

## **Walk This Way for Health**

**Billie Giles-Corti**

### ***Abstract***

Walking was firmly put on the public health agenda in 1996 following publication of the US Surgeon General's Report on Physical Activity. This report coincided with growing international concern about the burden of obesity, which in developed countries, is contributed to by increasingly inactive lifestyles. After reviewing decades of epidemiological evidence, the US Surgeon General concluded that physical inactivity was as important as smoking and diet as a risk factor for major causes of disease. Moreover, to gain health benefit the report recommended 30 minutes of daily moderate exercise – even brisk walking taken in three 10-minute bouts. Australian and US studies consistently find that walking is popular in both men and woman, but particularly in women and in those over 50 years. However, despite its popularity, many people do not walk and many others walk, but do insufficient to benefit their health. Results from a social ecological study of 1803 healthy working adults aged 18-59 years in a 408 km<sup>2</sup> area of metropolitan Perth will be presented. Overall, in the previous two weeks 72.1% of respondents had walked for transport and 68.5% had walked for recreation. However, only 17.3% did six 30-minute sessions per week of walking for recreation, health, fitness or going to and from somewhere. Recreational walking was the *only* form of exercise for 13.1% of respondents, but of these, 68.2% did insufficient to benefit their health. Similarly, walking for transport was the *only* form of exercise for 7.4% of respondents, but 86.4% did insufficient to benefit their health. Individual factors, social environmental factors and physical environmental factors that influence walking as recommended will be presented. Clearly, promoting walking and cycling and greater use of public transport, will not only achieve risk factor objectives, but will help achieve broader public health and community objectives related to a healthier, greener and safer environment. However, it requires a comprehensive approach including long-term awareness raising and educational campaigns; fundamental changes in local and state government policy; and development of supportive infrastructure that encourages walking, cycling and public transport use.

---

### ***Contact Author***

Dr Billie Giles-Corti  
Department of Public Health, The University of Western Australia  
PO Box 5771  
ALBANY.  
Western Australia, Australia, 6332.

Tel: (61) 8 9842 0888

Fax: (61) 8 9842 0877

E-mail: [billie@cyllene.uwa.edu.au](mailto:billie@cyllene.uwa.edu.au)

***Billie Giles-Corti BAppSc, MAppSc, PhD; Member of the Public Health Association  
and Australian Health Promotion Association***

Billie is the Director UWA Albany Centre and Senior Lecturer Department of Public Health, The University of Western Australia. She has worked in health promotion research and practice for 15 years and has a particular interest in social ecological research that considers environmental determinants of behaviour. Since 1994, she has been conducting research examining the relative influence of individual, social environmental and physical environmental determinants of physical activity.

## **Walk This Way for Health**

**Billie Giles-Corti**

### ***Introduction***

*Eating alone will not keep a man (sic) well; he must also take exercise.  
Hippocrates (c. 460-357 BC)*

Knowledge that physical activity beneficially influences health has been recognised since antiquity. Juvenal, (60 and 130 AD), encouraged the Greeks to pray ‘...for a healthy mind in a healthy body’ (Fraser, 1988) reflecting Hippocrates’ (c. 460-357 BC) wisdom that:

*‘All parts of the body which have a function, if used in moderation and exercised in labours in which each is accustomed, become ... healthy, well-developed and age more slowly, but if unused and left idle they become liable to disease, defective in growth, and age quickly’ (in Wagner et al., 1992 p451).*

As suggested by Hippocrates, the physically active body is healthier and works more efficiently than the inactive body because in evolutionary terms, the human species is adapted to a hunter-gatherer existence (Eaton, Konner and Shostak, 1988a; Eaton, Shostak and Konner, 1988b).

However, never before in the history of the human race have so many people been so inactive in the course of their daily lives (McKeown, 1988; Sallis and Owen, 1996) and increasing regular physical activity is a national goal in Australia (Commonwealth Department of Human Services and Health, 1994) and other developed countries (U.S. Department of Health and Human Services, 1996). However, advances in technology have resulted in a rapidly changing push-button culture dominated by the motor vehicle as the main form of transport. This trend minimises expenditure of energy associated with work, travel, preparation of daily sustenance and recreation.

### **Epidemiological Evidence**

While the link between physical activity and health has been understood intuitively since antiquity, over the past 40 years there has been a growing body of evidence that has established this link scientifically. Regardless of whether studies have measured physical *activity* (Paffenbarger, Wing and Hyde, 1978; Leon et al., 1987) or physical *fitness* (Blair et al., 1989), well-designed large-scale prospective epidemiological studies have found that both occupational and leisure-time physical activity are associated with decreased risks of premature morbidity and mortality (Powell et al., 1987; Berlin and Colditz, 1990).

Until relatively recently, most prospective cohort studies have focussed on white middle to upper class men. However, Blair and colleagues (Blair et al., 1989) found a similar effect of being physically unfit in both men and women.

Depending on whether physical activity or the more objective measure of physical fitness is used, estimates of the age-adjusted relative risk of cardiovascular disease in those who are inactive range from 2.0 (Powell et al., 1987; Berlin and Colditz, 1990) to 8.00 (Blair et al., 1989).

The results suggest that a moderate level of activity undertaken throughout the life cycle beneficially influences mortality and morbidity in both men and women, regardless of their other risk factors. Moreover, later research by Blair et al (1995) suggests that taking up physical activity throughout one's lifetime is likely to result in a decreased risk of mortality and morbidity.

For cardiovascular disease, the magnitude of the effect of inactivity is similar to other known behavioural and clinical risk factors including smoking, hypertension and elevated cholesterol (Powell et al., 1987; Berlin and Colditz, 1990). A decade ago, Hahn and others (1990) assessed the contribution that nine risk factors made to deaths from nine diseases in the United States using the attributable risk. The attributable risk is based on the risk associated with the risk factors plus the risk factor's prevalence. It provides an estimate of the maximum likely decrease in mortality that might result from the elimination of a risk factor.

Seven of the nine risk factors examined included cardiovascular risk factors: cigarette smoking, cholesterol levels  $\geq 5.20$  mmol/L, hypertension (systolic blood pressure  $\geq 140$  mm Hg), obesity  $\geq 110/130\%$  of desirable weight), no regular exercise, alcohol  $\geq 30$  g of ethanol/day) and diabetes (Hahn et al., 1990). The investigators estimated that while 25.1% of coronary heart disease deaths could be attributed to smoking, more than one third of deaths could be attributed to a sedentary life-style (34.6%). Thus, the analysis suggested that if physical inactivity were completely eliminated, the maximum likely reduction in mortality from coronary heart disease would be around 35%.

### **From Vigorous to Moderate**

Publication of the US Surgeon General's Report in 1996, resulted in a paradigm shift in the way public health academics, policy-makers and practitioners conceptualised the type and quality of physical activity required, to benefit health. Prior to 1996, the focus of the public health message for physical activity was on vigorous activity – activity that made one sweat and puff and pant. Thus, the main public health message was that to benefit health, adults required three 20 minute sessions of vigorous activity each week. Clearly, the message was unpopular. In most developed countries, less than 15% of the adult population complied with this public health message (U.S. Department of Health and Human Services, 1996).

In summary, the US Surgeon General's report (U.S. Department of Health and Human Services, 1996) concluded that:

- physical activity reduces the risk of overall premature mortality and morbidity. It reduces the risk of coronary heart disease, hypertension, colon cancer and diabetes, and it beneficially influences mental health and the health of muscles, bones and joints;
- people of all ages, both males and females, benefit from regular physical activity;

- significant health benefits can be obtained from undertaking 30 minutes of moderate physical activity undertaken on most, if not all days of the week (e.g., 30 minutes of brisk walking or raking leaves, 15 minutes of running); and
- additional health benefits can be gained through greater amounts of physical activity.

### **Walking and Health**

Thus, publication of the US Surgeon General Report put walking firmly on the agenda. Walking is the most popular form of exercise for adults in Australia (DASETT, 1988; DASET, 1992; Bauman et al., 1996a; Bauman et al., 1996b) and other developed countries including the United States (Stephens, Jacobs and White, 1985), particularly among women and those over 50 years of age. If undertaken at a brisk pace, it can also beneficially influence health.

Even more encouraging, from the point of view of developing a palatable public health message, is the evidence suggesting that short bouts of physical activity are as effective as longer bouts in increasing physical fitness (DeBusk et al., 1990). In the past, public health messages have focused on undertaking 20-30 minute sessions of activity in one bout. In the last decade, studies have addressed the question of the comparability of short and long sessions of exercise of equal total duration and intensity in achieving physical fitness (Ebisu, 1985; DeBusk et al., 1990; Jakicic et al., 1995). Investigators have found support for comparable increased levels of fitness and weight loss regardless of whether physical activity is undertaken in short or long sessions. One study of obese women (Jakicic et al., 1995) found that not only did prescribing short bouts of exercise enhance adherence, there was also a trend towards greater weight loss in the short bout group compared with the long bout group. This was because while the short bout group tended to reduce the number of bouts per day from three as prescribed to two bouts, they also exceeded the exercise prescription by exercising on more days per week for longer periods each day.

Together these results suggest that encouraging more walking – including walking as a means of transport – is likely to produce considerable public health benefit including improved health outcomes, fitness and weight loss.

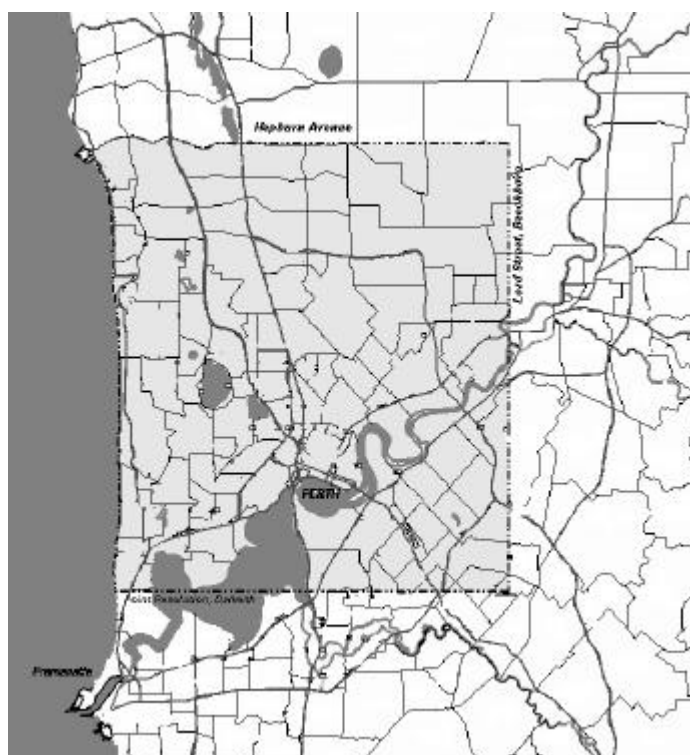
There have been few international studies examining the factors that influence walking and results from a Western Australian social ecological study are presented. I would like to acknowledge my colleagues, Professor Rob Donovan, Ms Melissa Broomhall and Mrs Jilda Hyndman.

### **Method**

The results reported are based on a cross sectional survey of 1803 adults aged 18-59 years. A probability cluster sample was drawn by the Australian Bureau of Statistics from 277 ABS collectors' districts. One eligible respondent was randomly selected from each household (the eligible person whose birthday fell closest to the day of the interview was selected). After allowing for three call-backs, a response rate of 52.9% of households was achieved.

To control for major confounding variables for recreational physical activity the study excluded: the unemployed; those who were physically active as part of their job; those with any medical condition likely to affect participation in recreational physical activity including walking (Hofstetter et al., 1991); those aged over 59 years (because of the likelihood that medical problems increase with age); and those who had occupied a household for less than one year). The final sample was a working healthy adult population that was restricted to those who were proficient in the English language.

A major focus of the study was to examine physical environmental determinants of physical activity. Thus, it was restricted to a 408 km<sup>2</sup> area of Perth, Western Australia (see Figure 1).



\*The light grey area within the border represents the study area. Scale: 7.5mm=2km

Figure 1: Map of the study area\*

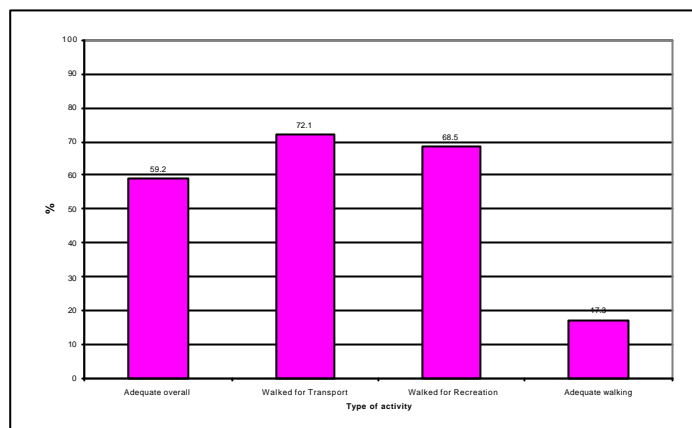
## **Results**

### **Physical Activity Behaviour**

Australian studies of adults indicate that about one-half of adults are 'inadequately' active i.e., they participate in less than 30 minutes of moderate activity on most days of the week. 'Moderate activity' includes any activity that increases the heart rate, including brisk walking.

As shown in Figure 2, our study of healthy working adults aged 18-59 years found that nearly 60% of adults did adequate amounts of physical activity. When the types of activity undertaken were examined, walking was the most popular form of physical activity with 72.1% claiming that in the last two weeks they had walked for transport and 68.5% claiming that they had walked for recreation. However, only 17.3% did an

adequate amount of walking to benefit their health i.e., defined as six 30 minute sessions of walking for recreation, health, fitness or going to or from somewhere.



**Figure 2: Types of physical activity undertaken by healthy working adults aged 18-59 years**

Thus, while walking is popular, to maximise the public health benefit, more people need to be doing more walking, more often. Table 1 demonstrates this more explicitly. To estimate the level of physical activity in the community, respondents in this study were asked if they participated in a number of types of physical activity: light to moderate activity (such as gardening, heavy household chores, gentle tennis etc); vigorous activity (that made them sweat or puff and pant); or walking (either for transport or recreation).

The majority of respondents reported undertaking a combination of these activities (66.5%); while 7.4% of respondents reported only walking for transport and 13.1% reported only walking for recreation. In those who only walked for transport or only walked for recreation – that is, more than one in five adults – the vast majority did inadequate amounts of walking to benefit their health (86.3% and 68.2% respective). In addition, a significant proportion of those who did other forms of activity, did insufficient exercise benefit their health. Thus, given the popularity of walking, from a public health perspective, there is enormous scope to encourage more people to do more walking even in those who prefer vigorous exercise.

**Table 1: Type of activity undertaken by physical activity level**

Type(s) of physical activity undertaken during the last two weeks	Physical activity level: %			
	Inadequate	Adequate	High	As a % of total sample
None at all (n=77)	100.0	-	-	4.3
Light to moderate activity only (n=70)	70.0	18.6	11.4	3.9
Vigorous activity only (n=82)	29.3	34.1	36.6	4.6
Walking for transport only (n=132)	86.3	9.8	3.8	7.4
Recreational walking only (n=233)	68.2	22.7	9.0	13.1
Combination of above (n=1179)	21.9	34.9	43.3	66.5

### **Factors that Influence Walking**

To assist in finding strategies to increase the level of walking in the community we adopted a social ecological approach to examining factors that influenced walking as recommended. This approach took into account individual, social environmental factors and physical environmental factors and included 12 main effect variables:

- five individual determinants (i.e., attitudes towards the process of exercising; frequency of trying to exercise in the past three months; perceived behavioural control or confidence that one can achieve a behaviour change; behavioural skills used in the last month; and intention to exercise in the next two weeks);
- four social environmental determinants (i.e., sport, recreation or outdoor club membership; dog ownership; number of significant others known to exercise weekly in the last month; and number of significant others who exercised with respondent weekly in the past three months); and
- four physical environmental determinants (i.e., functional environment; appeal of environment; access to golf courses; and access to attractive public open space).

The model also included five demographic variables used to adjust for potential confounding (age, sex, number of children under 18 years at home, household income and education).

Walking at recommended levels appeared to be associated with 12 of these 13 variables, although chance could not be ruled out as an explanation for many of these findings. Compared with others, the odds of achieving recommended levels of walking were 1.46 times higher in those with a very positive attitude towards the process of exercising (95% CI 0.90-2.37); 1.43 times higher in those who, in the past three months, had tried to be active weekly (94% CI 0.92-2.22); and were nearly twice as likely in those who had formed a high intention to be physically active in the next two weeks (OR 1.87; 95% CI 1.14-3.06).

The odds of achieving recommended levels of walking increased with the numbers of significant others who exercised weekly with the respondent over the past three months (test for trend  $p < 0.001$ ); were 1.32 higher in those who knew of four or more significant others who exercised weekly in the last month (95% CI 0.77-2.26); and were 1.57 higher in dog owners (95% CI 1.18-2.09).

Access to shops or footpaths also appeared to influence walking at recommended levels. Compared with those who had neither a shop nor a footpath in their street, those who had access to either one or both were 50% more likely to achieve recommended levels of activity (combined OR 1.50; 95% CI 0.96-2.33).

Achieving recommended levels of walking was approximately one third less likely in those with uncertain or low perceived behavioural control (combined OR 0.68; 95% CI 0.46-1.00) and in those who *used* behavioural skills in the last month regardless of how frequently (combined OR 0.69; 95% CI 0.47-1.03).

Members of sport, recreation or outdoor clubs were half as likely as others to achieve recommended levels of walking (OR 0.54; 95% CI 0.39-0.75), and the odds declined with decreasing levels of access to attractive public open space (test for trend  $p = 0.018$ ).

**Table 1: Odds ratios from logistic regression associating walking as recommended with individual, social environmental and physical environmental determinants**

Determinant	Logistic regression odds ratios		
	Final model <sup>2</sup>	95% CI	p value
<b>Attitude towards process</b>			
Negative/neutral <sup>1</sup>	1.00		
Positive	1.24	0.79-1.92	0.347
Very positive	1.46	0.90-2.37	0.128
<b>Frequency of past trying in past three months</b>			
Never	1.00		
1-2 times in 3 months	1.16	0.58-2.30	0.672
Once a month	1.19	0.50-2.83	0.690
2-3 times a month	0.57	0.28-1.20	0.138
Weekly	1.43	0.92-2.22	0.117
<b>Perceived behavioural control</b>			
High	1.00		
Uncertain	0.66	0.43-1.00	0.052
Low	0.75	0.38-1.47	0.400
<b>Behavioural skills used in last month</b>			
Never used	1.00		
Used 1-2 times	0.80	0.52-1.25	0.326
Used 2-3 times	0.62	0.39-0.98	0.039
Used weekly	0.68	0.42-1.10	0.118
> once a week	0.53	0.31-0.93	0.026
<b>Intention to be physically active in the next two weeks</b>			
Low	1.00		
Medium	1.15	0.71-1.86	0.582
High	1.87	1.14-3.06	0.013
<b>Sport, recreation or outdoor club membership</b>			
No	1.00		
Yes	0.54	0.39-0.75	0.000
<b>Dog ownership</b>			
No	1.00		
Yes	1.57	1.18-2.09	0.002
<b>Number of significant others known to exercise weekly in last month</b>			
None	1.00		
One	1.15	0.76-1.74	0.500
Two	1.24	0.80-1.92	0.336
Three	1.07	0.66-1.73	0.779
Four or more	1.32	0.77-2.26	0.305
<b>Number of significant others who exercised with respondent weekly over the three months</b>			
None	1.00		
One	1.81	1.30-2.52	0.000
Two	2.05	1.36-3.09	0.001
Three	1.49	0.75-2.93	0.254
Four or more	3.40	1.14-10.1	0.029
<b>Functional environment</b>			
No footpath, no shop	1.00		
No footpath, shop	1.33	0.22-8.15	0.756
Footpath, no shop	1.23	0.88-1.72	0.225
Footpath, shop	1.45	0.82-2.57	0.207
<b>Appeal of environment</b>			
No trees, major traffic	1.00		
Major traffic, some trees	1.42	0.89-2.24	0.137
Minor traffic, no trees	1.89	0.97-3.69	0.061
Minor traffic, some trees	1.62	0.98-2.67	0.060
<b>Access to attractive public open space</b>			
Top quartile of access	1.00		
2 <sup>nd</sup> top quartile	0.85	0.59-1.23	0.388
3 <sup>rd</sup> quartile	0.51	0.35-0.76	0.001
Bottom quartile	0.68	0.46-1.00	0.049

<sup>1</sup>Adjusted for age, sex, number of children under 18 years at home, household income, education. <sup>2</sup>n=1688.

The results suggest that those who achieved recommended levels of walking had a positive attitudes towards exercising, higher levels of perceived behavioural control and tended to walk habitually as evidenced by their behaviour over the past three months and intention to walk over the forthcoming two weeks. They also had a positive social environment with at least one other to exercise with and were more likely to be dog owners.

The physical environment also appeared to be important. Those who achieved recommended levels of walking were more likely to live in a street with footpaths or a local shop and were less likely to have poor access to attractive public open space.

**Relative influence of individual, social and physical environmental determinants**

To examine the relative influence of the main determinants, overall determinant scores for individual, social environmental and physical environmental determinants were developed using a method developed by Miettinen (Miettinen, 1976) and described fully elsewhere (Giles-Corti and Donovan, under review). The results presented in Table 3 show very little difference in the relative influence of individual, social environmental and physical environmental determinants play in influencing the achievement of recommended levels of walking. There was no evidence of multiplicative interaction, suggesting that the results were consistent with no effect modification on a multiplicative scale.

Compared with those in the lowest determinant score categories, the odds of achieving recommended levels of walking were 3.10 times higher in those in the high individual determinant score category (95% CI 2.20-4.37); 2.79 times higher in those in the high social environmental determinant score category (95% 2.00-3.90); and 2.13 times higher in those in the high physical environmental determinant score category (95% CI 1.54-2.94). The results suggest that for walking as recommended, the influence of the physical environmental determinants was equally important as individual and social environmental determinants.

**Table 3: Odds ratios from logistic regression associating walking as recommended with individual, social environmental and physical environmental determinant scores**

Determinant score	Logistic regression odds ratios		
	Model with all variables <sup>1,2</sup>	95% CI	p value
<b>Individual determinant score</b>			
Low	1.00		
Medium	1.65	1.16-2.35	0.006
High	3.10	2.20-4.37	0.000
<b>Social environmental determinant score</b>			
Low	1.00		
Medium	1.50	1.05-2.14	0.027
High	2.79	2.00-3.90	0.000
<b>Physical environmental determinant score</b>			
Low	1.00		
Medium	1.36	0.97-1.90	0.073
High	2.13	1.54-2.94	0.000

(n=1688). Adjusted for demographic determinant score. <sup>2</sup>No interactions were eligible for inclusion in the model.

### **Conclusion**

Increasing population physical activity levels is a major public health objective in most developed countries. Encouraging more walking – particularly walking for transport – is likely to meet public health objectives, as well as broader community objectives related to a healthier, greener and safer environment.

While walking is popular, few people do sufficient walking to gain maximum benefit to their health. We need to encourage more people to do more walking, more often. To achieve this will require a comprehensive strategy involving the health sector, as well as sectors outside of health. This is because our research shows that individual, social environmental and physical environmental factors are almost equal determinants of walking behaviour.

Consistent with research undertaken elsewhere, a major focus of mass communication campaigns should be on:

- increasing people's confidence that they can achieve recommended levels of walking;
- increasing people's intention to walk in the next two weeks;
- encouraging people to walking with someone else.

The finding that dog owners are more likely to achieve recommended levels of walking, provides another public health opportunity. Dog owners have better cardiovascular risk factors and do more recreational exercise than others (Anderson, Reid and Jennings, 1992). Moreover, nearly four million Australians and 2.6 million households own a dog (Harlock Jackson Pty. Ltd., 1995). Nevertheless, the vast majority of dog owners in this study (81%) did insufficient walking to be classified as 'walking as recommended'. On a population level, this equates to nearly 3.2 million people Australia-wide who have the potential to be mobilised through their love of "man's best friend". Given that many dog owners have an emotional commitment to ensuring the well being of their pet, targeting veterinarians to encourage dog owners to walk their pets for a minimum of 30 minutes each day may be a strategy that has important public health benefits. Increasing the number of dogs walking the streets has important implications for the planning of public open space, both in terms of its size, attractiveness, accessibility for dog owners and the provision of 'doggy bags' for the removal of faecal waste. Striking a balance between protecting the community against dog attack and disease and discomfort associated with contact with dog faeces, and seeking to have more dog owners walk their dog.

The results suggested that the physical environment plays an important role in influencing walking. Consistent with the qualitative research (Corti et al 1996; Wright et al., 1996), access to public open space, plus the aesthetic and functional aspects of the neighbourhood environment appeared to be important determinants of walking. A weakness of this study was that the streetscape survey items collected by the interviewers, assessed access to shops and the quality of the streetscape environment only in the respondent's own street and not the immediate neighbourhood. However, even with this somewhat weak measure, there appeared to be an association. The weakness is being addressed by colleagues at the University of Western Australia, under the leadership of Ms Terri Pikora (terri@dph.uwa.edu.au), who are currently undertaking research to examine environmental determinants of walking more fully.

### **Relative influence and interaction between determinants**

In this study the physical environment's direct influence on walking as recommended was similar to individual and social environmental determinants. The physical environment is important because it provides opportunities and acts synergistically with individual and social determinants of behaviour. This finding is important because despite the lack of empirical evidence, contemporary health promotion places considerable emphasis on creating supportive environments (World Health Organization, 1986). Intuitively, this makes sense. A supportive environment is likely to provide opportunities which, in Nancy Milio's words, makes 'health choices, easy choices' (Milio, 1981; Milio, 1986).

Access to a supportive physical environment determines whether or not recreational physical facilities are used, and in this way, *support* and *enhance* the achievement of recommended levels physical activity behaviour by providing opportunities (Corti, 1998). However, positive individual and social environmental factors also directly and indirectly determine whether or not recommended levels of walking will be achieved. It is likely that these factors act synergistically with one another and must be considered when designing interventions.

### ***Implications of the results for policy and practice***

Growing concern about the growth in motor vehicle use and the concomitant inevitable decline in air quality (Replogle, 1992; Department of the Environment and Department of Transport, 1994; Department of Environmental Protection, 1996) provides an unprecedented opportunity for health and environmental goals to be aligned. There is now growing recognition in sectors outside of health, that maximising use of the streets for walking (and cycling) requires careful state and local government planning to ensure safe, convenient and pleasant routes (British Medical Association, 1992; Department of the Environment and Department of Transport, 1994; King et al., 1995; Department of Environmental Protection, 1996; Western Australian Planning Commission, 1996), as well as complementary transport and parking infrastructure to support their use for non-motorised traffic (British Medical Association, 1992; Replogle, 1992; Department of the Environment and Department of Transport, 1994). Thus, there is a timely opportunity for strategic partnerships between health, transport, planning and local government sectors to encourage more walking and cycling to achieve complementary goals valued by all sectors (Harris et al., 1995). A comprehensive approach that includes long-term awareness raising and educational campaigns, changes in local and state government planning policies and development of supportive infrastructure that encourages walking, cycling and public transport use is essential.

### ***References***

- Anderson, W., Reid, C. and Jennings, G. (1992). 'Pet ownership and risk factors for cardiovascular disease.' *MJA* **157**(5): 298-301.
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, New Jersey, Prentice-Hall.
- Bauman, A., Bellew, B., Booth, M., Hahn, A., Stoker, L. and Thomas, M. (1996a). *NSW Health Promotion Survey 1994. Towards best practice for the promotion of physical activity in the Areas of NSW*. NSW Health Department, Centre for Disease Prevention & Health, NSW.

- Bauman, A., Wallner, F., Miners, A. and Westley-Wise, V. (1996b). *No ifs. No buts. Illawarra physical activity project. Baseline research report.* Illawarra Area Health Service, Illawarra.
- Berlin, J.A. and Colditz, G.A. (1990). 'A meta-analysis of physical activity in the prevention of coronary heart disease.' *Am J Epi* **132**(4): 253-87.
- Blair, S.N., Kohl, H.W., Barlow, C.E., Paffenbarger, R.S., Jr., Gibbons, L.W. and Macera, C.A. (1995). 'Changes in physical fitness and all-cause mortality. A prospective study of healthy and unhealthy men.' *JAMA* **273**(14): 1093-1098.
- Blair, S.N., Kohl, H.W., Paffenbarger, R.S., Jr., Clark, D.G., Cooper, K.H. and Gibbons, L.W. (1989). 'Physical fitness and all-cause mortality. A prospective study of healthy men and women.' *JAMA* **262**(17): 2395-2401.
- Booth, M., Owen, N. and Bauman, A. (1995). *Active & inactive Australians. Assessing and understanding levels of physical activity.* Canberra, DASET.
- British Medical Association (1992). *Cycling. Towards health and safety.* Oxford, Oxford University Press.
- Carroll, J. (1995). *Local government sport & recreation provision in Australia. A report examining local government involvement in sport and recreation provision and associated issues.* Confederation of Australian Sport, Canberra.
- Commonwealth Department of Human Services and Health. (1994). *Better health outcomes for Australians.* Commonwealth of Australia, Canberra.
- Corti, B., Donovan, R. and Holman, C.J. (1996). 'Factors influencing the use of physical activity facilities: Results from qualitative research.' *Hlth Prom J of Aust* **6**(1): 16-21.
- Corti, B., (1998). The relative influence of, and interaction between, environmental and individual determinants of recreational physical activity in sedentary workers and home makers. PhD Thesis, University of Western Australia.
- DASET (Department of the Arts Sport the Environment and Territories) (1992). *Pilot survey of the fitness of Australians.* Canberra, AGPS.
- DASETT (Department of the Arts Sport the Environment, Tourism and Territories) (1988). *Physical activity levels of Australians.* Canberra, AGPS.
- DeBusk, R.F., Stenstrand, U., Sheehan, M. and Haskell, W.L. (1990). 'Training effects of long vs short bouts of exercise in healthy subjects.' *Am J Card* **65**: 1010-1013.
- Department of Environmental Protection. (1996). *1997 State of the Environment Reference Group Draft Working Papers for Western Australia.* Government of Western Australia, Perth.
- Department of the Environment and Department of Transport (1994). *Planning policy guidance: Transport.* London, HMSO.
- Eaton, S.B., Konner, M. and Shostak, M. (1988a). 'Stone agers in the fast lane: Chronic degenerative diseases in evolutionary perspective.' *Am J Med* **84**: 739-749.
- Eaton, S.B., Shostak, M. and Konner, M. (1988b). *The paleolithic prescription. A program of diet & exercise and a design for living.* New York, Harper & Row.
- Ebisu, T. (1985). 'Splitting the distance of endurance running: on cardiovascular endurance and blood lipids.' *Jap J Phys Ed* **30**: 37-43.
- Fraser, D. (1988). *Dictionary of quotations.* Glasgow, Collins.
- Giles-Corti, B., and Donovan, R.J. The relative influence of individual, social and physical environmental determinants of physical activity. (Under review).
- Hahn, R.A., Teutsch, S.M., Rothenberg, R.B. and Marks, J.S. (1990). 'Excess deaths from nine chronic diseases in the United States, 1986.' *JAMA* **264**(20): 2654-2659.

- Harlock Jackson Pty. Ltd. (1995). *Public open space and dogs*. Harlock Jackson Pty. Ltd, Victoria.
- Harris, E., Wise, M., Hawe, P., Finlay, P. and Nutbeam, D. (1995). *Working together: intersectoral action for health*. Commonwealth of Australia, Canberra.
- Jakicic, J., Wing, R., Butler, B. and Robertson, R. (1995). 'Prescribing exercise in multiple short bouts versus one continuous bout: effects on adherence, cardio-respiratory fitness, and weight loss in overweight women.' *Int J Obesity* **19**: 893-901.
- King, A.C., Jeffery, R.W., Fridinger, F., Dusenbury, L., Provenca, S., Hedlund, S.A. and Spangler, K. (1995). 'Environmental and policy approaches to cardiovascular disease prevention through physical activity: Issues and opportunities.' *Health Education Quarterly* **22**(4): 499-511.
- Leon, A.S., Connett, J., Jacobs, D.R. and Rauramarr, R. (1987). 'Leisure-time physical activity levels and risk of coronary heart disease and death. The Multiple Risk Factor Intervention Trial.' *JAMA* **257**(17): 2388-2395.
- McKeown, T. (1988). *The origins of human disease*. Oxford, Blackwell.
- Miettinen, O.S. (1976). 'Stratification by a multivariate confounder score.' *American Journal of Epidemiology* **104**(6): 609-620.
- Milio, N. (1981). 'Promoting health through structural change: Analysis origins and implementation of Norway's Farm-Food-Nutrition policy.' *Social Science and Medicine* **15A**: 721-734.
- Milio, N. (1986). *Promoting health through public policy*. Ottawa, Canadian Public Health Association.
- Paffenbarger, R.S., Jr., Wing, A.L. and Hyde, R.T. (1978). 'Physical activity as an index of heart attack risk in college alumni.' *American Journal of Epidemiology* **108**(3): 161-175.
- Powell, K.E., Thompson, P.D., Caspersen, C.J. and Kendrick, J.S. (1987). 'Physical activity and the incidence of coronary heart disease.' *Annual Review of Public Health* **8**: 253-87.
- Replogle, M. (1992). 'Bicycle access to public transportation: Learning from abroad.' *ITE Journal* **December**: 15-21.
- Sallis, J.F. and Owen, N. (1996). 'Ecological models' *In Health behavior and health education: Theory, research, and practice (second edition)* (K. Glanz, F. M. Lewis and B. K. Rimer, eds.), pp. 403-424. San Francisco, Jossey-Bass.
- Stephens, T., Jacobs, D. and White, C. (1985). 'A descriptive epidemiology of leisure-time physical activity.' *Public Health Reports* **100**(2): 147-158.
- Stephenson, G. and Hepburn, J. (1955). *Plan for the metropolitan region Perth and Fremantle*. Government Printing Office, Perth, Western Australia.
- U.S. Department of Health and Human Services. (1996). *Physical activity and health. A report of the Surgeon General*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, NCCDPHP, Atlanta, Georgia.
- Wagner, E.H., LaCroix, A.Z., Buchner, D.M. and Larson, E.B. (1992). 'Effects of physical activity on health status in older adults I: Observational studies.' *Annual Review of Public Health* **13**(451-468): p451-468.
- Western Australian Planning Commission. (1996). *State planning strategy*. Western Australian Planning Commission, Perth.
- World Health Organization (1986). 'The Ottawa Charter for health promotion.' *Health Promotion International* **1**: 3-5.
- Wright, C., MacDougall, C., Atkinson, R. and Booth, B. (1996). *Exercise in daily life. Supportive environments. Report of a National Heart Foundation Research project funded by the Commonwealth Department of Health and Family Services*. Commonwealth of Australia, Wingfield, South Australia.