 km/h as the 'ideal' speed limit (Taylor 1994). Convened before the release of the McLean report, the Urban Speed Limit Advisory Group focussed on lower residential speed limits and did not identify that it is traffic on arterial roads that most urgently needs to be slowed.

High motor vehicle speed has been identified as a major obstacle to cycling in Australia. This obstacle exists both because of the real and dramatic contribution that vehicle travel speeds have on road safety and because of the perception of danger that most non-cyclists have of cycling on our roads (Parker 1994; Parker 1995).

12.8.4 Integrated education

The *Delhi Declaration* states that:

'Each element of a program to promote traffic safety—education and enforcement, changes in the road environment, and improvements in vehicle design—can make important contributions, but these elements are most effective when they are integrated into a comprehensive program appropriate for the physical, cultural, and social environment of the particular region or country.' (ICTS 1992, Point 5)

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It seems to have been recently accepted amongst South Australian road safety professionals that road safety education is of little benefit (White 1994). It is unclear whether this belief focusses on education designed to change behaviour or education designed alter attitudes, or both. However the Delhi Declaration highlights the need for integrated engineering, education and enforcement for improved road safety. Education seeks to alter behaviour by first altering attitudes while enforcement seeks to alter attitudes by first altering behaviour. Most powerfully of all, sound engineering with clear road safety goals in mind can subliminally suggest appropriate driver behaviour and enhance education and enforcement campaigns.

12.8.5 Motor vehicle traffic demand management

The *Delhi Declaration* states that:

‘Well-designed and maintained public transport systems can reduce overall casualty rates, by encouraging low risk travel. Good urban planning reduces risk by diminishing unnecessary and inefficient journeys.’ (ICTS 1992, Point 2)

The international road safety community appreciates the road safety value reducing private vehicle trips by encouraging modal shifts to other less threatening and dangerous forms of transport. The Delhi Declaration also points out that poor urban planning can increase unnecessarily the demand for motor vehicle travel.

12.8.6 Safer cars for non-occupants

The *Delhi Declaration* states that:

‘Vehicle exteriors can be designed to be less injurious to vulnerable road users. Such designs should be introduced by vehicle manufacturers and enforced through national and international regulations and by greater legal liability.’ (ICTS 1992, Point 8)

Steps are needed to ensure that the exterior and especially the front of motor vehicles is made as safe as possible. The attachment of accessories that increase the risk of injury to cyclists and pedestrians should be banned.

12.9 Conclusion

Cyclists have been disadvantaged and prospective cyclists discouraged because there has been a general:

- failure to recognise the private automobile as a vector for various lifestyle-related diseases because of the sedentary lifestyle it engenders
- characterisation of cycling as dangerous and car driving as safe
- reluctance to recognise the important structural influences on human behaviour and health
- tendency to adopt simplistic models of public health intervention.

There is a developing climate of opinion around the world that cycling and walking should be promoted as environmentally sustainable and health promoting modes of transport. Strategies are needed that reduce the hazards projected by motor vehicles onto other road users. The most significant improvements could be achieved by lowering vehicle travel speeds in urban areas especially on arterial roads.

Cyclists need road safety professionals to:

- accept that cycling and walking are not just legitimate but desirable forms of transport
- identify accurately the source of risk on our roads
- develop professional skills in and understanding of the safety needs of cyclists
- develop and introduce programs to reduce risk for cyclists and pedestrians
- become actively involved in securing a safe and pleasant environment for cycling.

Planning for cycling needs to be integrated into broader transport and urban planning. As a beginning, the *Delhi Declaration* could be widely adopted as a set of guiding principles for road safety. Discouragement of cycling as a road safety measure needs to be identified as inequitable and replaced with policies that improve cyclist safety by addressing the source of the hazard and reducing the hazard that motor vehicles project onto cyclists and pedestrians. Research is needed to identify strategies to improve the safety of cyclists rather than to discourage cycling.

13. APPENDICES

13.1 The Delhi declaration on the safety of the ‘vulnerable road user’ (ICTS 1992)

An International Conference on Traffic Safety was held in New Delhi 27-30 January 1991 on the theme ‘The Vulnerable Road User’. The conference was sponsored by the: World Health Organisation; Association for the Advancement of Automotive Medicine; Indian Institute of Technology; International Association for Accident and Traffic Medicine; International Committee on Alcohol, Drugs and Traffic Safety; International Federation of Pedestrians; International Research Council on the Biokinetics of Impacts. The following declaration was adopted at the conference:

- 1. The groups that are today the vulnerable road users are an important and desirable part of the entire transport system. Walking and bicycling in particular are to be encouraged and promoted by appropriate planning of the transport environment because of their low cost, negligible energy consumption, and environmental compatibility.*
- 2. Well-designed and maintained public transport systems can reduce overall casualty rates, by encouraging low risk travel. Good urban planning reduces risk by diminishing unnecessary and inefficient journeys.*
- 3. Inappropriate speeds by motor vehicles are a major cause of accidents, especially in urban situations. Lower speeds generally result in fewer crashes and less severe injuries, and therefore should be systematically fostered in urban areas.*
- 4. Road environments can be designed to control speeds; to separate road users of different sizes, weights, and velocities; to reduce the probability of road users making mistakes; and to minimise injuries if a crash does occur.*
- 5. Each element of a program to promote traffic safety—education and enforcement, changes in the road environment, and improvements in vehicle design—can make important contributions, but these elements are most effective when they are integrated into a comprehensive program appropriate for the physical, cultural, and social environment of the particular region or country.*
- 6. There is need for improved emergency communications, patient transport, and trauma care systems.*
- 7. Resources in less motorised countries are very limited, and therefore transport safety programs should be carefully planned and optimised. A good database is essential and the development of adequate definitions and data collection systems are vital for planning appropriate countermeasures and evaluating their effectiveness.*
- 8. Vehicle exteriors can be designed to be less injurious to vulnerable road users. Such designs should be introduced by vehicle manufacturers and enforced through national and international regulations and by greater legal liability.*

13.2 The Ottawa Charter for health promotion (WHO 1986)

The first *International Conference on Health Promotion*, meeting in Ottawa this 21st day of November 1986, hereby presents this charter for action to achieve health for all by the year 2000 and beyond.

This conference was primarily a response to growing expectations for a new public health movement around the world. Discussions focused on the needs in industrialised countries, but took into account similar concerns in all other regions. It built on the progress made through the *Declaration on Primary Health Care* at Alma Ata, the World Health Organization's *Targets for Health for All* document, and the recent debate at the World Health Assembly on intersectoral action for health.

Health promotion

Health promotion is the process of enabling people to increase control over, and to improve, their health. To reach a state of complete physical, mental and social well-being, an individual or group must be able to identify and to realise aspirations, to satisfy needs, and to change or cope with the environment. Health is, therefore, seen as a resource for everyday life, not the objective of living. Health is a positive concept emphasising social and personal resources, as well as physical capacities. Therefore, health promotion is not just the responsibility of the health sector, but goes beyond healthy lifestyles to well-being.

Prerequisites for health

The fundamental conditions and resources for health are:

- peace
- shelter
- education
- food
- income
- a stable ecosystem
- sustainable resources
- social justice
- equity.

Improvement in health requires a secure foundation in these basic prerequisites.

Advocate

Good health is a major resource for social, economic and personal development and an important dimension of quality of life. Political, economic, social, cultural, environmental, behavioural and biological factors can all favour health or be harmful to it. Health promotion action aims at making these conditions favourable through advocacy for health.

Enable

Health promotion focuses on achieving equity in health. Health promotion action aims at reducing differences in current health status and ensuring equal

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opportunities and resources to enable all people to achieve their fullest health potential. This includes a secure foundation in a supportive environment, access to information, life skills and opportunities for making healthy choices. People cannot achieve their fullest health potential unless they are able to take control of those things which determine their health. This must apply equally to women and men.

Mediate

The prerequisites and prospects for health cannot be ensured by the health sector alone. More importantly, health promotion demands coordinated action by all concerned by:

- governments
- local authorities
- health and other social and economic sectors
- industry
- non-governmental and voluntary organisations
- the media.

People in all walks of life are involved as individuals, families and communities. Professional and social groups and health personnel have a major responsibility to mediate between differing interests in society for the pursuit of health.

Health promotion strategies and programmes should be adapted to the local needs and possibilities of individual countries and regions to take into account differing social, cultural and economic systems.

Health promotion action means:

Build healthy public policy

Health promotion goes beyond health care. It puts health on the agenda of policy makers in all sectors and at all levels, directing them to be aware of the health consequences of their decisions and to accept their responsibilities for health.

Health promotion policy combines diverse but complementary approaches including legislation, fiscal measures, taxation and organisational change. It is coordinated action that leads to health, income and social policies that foster greater equity. Joint action contributes to:

- ensuring safer and healthier goods and services
- healthier public services and
- cleaner, more enjoyable environments.

Health promotion policy requires the identification of obstacles to the adoption of healthy public policies in non-health sectors, and ways of removing them. The aim must be to make the healthier choice the easier choice for policy makers as well.

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Create supportive environments

Our societies are complex and interrelated. Health cannot be separated from other goals. The inextricable links between people and their environment constitutes the basis for a socio-ecological approach to health. The overall guiding principle for the world, nations, regions and communities alike, is the need to encourage reciprocal maintenance—to take care of each other, our communities and our natural environment. The conservation of natural resources throughout the world should be emphasised as a global responsibility.

Changing patterns of life, work and leisure have a significant impact on health. Work and leisure should be a source of health for people. The way society organises work should help create a healthy society. Health promotion generates living and working conditions that are safe, stimulating, satisfying and enjoyable.

Systematic assessment of the health impact of a rapidly changing environment—particularly in areas of technology, work, energy production and urbanisation—is essential and must be followed by action to ensure positive benefit to the health of the public. The protection of the natural and built environments and the conservation of natural resources must be addressed in any health promotion strategy.

Strengthen community action

Health promotion works through concrete and effective community action in setting priorities, making decisions, planning strategies and implementing them to achieve better health. At the heart of this process is the empowerment of communities, their ownership and control of their own endeavours and destinies.

Community development draws on existing human and material resources in the community to enhance self help and social support, and to develop flexible systems for strengthening public participation and direction of health matters. This requires full and continuous access to information, learning opportunities for health, as well as funding support.

Develop personal skills

Health promotion supports personal and social development through providing, information, education for health and enhancing life skills. By so doing, it increases the options available to people to exercise more control over their own health and over their environments, and to make choices conducive to health.

Enabling people to learn throughout life, to prepare themselves for all of its stages and to cope with chronic illness and injuries is essential. This has to be facilitated in school, home, work and community settings. Action is required through educational, professional, commercial and voluntary bodies, and within the institutions themselves.

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Reorient health services

The responsibility for health promotion in health services is shared among individuals, community groups, health professionals, health service institutions and governments. They must work together towards a health care system which contributes to the pursuit of health.

The role of the health sector must move increasingly in a health promotion direction, beyond its responsibility for providing clinical and curative services. Health services need to embrace an expanded mandate which is sensitive and respects cultural needs. This mandate should support the needs of individuals and communities for a healthier life, and open channels between the health sector and broader social, political, economic and physical environmental components.

Reorienting health services also requires stronger attention to health research as well as changes in professional education and training. This must lead to a change of attitude and organisation of health services, which refocusses on the total needs of the individual as a whole person.

Moving into the future

Health is created and lived by people within the settings of their everyday life; where they learn, work, play and love. Health is created by caring for oneself and others, by being able to take decisions and have control over one's life circumstances, and by ensuring that the society one lives in creates conditions that allow the attainment of health by all its members.

Caring, holism and ecology are essential issues in developing strategies for health promotion. Therefore, those involved should take as a guiding principle that, in each phase of planning, implementation and evaluation of health promotion activities, women and men should become equal partners.

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Commitment to health promotion

The participants in this conference pledge:

- to move into the arena of healthy public policy, and to advocate a clear political commitment to health and equity in all sectors
- to counteract the pressures towards harmful products, resource depletion, unhealthy living conditions and environments, and bad nutrition; and to focus attention on public health issues such as pollution, occupational hazards, housing and settlements
- to respond to the health gap within and between societies, and to tackle the inequities in health produced by the rules and practices of these societies
- to acknowledge people as the main health resource; to support and enable them to keep themselves, their families and friends healthy through financial and other means, and to accept the community as the essential voice in matters of its health, living conditions and well-being
- to reorient health services and their resources towards the promotion of health; and to share power with other sectors, other disciplines and most importantly with people themselves
- to recognise health and its maintenance as a major social investment and challenge
- to address the overall ecological issue of our ways of living.

The conference urges all concerned to join them in their commitment to a strong public health alliance.

Call for international action

The Conference calls on the World Health Organisation and other international organisations to advocate the promotion of health in all appropriate forums and to support countries in setting up strategies and programmes for health promotion.

The Conference is firmly convinced that if people in all walks of life, non-governmental and voluntary organisations, governments, the World Health Organisation and all other bodies concerned join forces in introducing strategies for health promotion, in line with the moral and social values that form the basis of this charter, Health For All by the year 2000 will become a reality.

This charter for action was developed and adopted by an international conference, jointly organised by the World Health Organisation, Health and Welfare Canada and the Canadian Public Health Association. Two hundred and twelve participants from 38 countries met from November 17 to 21, 1986, in Ottawa, Canada to exchange experiences and share knowledge of health promotion.

The Conference stimulated an open dialogue among lay, health and other professional workers, among representatives of governmental, voluntary and community organisations, and among politicians, administrators, academics and practitioners. Participants coordinated their efforts and came to a clearer definition

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of the major challenges ahead. They strengthened their individual and collective commitment to the common goal of *Health for All by the Year 2000*.

This **charter** for action reflects the spirit of earlier public charters through which the needs of people were recognised and acted upon. The **charter** presents fundamental strategies and approaches for health promotion which the participants considered vital for major progress. The Conference report develops the issues raised, gives concrete examples and practical suggestions regarding how real advances can be achieved, and outlines the action required of countries and relevant groups.

The move towards a new public health is now evident worldwide. This was reaffirmed not only by the experiences but by the pledges of Conference participants who were invited as individuals on the basis of their expertise. The following countries were represented: Antigua, Australia, Austria, Belgium, Bulgaria, Canada, Czechoslovakia, Denmark, Eire, England, Finland, France, German Democratic Republic, Federal Republic of Germany, Ghana, Hungary, Iceland, Israel, Italy, Japan, Malta, Netherlands, New Zealand, Northern Ireland, Norway, Poland, Portugal, Romania, St. Kitts-Nevis, Scotland, Spain, Sudan, Sweden, Switzerland, Union of Soviet Socialist Republic, United States of America, Wales and Yugoslavia.

13.3 Better health outcomes for Australians

The Sections 12.3.1 and 12.3.2 are extracted from *Better Health Outcomes for Australians* (DHS 1994).

13.3.1 Physical inactivity and Coronary Heart Disease

The evidence is strong that regular physical activity benefits overall health, particularly cardiovascular health. Increasing participation in physical activity is becoming a public health priority in the developed world.

There is increasing evidence that moderate physical activities, particularly walking, have as much cardiovascular benefit as the vigorous exercise previously thought necessary (Blair et al. 1989). The greatest health benefits to the community are likely to result from encouraging those who are sedentary to participate in regular moderate exercise, rather than persuading those who are already active to exercise more.

The fact that about a third of the adult population do no regular physical activity represents a challenge for health promotion endeavours. National exercise promotion campaigns can significantly raise knowledge, but behaviour is unlikely to change unless it is easy for people to make exercise part of their lives, and that change is seen as convenient and enjoyable. That is why strategies in this area must be coordinated with mass media campaigns to raise awareness supported by appropriate community facilities and programs, and vice versa. The effects of structural changes to encourage people to walk or cycle instead of using motor transport should also be investigated.

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Various population groups may need different strategies, as they have different reasons for being inactive. Older people and those in low socio-economic groups may benefit most from convenient and inexpensive facilities, and information about the benefits of simple activities such as walking. Those who perceive that they have little spare time to exercise may be motivated instead by work site programs which make exercise more convenient. School curricula should encourage a pattern of physical activity which can be continued throughout later life, so that fewer of today's children become the sedentary adults of the next generation.

Strategies

- Governments should develop strategies to encourage employers to offer their staff physical activity and fitness programs or incentives to participate in outside programs.
- States and Territories should work with Australian Council for Health, Physical Exercise and Recreation (ACHPER) and the National Heart Foundation (NHF) to ensure that school curricula involve the regular participation of all children and adolescents in primary and high school in physical education programs several times a week.
- States and Territories should work with ACHPER and the NHF to ensure that school physical education programs consist of physical activities which may be continued and maintained through later life.
- Tertiary education facilities should be encouraged to develop programs which increase the proportion of students who participate in sport or active recreation.
- **Governments and non-government organisations such as the NHF should develop programs to further reinforce the convenience of regular, moderate physical activity for the maintenance of cardiovascular health.**
- **States and local governments should be encouraged to include walking and cycle paths and low-traffic areas as part of community recreation and transport planning activities. The NHF should continue to work with local governments to increase community exercise facilities and programs.**
- **States and local governments should investigate structural changes which will encourage people to walk or cycle instead of using motor transport wherever possible. Possibilities are car-free areas in cities (except for the disabled or elderly), and strategies to encourage cycling instead of driving.**
- There should be a coordinated national system for the reliable and valid assessment of prevalence and trends in physical activity participation.
- The Commonwealth should fund research into effective means of promoting more widespread participation in exercise.

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13.4 Exercise and energy expenditure

Table 3 Energy expenditure for various activities

Activity	Energy Intensity (kCal kg ⁻¹ hour ⁻¹)
Babysitting	1.5
Badminton	5.5
Bicycling	4.5
Gardening	4.5
Driving	1.4
Walking	3.5

(Caspersen, Bloemberg et al. 1990, p1092)

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