Prevalence, Cost and Correlates of Physical Activity Participation by Adults in an Australian Regional City

JAYANTHA DASSANAYAKE

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School of Human Movement and Sport Sciences

University of Ballarat
PO Box 663
University Drive, Mount Helen
Ballarat, Victoria 3353
Australia

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ABSTRACT

The report into the burden of disease of local government areas and regions of Victoria (Department of Human Services [DHS], Victoria, 2000) identified physical inactivity as a significant contributor to the burden of disease, especially cardiovascular disease, in the regional city of Ballarat. With a regional focus absent from previous research, the current study examines Ballarat's levels of activity, influencing factors, attributable health burden and community cost.

Quantitative methodology was used for this study. A self-administered mail survey, based on the 1999 National Physical Activity Survey (Armstrong, Bauman, & Davies, 2000) and the Canadian Fitness Survey (Canadian Fitness and Lifestyle Research Institute, 1983), was mailed to 3,600 randomly selected Ballarat residents, receiving a 40% response rate. Statistical analyses involved descriptive analysis, chi square test and multivariate logistic regression analysis, with Bonferroni correction factor employed where appropriate.

One third of respondents (34.4%) were found to be insufficiently active. There were more sufficiently active respondents (65.6 %) than the national average, largely due to higher rates of walking and vigorous-intensity exercise. The proportion of cardiac disease attributable to insufficient physical activity was 15.4% (PAR), and the overall annual cost for coronary heart disease (CHD) and stroke attributable to inactivity was $2.15 million. A one percent decrease in the rate of physical inactivity would result in a $58,904 reduction in the health care cost of CHD and stroke annually.

The proportional cost for CHD and stroke in Ballarat was higher than national figures, although Ballarat respondents had better knowledge of physical activity recommendations. Factors affecting increased participation were ill health, lack of energy, lack of time due to work or study, and financial expense (all barriers); and someone to participate with, common interest friends, more leisure time, and affordable facilities (all facilitators). Major predictors of insufficient physical activity were low confidence level, ill health, low education level, lack of desire to participate, and lack of support from family and friends. The barriers and facilitators identified were discussed within the theoretical framework of Socioecological model (McLeroy, Bibeau, Steckler, & Glanz, 1988), Social Cognitive Theory (SCT) (Bandura, 1986), and Transtheoretical model (TTM) (Prochaska & DiClemente, 1982, 1984).

STATEMENT OF AUTHORSHIP

Except where explicit reference is made in the text of the thesis, this thesis contains no material published elsewhere or extracted in whole or in part from a thesis by which I have qualified for or been awarded another degree or diploma. No other person's work has been relied upon or used without due acknowledgement in the main text and bibliography of the thesis.

Signed:_____________________________

Dated: _____________________________

Jayantha Dassanayake

Candidate

Signed:_____________________________

Dated: _____________________________

Professor Warren Payne

Principal Supervisor

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INTRODUCTION

Rationale

Even though the prevalence of cardiovascular disease (CVD) has decreased significantly during the past 30 years, it remains the major cause of death in Australia (Australian Institute of Health and Welfare [AIHW], 1999). In the period 1993–94, 42% of deaths were attributable to CVD, incurring a health care cost of $3.7 billion (12% of the total health care cost in Australia). Although the death rate of females from CVD differs little between rural, remote and urban regions, males in rural and remote areas of Australia are more likely to die from CVD than their metropolitan counterparts (Mathur & Gajanayake, 1998; Strong, Trickett, Titulaer, & Bhatia, 1998).

The National Health Priority Area (NHPA) report on cardiovascular health, in noting the lowered rates of tobacco smoking and high blood pressure in the Australian population, stressed the importance of identifying other preventative measures that may improve the cardiovascular health of Australians (AIHW, 1999). The report also stated that, while levels of physical inactivity have only changed slightly during the past 20 years, the number of individuals who are overweight or obese has increased markedly. Armstrong, Bauman, and Davies (2000) noted a decrease, over the period 1997–99, in the sufficient levels of physical activity needed to achieve a health benefit, despite a trend towards increased participation in physical activity by older adults, and Mathers, Vos, Stevenson, & Stephen (2001) reported that approximately 6% of the burden of disease in Australia could be attributed to physical inactivity—second only to tobacco smoking.

In 2000, a report on the findings of the 1996 Victorian Burden of Disease Study was published (Department of Human Services [DHS], Victoria, 2000). The study detailed the estimated disease burdens in local government areas (LGAs) of Victoria that could be attributed to specific diseases, injuries and risk factors. The major causes of death and illness in Victoria were ranked in order as cardiovascular disease, cancer, mental illness, neurological and sense disorders, and chronic respiratory disease. Victoria's Grampians region (of which Ballarat is the major provincial centre) had the lowest disability adjusted life expectancy (DALE) of all nine Victorian DHS regions in the 1992–96 period. The DALE for both males and females in the Grampians region (68.26 and 73.43 years, respectively) was significantly below the Victorian average (69.12 and 74.43 years, respectively). The greatest single contributor to this situation was CVD, which contributed 25% to the total burden of disease.

Attributable Burden of Disease, Grampians Region

When investigating the burden of disease, it is important to look not only at the diseases themselves but also at the factors contributing to these diseases. According to the study of the burden of disease in local government areas of Victoria (DHS, Victoria, 2000), the factors most responsible for the burden of disease in the Grampians region are tobacco smoking (7% female, 13% male) and physical inactivity (8% female, 6% male).

The fact that approximately 7% of the burden of disease is attributable to physical inactivity is of concern, considering its probable contribution to other attributable burdens such as obesity (5% of total burden), high blood pressure (6.5% of total burden) and high blood cholesterol (2% of total burden). If interventions were introduced to reduce exposure to these risk factors, as has been suggested by the Burden of Disease study, then major health gains could be achieved.

The physical activity patterns of rural populations compared with metropolitan populations have not been studied in detail in Australia-wide studies. However, Smith, Owen, Leslie, and Bauman (1999) reported in their Physical Activity Patterns and Health Impacts in Victoria study that participation in physical activity across male and female groups in Victoria was lower in rural and remote areas (53%) than in rural centres (58%) and metropolitan areas (58%). This is supported by a U.S. study by the Centers for Disease Control (United States Department of Health and Human Services [USDHHS], 1998), which found higher rates of physical activity in rural centres compared to urban centres, even after income, education, sex, and age adjustments were taken into account.

It is clear that effective interventions designed to increase the rates of physical activity would result in substantial savings to health care expenditure through improved health. Smith et al. (1999), using 1994 data, estimated the health care cost of heart disease, stroke, colon cancer and diabetes attributable to physical inactivity to be $265 million per year in Victoria. They further reported that a 1% per annum increase in rates of physical activity would save 110 premature deaths (or 905 life years) in Victoria. Increased physical activity would also lead to other health care cost savings in such areas as musculoskeletal and mental health conditions.

Burden of Disease, Ballarat

Cardiovascular disease is the major contributor to the burden of disease (25% of males and 26% of females) in the city of Ballarat (DHS, Victoria, 2000). This mirrors the national and regional trends discussed above. However, in presenting these results, it should be noted that researchers have warned against accepting data produced from small area population disease burden studies, particularly those using demographic and economic rather than empirical methodology (Taylor, 2001).

The physical inactivity data for the Grampians region that was presented in the burden of disease study of local government areas (DHS, Victoria, 2000) was estimated (due to the unavailability of specific figures) by applying the attributable fractions calculated for the state to the Grampians region. This affects the strength of the evidence; in fact, it is acknowledged in the report that, had regional risk factor prevalence data been available for analysis, there would most likely have been a greater variation in burden estimates for risk factors across DHS regions. This limitation obviously reduces the relevance of the data when it comes to the design or implementation of any locally targeted intervention studies.

Factors Affecting Physical Activity in Rural and Regional Victoria

The high rates of physical inactivity in rural areas are obviously of concern, and require intervention. However, before the health of a community can be improved and health expenditure attributable to physical inactivity can be reduced, it is necessary to identify the factors that contribute to this inactivity. Only when these factors have been identified and investigated, and specific target groups isolated, can intervention programs be designed and implemented with any success (Smith et al., 1999).

Two recent major Australian studies on physical activity—the 1996 Burden of Disease study of local government areas (LGAs) and regions of Victoria (DHS, Victoria, 2000) and the *Active for Life* study (Smith et al., 1999)—have shown there is enormous potential for the implementation of environmental and policy strategies to improve physical activity participation levels in rural settings. Smith et al. identified the key target groups for such campaigns as: women of all ages, middle-aged and older individuals, those with lower education levels, those with lower occupational status (including those engaged in home duties), and those from non-English speaking backgrounds. However, these studies did not explore in depth the factors that contributed to the high levels of physical inactivity, particularly in regional Victoria.

Significance of the Study

The present study pioneers research into physical activity levels within an Australian regional setting. It then investigates the association between physical activity levels and the incidence of CHD, non-insulin dependent diabetes mellitus (NIDDM), colon cancer, stroke, breast cancer, and all-cause mortality within the same setting, using population attributable risk (PAR). Health care costs attributable to insufficient levels of physical activity are then calculated. Stephenson, Bauman, Smith, and Bellew (2000) conducted a similar study using data from the 1997 Active Australia Survey (Australian Sports Commission [ASC], 1998) to estimate the level of PAR and examine the cost of illness attributable to physical inactivity; however, that study did not have a regional focus, and the cost of illness attributable to inactivity on a regional level was not investigated.

Since 1984, there have been many physical activity surveys conducted in Australia using a range of instruments and methods. In 1997, Professor Adrian Bauman and his expert working group developed a survey to gauge the effectiveness of the *Active*

Australia campaign that had been running in New South Wales. That survey, which has become known as the Active Australia Baseline Survey (ASC, 1998), was then used as the basis for two further national physical activity surveys: in 1999 (Armstrong et al., 2000), and in 2000 (Bauman, Ford & Armstrong, 2001). The survey used in the current study is based on the same instrument, but, significantly, this is the first time it has been used in a mail out format.

Statement of the Problem

Data collected for the 1996 Victorian Burden of Disease Study (LGAs) showed that Ballarat had one of the highest rates of CVD in Victoria. It also showed that physical inactivity was a significant contributory factor (second only to tobacco smoking) to this high level of CVD (DHS, Victoria, 2000). However, the Victorian study did not examine regional populations in any detail. The present study addresses this gap in research by focusing on activity and inactivity levels and associated health burdens within a regional location: the Victorian city of Ballarat.

Statement of Purpose

The study aimed to determine current levels of activity and inactivity in the regional city of Ballarat, using a sample of 3,600 adults. It also aimed to identify the perceived barriers and facilitators affecting increased participation in physical activity and discuss these using a range of existing theoretical models. The study then aimed to compare levels of physical activity and inactivity, using demographic variables, with the overall Australian adult population. A related purpose was to investigate the relationship between physical inactivity and the incidence of CHD, NIDDM, colon cancer, stroke, breast cancer and all-cause mortality using PAR within the region. An estimate of the health care cost of physical inactivity within the region was then produced.

Research Questions

The present study aims to investigate the following research questions (see Figure 1):

1. What is the current level of physical activity undertaken by adults in the regional city of Ballarat?
2. How do the physical activity levels of adults in the City of Ballarat compare with the overall Australian adult population?
3. What is the PAR for physical inactivity and CHD, NIDDM, colon cancer, stroke, breast cancer, and all-cause mortality in the City of Ballarat?
4. What is the current cost of CHD, and stroke, attributable to physical inactivity in the City of Ballarat?
5. What are the major determinants of, and related theoretical models for, promoting and inhibiting physical activity participation by adults in the City of Ballarat?

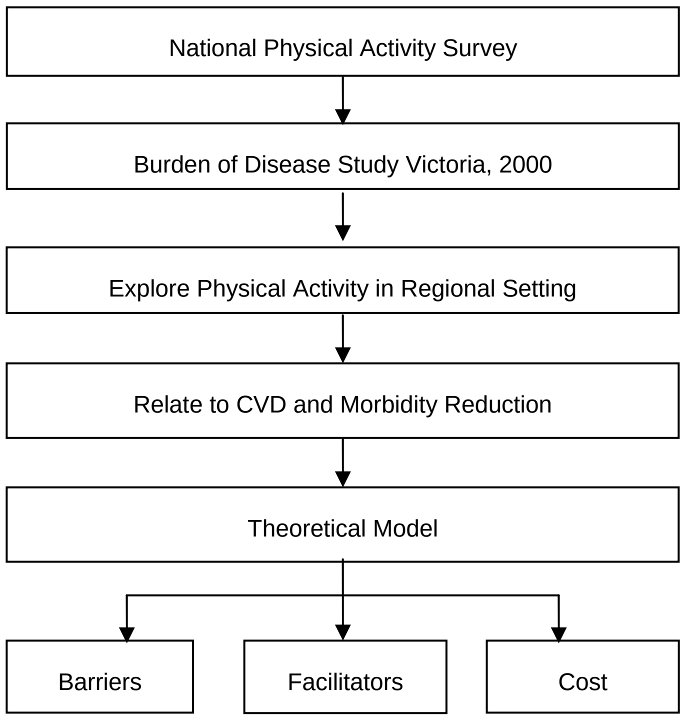


Figure 1
Conceptual Framework Map

ASSUMPTIONS

1. The survey questionnaire was a valid and reliable tool to measure physical activity and inactivity levels.
2. The random sample chosen was representative of the population being studied.
3. The research participants were prepared to answer all the questions in the survey honestly.
4. The research participants in all age groups complied with the instructions for returning the survey.
5. The questionnaire was answered by the person to whom it was addressed or by somebody else under direct instructions from that person.

DELIMITATIONS

The study had the following delimitations:

1. The study was limited to a cross-section of the regional city of Ballarat.
2. The random sample was limited to adults 18 years or older who were registered on the electoral roll at the end of 2000.

LIMITATIONS

The study contained the following limitations:

1. External validity may have been reduced by the number of questionnaires returned.
2. Internal validity may have been affected by incorrect responses given in the questionnaire.
3. The questionnaire was self-administered.
4. Questionnaires not returned by the set date were disregarded in the analysis.

5. Sample bias may have been incurred due to the mail survey being mostly self-selective (i.e., individuals taking issues of physical activity and health seriously would have been more likely to complete and return the questionnaires than individuals with no such interest.)
6. The return rate of questionnaires was difficult to control because, as a mail survey, the participants were responsible for their return.
7. Mail surveys have a higher number of missing values than telephone survey.
8. There was no opportunity to explain questions to the participants due to the questionnaire being self-administered.

LITERATURE REVIEW

> Generally speaking, all parts of the body which have a function, if used in moderation and exercised in labors to which each is accustomed, becomes thereby healthy and well developed, and age slowly: but if left unused and left idle, they become liable to disease, defective in growth, and age quickly.
>
> Hippocrates (ca 460–377 BC)

Historical Background of Physical Activity

All living things, especially plants, animals and human beings, have always needed food for their survival. In early human history, people obtained their food through farming and hunting. These activities involved physical labour requiring movement of the body. In order to produce the energy needed to generate the muscle contractions required, people gathered food substances such as carbohydrates, fats and proteins.

The human body needs food and sound nutrition for general health and to be free from disease (Sallis & Owen, 1999). Since the Stone Age, the gradual change from hunting to farming, and then from farming to industry has resulted in dramatic alterations to people’s lifestyles and physical activity patterns. These changes have had remarkable effects on human health, vitality, and longevity (Eaton, Shostak, & Konner, 1988).

Sallis and Owen (1999) observed that the 20th century Industrial Revolution was the landmark for modernisation and mechanisation of industrial nations. In the process of this mechanisation, labour-intensive work was converted into work completed by machines. As a result, individuals spent little energy compared to ancient times, especially on finding food. Manual farming and day-to-day domestic work changed dramatically with the advent of agricultural machinery, and domestic machinery such as lawn mowers, power tools, and washing machines. Instead of walking and carrying a message from place to place, the process was converted to automobile transportation, telephone, fax, and electronic mail. These changes have caused people to lead a more sedentary and inactive lifestyle.

Physical activity was once an important component of social, cultural and religious expression. The natural cycle of strenuous farming or hunting took place over one or two days, followed by a similar amount of time for rest and recuperation. During this rest time, celebrations took place. Friends and relatives were visited and trading was undertaken, often by walking distances of up to ten or twenty miles. As well, dances and cultural performances took place as a part of daily village life (Eaton et al., 1988).

Shampo and Kyle (1989) reported that, according to ancient Chinese history as early as 3000–1000 B.C., the *Yellow Emperor's Book of Internal Medicine* described the prevention of illness as the key to human health and long life. Taoist philosophers in the 6th century B.C. believed that simple living was the key to health and longevity in the Chinese culture (USDHHS, 1996). Indian history shows that proper diet and exercise are essential components for daily living. In India, in early 3000 B.C., the *Ajur Veda* collection described the value of ancient yoga exercises, acknowledged for creating physical suppleness and proper breathing, and seen as vital elements to control the mind and emotions (Snook, 1984). Both the Chinese and Indian histories illustrate that physical activity and exercise are not just a lifestyle issue, but a cultural concern. Sallis and Owen (1999) have noted that, in place of ancient leisure-time physical activities, the modern leisure-time activities of television, movies and videos have encouraged people to undertake sedentary recreations. Again, this is an example of lifestyle change.

Sallis and Owen (1999) investigated the role played by militarisation in the promotion of physical activity. During World War II, it was found that U.S. military recruits had unacceptably low levels of physical fitness due to their sedentary lifestyle (Sallis & Owen). The attention drawn to this lack of fitness in military recruits led to a greater interest in the development of physical fitness throughout the nation (Shea, 1993), and the U.S. government aimed to increase interest in physical education, predominantly in physical fitness testing and fitness training. In 1940, President Franklin Roosevelt appointed John Kelly as the director of physical training, and physical fitness among girls and women was promoted (Berryman, 1995; Park, 1989). Following World War II, the American Medical Association continued research into exercise science (Shea).

The consequences of physical inactivity have long been researched. In 1700, Italian Bernardino Ramzzini asked that tailors be advised to take physical exercise at any rate on holydays (USDHHS, 1996). In their landmark English study, Professor Morris and his colleagues reported that the death rate was lower among those who engaged in physical activity compared to sedentary and inactive individuals (Morris, Hardy, Raffle, Roberts & Parks, 1953). They found that London double-decker bus drivers had a significantly higher rate of heart disease than bus conductors. This was attributed to the fact that, while bus drivers sit most of the time, conductors must continually climb steps and walk up and down the bus, thus providing them with exercise—a benefit preventing heart disease. They further reported that an active lifestyle could result in a decrease in public health burdens. The researchers later extended their studies from bus conductors to executive-grade civil servants, and reported consistent evidence to support the previous findings (Morris et al., 1953; Morris, Clayton, Everitt, & Pollard, 1980; Morris, Kagan, & Pattison, 1966).

In addition to the above studies, to celebrate the centennial Olympic games in Atlanta, the U.S Surgeon General investigated the link between physical activity and health, (USDHHS, 1996). This report, currently the most scientifically accepted, demonstrated that physical activity had significant health benefits, especially in the prevention of cardiovascular disease, diabetes, and some forms of cancers. The report highlighted and discussed previous studies that had addressed the relationship between health and physical activity, concluding that health benefits gained from participation in physical activity were undeniable.

This literature review will further explore the relationship between health and physical activity by examining health, lifestyle and behavioural issues in the context of physical activity and inactivity levels. The following themes will now be explored:

- Physical activity and health
- Physical activity and sedentary living
- Physical activity, all-cause mortality and longevity
- Physical activity and cardiovascular disease
- Physical activity and body weight
- Physical activity and diabetes
- Physical activity and cancer risk
- Physical activity and mental health
- Physical activity and population attributable risk (PAR)
- Cost of illness due to physical inactivity

- Physical activity measurements
- Barriers and facilitators affecting participation in physical activity
- Models of physical activity

Physical Activity and Health

> 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.
>
> Ottawa Charter (World Health Organization, 1986)

LIFESTYLE ISSUES AND HEALTH

The 1992 International Consensus Conference on Physical Activity, Physical Fitness and Health declared that "Lifestyle comprises the aggregate of an individual's actions and behaviours of choice which can affect health-related fitness and health status. Habitual physical activity is one such behaviour over which the individual has a large measure of voluntary control" (Bouchard, Shephard, & Stephens, 1994, p. 84). While Bouchard et al. were particularly concerned with behaviours such as smoking, poor diet, and excessive alcohol consumption, Lupton (1995) argued that, in addition to these behaviours, other risk factors and behaviours impact on health, such as body weight, exercise patterns, stress management, driving behaviour, sexual activity, sleep patterns, and medication. Craig and Hancock (1996) noted that non-communicable diseases such as coronary heart disease, cancer, hypertension, and asthma are related to lifestyle. In addition to activity and behavioural factors, sedentary lifestyle has been identified as one of the attributable factors to ill-health and unnecessary death in industrialised countries, and one that is increasing in developing countries (WHO, 1995).

BENEFITS OF PHYSICAL ACTIVITY

The health benefits of physical activity have been recognised in the U.S. Surgeon General's report on physical activity (USDHHS, 1996). The report, *Exercise for Health*, by the WHO International Federation of Sports Medicine Committee on Physical Activity for Health, noted that physical inactivity is responsible for a substantial amount of wasted human potential, and that coronary heart disease is twice as prevalent among those who are inactive compared to those who are active (WHO, 1995).

A large amount of evidence from epidemiological studies supports the health benefits of physical activity (Powell, Thompson, Caspersen, & Kendrick, 1987). These studies indicate that physical activity impacts particularly upon all-cause cardiovascular mortality (Morris et al., 1966), hypertension (Blair, Goodyear, & Gibbsons, 1984), type 2 diabetes (Anderson et al., 1999; Hu, Sigal & Rich-Edwards, 1999; Mayer-Davis, D'Agostin, & Karter, 1998), osteoporosis (Kelly, 1998), and colon cancer (Thune & Lund, 1996). Other benefits of physical activity are also supported by experimental studies on body composition, blood lipid profile, glucose tolerance, and insulin sensitivity (Bouchard, Despres, & Tremblay, 1993; Haskell, 1986; Koivisto, Yki-Jarvinen, & DeFronzo, 1986).

Smith et al. (1999), in their study of physical activity patterns and health impacts in Victoria, highlighted that physical activity is currently prominent on the public health agenda because it can assist in the maintenance of good health and prevention of disease. The *Exercise for Health* committee (WHO, 1995) reflected that governments around the world should consider the relationship between physical activity and health promotion as an important aspect of public health policy.

According to the Global Burden of Disease study, physical inactivity has been ranked eighth out of 11 factors attributable to the global burden of disease (Murray & Lopez, 1997). A study of the burden of disease and injury in Australia by Mathers, Vos, and Stevenson (1999) showed that, among the modifiable risk factors attributable to ill-health and disease in Australia, physical inactivity ranks second next to tobacco smoking. Physical inactivity is responsible for 6.6% of the total burden of disease, which is higher than stroke (DHS, Victoria, 1999). The data from the burden of disease study of local government areas of Victoria (DHS, Victoria, 2000) highlights two key factors that contributed most to the burden of disease within the Grampians region of Victoria: physical inactivity and tobacco smoking.

As mentioned previously, studies have suggested that there is a link between lifestyle and health-related fitness, which has been established by comparing lifestyle and physical activity levels against the incidence of disease. Kilander, Berglund, Boberg, Vessgy and Lithell (2001) investigated the association in Swedish 50-year-old men between education, lifestyle factors, and mortality from cardiovascular disease and cancer. The results showed that modifiable lifestyle factors moderate the inverse gradient between education and death from cerebral and cardiovascular disease. Furthermore, smoking, physical activity, and dietary factors explained half of the high levels of cancer mortality in the lesser-educated group. Unfortunately, the study did not examine men and women aged 18–49 in detail. Blair, Cheng, and Holder (2001) reinforced this relationship between fitness and health, stating that fitness variables were the deciding factors in a number of health outcomes, and that the causal relationship between fitness and health had been validated in some cases by the presence of specific biological mechanisms.

Up until this point, most Australian studies on physical inactivity have been conducted at a national and metropolitan level; however, it cannot be assumed that the national and metropolitan data reflects the regional setting. It is necessary to examine current patterns of physical inactivity at the regional level to fill in the present gaps in data. The regional city of Ballarat has been selected for this study as it is one of the largest inland cities in Australia, and can, therefore, guarantee a wide sample to ensure data validity.

Physical Activity and Sedentary Living

Advances in modernisation and mechanisation in today's society have created an epidemic of sedentary living and concomitant health consequences "unique…in human history" (Sallis & Owen, 1999, p. 6). Using the Department of Health and Ageing (Department of Health and Ageing [DHA], 1999) guidelines (30 minutes or more of daily moderate physical activity most days of the week, or 30 minutes or more of vigorous-intensity physical activity 3 to 4 times per week), an individual can be rated as sedentary, infrequently physically active, moderately active, or vigorously physically active (Bauman, Owen, & Leslie, 2000). Physical activity assessments can then be applied to estimate the number of people in a given community who are sufficiently or insufficiently active. Five Australian population surveys carried out between 1984 and 1987 have found that 30% of Australian men and women were sedentary (Bauman et al.), and the Victorian study by Smith et al. (1999) found 43% of Victorians to be insufficiently active.

Although a large proportion of the deaths attributable to physical inactivity are due to cardiovascular disease (CVD), deaths due to cancer and type 2 diabetes have also been shown to be caused by physical inactivity (McTiernan, Ulrich, Slate & Potter, 1998; Powell & Blair, 1994). Several recent studies (Anderson et al., 1999; Hu et al., 1999;

Mayer-Davis et al., 1998) have suggested that moderate-intensity activity can assist in the prevention of diabetes, cancer and cardiovascular disease.

Hu, Leitzmann, Stampfer, and Colditz et al. (2001) recruited 37,918 men aged 40–75 years, who were free of diabetes, cardiovascular disease and cancer, to examine whether prolonged television viewing would increase the risk of type 2 diabetes. They compared men who were most active with those who were least active. The most active group was defined as those who viewed less than 3 hours of television per week; the least active (or most sedentary) group viewed for more than 75 hours per week. The researchers found a significantly increased risk of type 2 diabetes in those who viewed television for more than 15 hours per week. In addition, they found that an increase in physical activity, especially walking, was associated with a significant reduction in the risk of type 2 diabetes. Similar findings suggested that those who have engaged in moderate intensity physical activity prevented the risk of type 2 diabetes and cardiovascular disease (Anderson et al., 1999; Hu et al., 1999; Mayer-Davis et al., 1998).

A number of studies have been conducted that examine the relationship between colon and rectal cancer and physical inactivity. These studies report a clear and consistent association between physical inactivity and colon cancer (Colbert et al., 2001). It has been estimated that 32% of the deaths due to colon cancer can be attributed to inactivity or a sedentary lifestyle (Powell & Blair, 1994). Thune and Lund (1996) examined the relationship between occupational and recreational physical activity and the risk of colorectal cancer in Norwegian men and women. They concluded that physical activity at a level equivalent to walking or bicycling for at least 4 hours a week during leisure-time was associated with a decreased risk of colon cancer among females when compared with the sedentary group. The evidence from these studies suggests that regular participation in physical activity and the resultant higher level of cardiorespiratory fitness leads to a reduced risk of colon and rectal cancer.

Over the past 50 years, many epidemiological studies have examined the association between physical activity, coronary heart disease risk, and sedentary living. The findings of these studies consistently show that physically active men and women experience lower rates of CHD than those who are sedentary, but the optimum intensity and duration of physical activity requirements are less clear (Lee & Paffenbarger, 2000).

Drygas, Kostka, Jegier, and Kunski (2000) studied the long-term effects of different levels of physical activity and CHD. This study recruited 198 male volunteers aged between 28 and 65 in Poland. It reported that stabilisation of most coronary risk factors was achievable by expending 1000 kcal per week in physical activity. An additional benefit, the modification of HDL cholesterol, could be achieved by expending over 2000 kcal per week. Other researchers have demonstrated that a lower incidence of fatal myocardial infarction heart attack in men who exercised moderately or participated in vigorous sports activity and increased their energy expenditure range between 1000–2500 kcal per week or more (Paffenbarger, Hyde, & Wing, 1978; Paffenbarger, Lee, et al., 1993; Paffenbarger, Lee, Hyde, Wing, & Leung, 1994).

Lee, Hsieh, and Paffenbarger (1995) and Manson et al. (1999) postulated that in order to derive the health benefits of physical activity—longevity and reduced coronary heart disease—individuals needed to exercise at an intensity of 3-6 METs (metabolic equivalents). This represents brisk walking at an equivalent of 3–4 km or more (Pate et al., 1995). However, estimation of exercise intensity is difficult for people who do not exercise on a regular basis (Montoye, Kemper, Saris, & Washburn, 1996). Duncan, Sydeman, Perri, Limacher, and Martin (2001) conducted an investigation into whether sedentary middle-aged adults could accurately estimate the intensity and duration of their physical activity by recruiting 94 sedentary men and women aged 30–69 years to engage in an exercise intervention program. They found that sedentary middle-aged adults tended to overestimate the intensity of their physical activity because they were not able to perform any hard, or very hard, physical activity. This overestimation was evident mainly with moderate intensity physical activity. The researchers argued that the epidemiological studies that closely associated vigorous physical activity of 6 METs with longevity (Lee et al., 1995) and reduced coronary incidents prompted the question of whether most sedentary middle-aged adults were able to perform such vigorous exercise. In fact, King, Haskell, Young, Oka, and Stefanick (1995) provided data that suggested that most sedentary middle-aged adults were not able to perform prolonged vigorous physical activity of 6 METs or more, and that the fitness levels of most sedentary adults declined with inactivity and age. Considering the conflicting arguments presented on this subject, it is difficult to draw any definite conclusions. In order to generalise the findings, a larger sample size and a more accurate measurement technique is needed.

Physical Activity, All-Cause Mortality and Longevity

In their struggle for survival, early humans needed to maintain a high level of physical fitness. Today, as the struggles have lessened, so too have the levels of fitness (Erikssen, 2001). The argument that those who participate in regular physical activity reduce all-cause mortality is consistent and strong (Bauman, 2001; Kampart, Blair, Barlow, & Kendrick, 1996); those people who engage in moderate to vigorous levels of physical activity have higher levels of cardiorespiratory fitness and a low level of mortality (Lee & Paffenbarger, 1997). In regard to overall all-cause mortality rates, Australia ranked eleventh in the world, for both men and women (Kesteloot, 2001). The link between physical activity and all-cause mortality evident in longitudinal studies suggests that people who are physically active later in life reduce the risk of mortality (Blair, Kohl, et. al, 1995). The individual who is overweight, or obese, but physically active and fit is less likely to suffer early death than the person who leads a sedentary lifestyle (Blair & Brodney, 1999). Studies on diverse populations demonstrate that physical activity increases lifespan and reduces all-cause mortality (USDHHS, 1999.

The focus of current research is the association between physical activity and longevity (Sallis & Owen, 1999). Shimokata (2001) argued that a person's lifespan and all-cause mortality was determined by their genetic endowment as well as environmental and lifestyle factors, such as physical activity, nutrition, smoking, and alcohol use. Blair et al. (1996) strongly suggested that there were direct and independent effects from physical activity that lowered all-cause mortality, whether or not the participant was healthy, overweight, had high blood pressure, high cholesterol, high blood glucose, had smoked, or had a family history of heart disease.

The relationship between physical activity and all-cause mortality in sedentary men has also been investigated (Powell et al., 1987). This research discovered that those engaged in physical activity later in life decreased their all-cause mortality (Suzuki, Wilcox, & Wilcox, 2001). Regular participation in physical activity, particularly walking (Paffenbarger, Lee, et al., 1993), and participation in physical activity in a dose-response manner was found to decrease all-cause mortality (Winett & Carpinelli, 2000).

ALL-CAUSE MORTALITY

A number of recent studies have examined the association between physical activity and all-cause mortality in both men and women across all age groups. Andersen, Schnohr, Schroll, and Hein (2000) evaluated the relationship between all-cause mortality and the levels of physical activity during work, leisure-time, bicycling to work, and sports participation. The study found that leisure-time physical activity had an association with all-cause mortality in both men and women across all age groups; and further noted that moderate levels of leisure-time physical activity, participation in sports, and bicycling to work decreased the risk of mortality in both men and women. These results confirm previous research that found elderly people who participated in regular physical activity experienced a decrease in all-cause mortality (Kaplan, Seemen, Cohen, Knudsen, & Guralnik, 1987; Linsted, Tonstad, & Kuzma, 1991). However, Anderson et al. examined only those factors related to cardiovascular mortality; future research needs to examine other variables such as occupational status, asthma, diabetes, mental illness, cancer, and injury.

Walking

In a similar vein, Hakim et al. (1998) examined the association between walking and all-cause mortality. The authors found that the mortality rate was reduced when the distance walked was increased. These findings also established that even those in the older age group who engaged in regular lower-intensity physical activity had lower overall mortality.

These findings are supported by the evidence of Stessman, Marravi, Razeberg, and Cohen (2000). However, the study of Stessman et al. was conducted across a homogeneous population, and limited to non-smoking males. If it had been conducted across a mixed population of males and females, smoking and non-smoking, it may have been generalisable. Yet, these findings are strong and they support the argument that lifestyle factors and physical activity have a stronger association with all-cause mortality than genetics.

Cardiorespiratory Fitness

Lee, Blair and Jackson (1999) conducted a quantitative examination of physical activity to study the relationship between low cardiorespiratory fitness and mortality in normal weight, overweight, and obese men. They found lower cardiorespiratory fitness was a strong and independent parameter for all-cause mortality and CVD. Although CVD has a genetic factor (Bouchard & Malina, 1986), a major determinant is the level of cardiorespiratory fitness; this fitness is improved in most people who participate in regular exercise (American College of Sports Medicine [ACSM], 1998; USDHHS, 1996). To generalise these findings, a larger sample including women and all socio-economic groups needs to be studied.

LONGEVITY

How long a person lives will be determined by lifestyle and environmental factors—nutrition, smoking, alcohol consumption and physical activity—as well as genetic endowment (Shimokata, 2001). Longevity is a very basic measure of the health status of a population. A Japanese study on longevity highlighted nutrition as the main factor influencing longevity, but also suggested that increased physical activity, especially at older ages, contributed to an increased lifespan (Suzuki et al., 2001). Current research is attempting to discover whether physical activity can add time to an individual's life (Sallis & Owen, 1999).

The relationship between levels of activity, fitness, quality of life, hypertensive metabolic atherosclerotic disease (HMAD) and longevity as illustrated by Paffenbarger et al. (1994, p. 119) is shown in Figure 2.

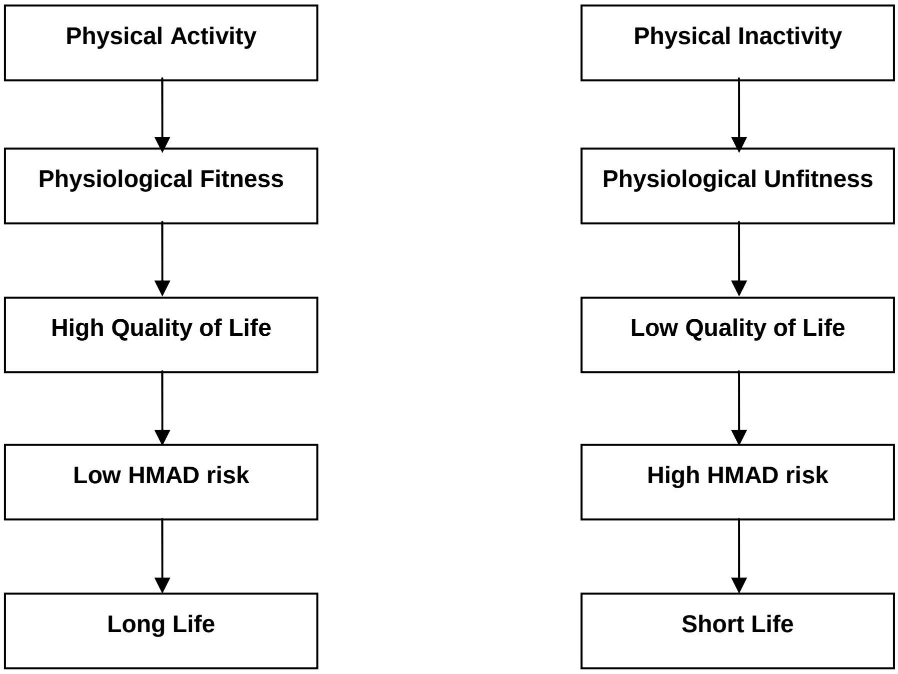


Figure 2
Relationship Between Physical Activity and Longevity

Longevity and Lifestyle Factors

Numerous studies have found strong and independent effects from physical activity, including the lowering of all-cause mortality whether or not the participant has smoked, has high blood pressure, high cholesterol or high blood glucose, is healthy or unhealthy, is overweight, or has a family history of heart disease. Another reported effect was a lower heart rate in both men and women (Blair & Brodney, 1999; Blair & Connelly, 1996). A study by Paffenbarger et al. (1994) looked at longevity and the lifestyle factors that affect it, such as body mass index (BMI), physical activity, smoking, and hypertension. It found that while changes in BMI had little influence, quitting smoking, avoiding hypertension (normotensive) and taking up a physically active lifestyle was found to delay all-cause mortality and extend longevity.

Longevity and Sedentary Living

In the recent past, researchers have examined physically active people who live longer than sedentary people. It is widely recognised that active men live longer than those who are less active (Hakim et al., 1998; Wannamethee, Shaper & Walker, 1998). Paffenbarger, Hyde, Wing, & Hsieh (1986) compared the lifespan of active and inactive men, and found that the physically active men lived two or more years longer than sedentary people. Lissner, Bengtsson, and Wedel (1996) investigated the initial levels of physical activity in Swedish women aged 38–60 years as risk factors for all-cause mortality. The study concluded that a decrease in leisure-time physical activity over six years was a significant risk factor for all-cause mortality, and that low initial levels were strong risk factors for mortality in women. Sherman, D'Agostino, and Cobb (1994) found similar associations between physical activity and mortality in middle-aged and elderly women in Framingham County.

Few studies have examined how much physical activity is needed to achieve health benefits. Previous studies found that walking and increased greater expenditure of energy was associated with longevity (Lee & Paffenbarger, 2000), and moderate-intensity activity was reported to be beneficial for longevity among alumni men (Leon, Connett, & Jacobs, 1987) and U.S. postmenopausal women (Kushi et al., 1997). Moreover, studies on British civil servants (Morris et al., 1980; Morris, 1990), Finnish men (Lakka, Venalainen, & Rauraman, 1994), and U.S. railroad workers (Slattery, Jacobs, & Nichaman, 1989) found a clear association between vigorous physical activity and longevity.

Lee & Paffenbarger (1994) investigated the association between longevity and light, moderate and vigorous intensity physical activity. The longitudinal study recruited 13,485 men of an average age of 57.5 years from the Harvard University Alumni, and followed them over a period of 15 years. It concluded that moderate activity of 4–≤6 METs appeared to be somewhat beneficial and that vigorous activity of >6 METs clearly predicted lower mortality rates. Both walking and climbing stairs correlated to longevity. It is important to note, however, that participants recruited in the Harvard alumni study were of middle-to-upper socio-economic status and had high education levels and, therefore, results of this landmark study should not be generalised to other population groupings.

Many people are not aware of the protective effect of physical activity, but it is clear that—in addition to genetic and environment lifestyle factors—physical activity has a direct impact on longevity, general health and the well-being of society.

Physical Activity and Cardiovascular Disease

It is clear from the literature that the greatest health benefit of physical activity is in the prevention of disease of the blood vessels and the heart, particularly coronary heart disease (Berlin & Colditz, 1990; Lee & Paffenbarger, 1997), stroke (Paffenbarger et al., 1986), and hypertension (Motoyama et al., 1998). Cardiovascular disease is the most common cause of death in industrialised countries, and it is also increasing in the developing countries (WHO, 1995). Out of thirty leading causes of worldwide Disability-Adjusted Life Years (DALYs) for both genders, ischemic heart disease ranked fifth and cerebrovascular disease ranked sixth (Murray & Lopez, 1997). Australian men and women ranked twelfth in rates of cardiovascular mortality for the 65–75 years age group (Kesteloot, 2001). The population attributable risk for CVD due to inactivity has been estimated at about 18% for CHD and 16% percent for stroke (Stephenson et al., 2000). It has also been estimated that of the total death rate in Australia in 1996, 42% of deaths were attributable to stroke and cardiovascular disease (Australian Bureau of Statistics [ABS], 1999).

CARDIOVASCULAR DISEASE

Over 40% of deaths in Victoria were reported to have resulted from cardiovascular disease (ABS, 1993). According to the 1996 Burden of Disease Study LGAs Victoria, the major disease burden in the Grampians region was CVD, with over 45% of deaths in both males and females in Ballarat attributable to CVD (DHS, Victoria, 2000). Physical inactivity was accountable for 2.5% of ischaemic heart disease and 1.3% of stroke in Victoria in 1996 (DHS, Victoria).

The maximum cardiovascular benefit can be achieved when people move from a sedentary lifestyle, or lower level of cardiorespiratory fitness, to a moderately active or moderate fitness level (Blair, Booth, et al., 1995). It appears that, following recent recommendations, at least 30 minutes of moderate-intensity physical activity, such as brisk walking on most days, is considered sufficient (Lee et al., 2001). Vigorous activity confers an even greater benefit for reduction in the risk of CHD (Manson et al., 1999). However, data regarding the optimal amount of intensity and duration of physical activity required to decrease CHD risk have been less clear (Lee et al.).

Previous studies have shown that those who are sedentary or less physically active have a two-fold increase in the risk of fatal or non-fatal cardiovascular events such as coronary heart disease or acute myocardial infarction (Bauman & Owen, 1999; Berlin & Colditz, 1990; USDHHS, 1999. Many researchers have investigated the long-term association between long-term physical inactivity, sedentary living and cardiovascular disease. Fung et al. (2000) conducted a quantitative investigation on long-term leisure-time physical activity, television watching, and biomarkers of cardiovascular disease, using data collected on 468 healthy male health professionals aged 40–75 who were selected from the U.S. Health Service. The data reflected that increased television watching was associated with lower high-density lipoprotein levels (HDL), higher cholesterol levels, and higher leptin levels. They concluded that long-term physical inactivity and television watching is significantly associated with several biochemical indicators of obesity and cardiovascular disease risk. Unfortunately, this study investigated men only; therefore, it is necessary to recruit both genders in future research of this type.

Research into the prevention of premature death and coronary artery disease, has often concentrated on the question of whether it is necessary to start exercise early or late in life in order to obtain the apparent health benefit from physical activity (Blair, Booth, et al., 1995; Paffenbarger, Lee, et al., 1993). Some studies have reported that current participation rates in moderately vigorous sports activity decreased the risk of death by 23–29%, whereas participation in the distant past (e.g., college athletic programs) had no effect (Paffenbarger et al.). Blair et al. suggested that physical activity in the distant past had no independent effects on morbidity or mortality rates in men, but that men who were the least physically fit had the highest mortality rate. However, Williams (1997) questioned whether people could actually change fitness levels as Blair et al. argued. Sherman, D'Agostino, Silbershatz, and Kannel (1999) examined past versus recent physical activity and how this related to premature death and coronary artery disease. They looked at 5,209 men and women aged 30–65 who were initially recruited in 1948 from Framingham, Massachusetts. Physical activity assessment was conducted over a 16-year period: assessments undertaken from 1956–58 were defined as *distant* activity and assessments from 1969–73 were defined as *recent* activity. They concluded that recent activity was more associated with a reduction in overall mortality than distant activity. The authors also noted that it is never too late for any sedentary person to begin exercise. The findings of this study are consistent with previous research, providing more evidence to support the notion that recent activity is more beneficial than past activity.

Previous research has demonstrated that sedentary individuals could change their fitness level once they became active and reduced their CVD risk factors; however, the amount of physical activity appropriate for the primary prevention of CVD risk factors is still uncertain. The Harvard Alumni study suggests the lowest incidence of CVD and all-cause mortality risk is found in men with training-related energy expenditure of more than 2000 kcal per week (Paffenbarger, Hyde & Wing, 1978). Sesso, Paffenbarger, Ha, and Lee (1999) investigated the relationship between physical activity and CVD risk factors in 1,564 middle-aged women aged over 45 from the University of Pennsylvania Alumni. The findings showed that walking 6 miles (9.7 km) per week was associated with a 33% decreased risk of CVD. In addition to this, the authors found that walking was reported more precisely than other kinds of activities. These findings are consistent with evidence from such studies as the Honolulu Heart Program, where Hakim et al. (1999) reported that elderly men who increased their walking distance reduced their risk of CVD. This suggests encouraging the elderly to walk could derive important benefits. Paffenbarger, Lee, et al. (1993, 1994) found similar results in men who participated in moderate or vigorous sports activity and increased energy expenditure to 1500 kcal or more per week.

Drygas et al. (2000) recruited 198 male volunteers aged 28–65 years to examine the long-term effects of different levels of physical activity on rates of CVD. The study reflected that long-term stabilisation of most coronary risk factors was achievable by expending 1000 kcal per week, and that additional benefits could be achieved by expending more than 2000 kcal per week, especially with the favourable modification of high-density lipoprotein (HDL) cholesterol. Although outcomes were not analysed separately for men and women, these findings are consistent with the Alameda County study, which reported that individuals who swam or undertook long walks demonstrated a lower risk of CVD mortality compared to those who never participated in exercise (Kaplan, Strawbridge, & Cohen, 1996). Physical activity has been postulated to reduce the risk of developing CVD through various mechanisms such as decreased systolic and diastolic blood pressure (Hagberg & Brown, 1995), decreased high-density lipoproteins (Wood, Stefanick, & Williams, 1991), lower low-density lipoproteins, (Williams, 1997), and increased insulin sensitivity and glucose tolerance (Holloszy, Schultz, & Kusnierkiewicz , 1986).

STROKE

Stroke places a tremendous burden on health resources throughout the world (Sacco et al., 1998). Mathers et al. (2001) reported that, of the leading causes of disease burden in Australia, stroke ranked second (5.4%) next to ischemic heart disease. Annually, around 3,000 deaths from stroke are recorded in Victoria (ABS, 1993), and Ballarat has a 10% mortality rate from stroke, the second highest cause of death in the city (DHS, Victoria, 2000).

Previous researchers have examined the association between physical activity and stroke (Kiely, Wolf, & Cupples, 1994; Shinton & Sagar, 1993). The Copenhagen Heart

Study provided evidence that those who were inactive were more likely to be associated with an increased risk of stroke (Lindenstrom, Boysen, & Nyboe, 1993). It has also been reported that physical activity confers some protection from blood clot formation and thrombosis (Ferguson, Bernier, & Banta, 1987). Ellekjaer, Holmen, Ellekjaer, and Vatten (2000) recruited 18,672 women over 50 years of age in Norway and examined the association between different levels of leisure-time physical activity and stroke. The most active group had an approximately 50% lower risk of death from stroke mortality compared to the least active group. Future studies need to examine this association with the inclusion of a male sample (Kushi et al., 1997; Weller & Corey, 1998).

Prevention

A limited number of studies have investigated the effects of physical activity and subtypes of stroke. These studies have shown that regular physical activity decreases the risk of strokes in men and women (Abbott, Rodriguez, Burchfield, & Curb, 1994; Gillum, Mussolino, & Ingram, 1996; Lee et al., 1999). Hu et al. (2000) examined the detailed relationship between physical activity and stroke in a study of nurses aged 30–55 years. The results demonstrated that physical activity, including moderate intensity exercise such as walking, was associated with the reduction of total and ischemic stroke in women in a dose-response manner. However, in order to generalise these findings, it is necessary to include different socio-economic and ethnic populations.

In a study of 21, 823 U.S. male physicians aged 40–84 years, Lee, Hennekens, and Berger (1999) provided data that suggested physical activity reduced the risk of developing stroke in men. Similar evidence had been found in previous studies, such as the Framingham Heart Study (Kiely et al., 1994) and the Honolulu Heart Study (Abbott et al., 1994), and Sacco et al. (1998) found in their Northern Manhattan Stroke Study that physical activity, particularly walking, reduced the risk of development of stroke.

Biological Mechanism

Several studies have investigated the possible biological mechanisms of stroke, thrombosis, and fibrinolysis (Powell et al., 1987). It has been reported that those who engaged in regular aerobic exercise improved the balance of their haemostatic system by reducing thrombogenic factors and increasing fibrinolytic capacity (Curfman, 1993; LaMonte, Eisenman, & Adams, 2000). DeSouza, Jones, and Seals (1998) tested whether or not physical activity could reverse age-related changes in specific coagulation and fibrinolytic factors in a study of 24 pre-menopausal and 27 post-menopausal women. They concluded that fibrinolytic levels increased with age in sedentary and active postmenopausal women, but that increased fibrinolytic levels were twice as high in sedentary women. Rankinen, Rauramaa, Vaisanen (1993) also noted that fibrinogen levels were higher in physically inactive women and post-menopausal women who were obese.

Blood Pressure

According to the Australian Institute of Health and Welfare (AIHW, 1999), around 2.2 million (17%) Australian adults are reported to have high blood pressure. Mathers et al. (2001) noted that the attributable risk of high blood pressure to the burden of disease in Australia was 6.6%. In the period 1989–1990, hypertension was reported in Victoria in excess of 140,000 Victorian men and 198,000 Victorian women (ABS, 1991). In addition to the overall Victorian levels, 20% of male and female Victorians living in urban areas were reported to have hypertension (National Heart Foundation [NHF} Australia, 1989). In Victoria, 0.2% of DALYs were due to hypertension attributable to inactivity (DHS, Victoria, 1999); in Ballarat, overall hypertension cases were reported as contributing 1% of DALYs (DHS, 2001).

Numerous observational studies have demonstrated the inverse relationship between physical activity and CVD risk factors (Blair & Connelly, 1996; Paffenbarger, Lee, et al., 1993; Powell et al., 1987). Studies have shown that physical activity decreased systolic and diastolic blood pressure (Arroll & Beaglehole, 1992; Kelley et al., 1994). However, physical activity was also associated with other risk factors such as obesity and high body mass index (Garrow & Summerbell, 1995), and played a role in improving unfavourable HDL blood cholesterol levels (Moore, 1994).

Young et al. (1999) reported that light-intensity physical activity reduced blood pressure in older individuals. Moreau, DeGarmo, and Langley (2001) investigated the effects of moderate-intensity physical activity on blood pressure, by examining the impact of the 30 minutes of daily moderate-intensity physical activity recommended by the American College of Sports Medicine to enhance health benefits, particularly blood pressure. For this study, 24 post-menopausal women aged 54 ±1 years with borderline (higher than normal) hypertension and stage 1 hypertension were recruited. (Borderline hypertension is defined as systolic BP 130-139 mm Hg and/or diastolic BP of 85-89, stage 1 is defined as systolic BP 140–159 mm Hg and/or diastolic BP of 90–99 mm Hg, and stage 2 is defined as systolic BP 160–179 mm Hg and/or diastolic BP of 100–109 mm Hg [ACSM, 2000a]) The study, using 12-week and 24-week walking programs (designed according to ACSM-CDC physical activity guidelines) reported a reduction in systolic blood pressure in postmenopausal women with borderline–to–stage 1 hypertension. After the first 12 weeks, the women who walked 3 km per day had lower systolic blood pressure, with the average systolic blood pressure reduction reported as 11 mm Hg. The systolic blood pressure was further reduced in the second half of the program. Ready and Naimark (1996) also reported that regular walking reduced systolic blood pressure in postmenopausal women. In order to validate these results, an equivalent study needs to be conducted with a larger sample which includes different age groups and both male and female participants.

Researchers have further identified the relationship between hypertension and a sedentary lifestyle. Folsom, Prineas, Kaye, and Munger (1990) found that physically active women were less likely to develop hypertension compared to sedentary women. Tedesco et al. (2001) observed an association between education level, socio-economic level and hypertension. This Italian study recruited 378 men and 434 women aged 28–70 who had stage 1 or stage 2 hypertension. The study concluded that patients who had a sedentary lifestyle had higher levels of hypertension and other cardiovascular risk factors. These findings are supported by a study on 40,000 sedentary clerks in Chicago, which found that sedentary educated clerks had higher levels of hypertension (Dyer, Stamler, Shekelle, & Schoenberger, 1976).

Previous research has found that vigorous physical activity decreased the risk of developing hypertension as well as reducing systolic and diastolic blood pressure (Ishikawa, Ohta, Zhang, Hashimoto, & Tanaka, 1999; Kelly & McClellan, 1994; Paffenbarger, Wing, Hyde, & Jung, 1983). It has also been demonstrated that moderate intensity physical activity produced a greater decrease in systolic blood pressure compared to high intensity physical activity (USDHHS, 1996).

Physical Activity and Body Weight

Obesity is a serious and growing health problem affecting both developed and developing countries (Crawford & Ball, 2002). Modern epidemiological studies agree that obesity is generally not of genetic origin but is based on modern environmental factors, such as television and computer use; use of cars; modern communication facilitators; and minimal physical activity at work, home and in the community in general (Peters, 2002). Added to these are the behavioural influences such as eating too much and moving too little (Crawford & Ball) that have been associated with epidemics such as cardiovascular disease, hypertension, and cancer (Sallis & Owen, 1999)

The number of overweight and obese individuals in Australia is rapidly increasing to the point where, according to international data, it is one of the highest ranked countries (WHO, 1998). In 1995, it was estimated that approximately 2.2 million adults (around 17% of the Australian population) were overweight (AIHW, 1999). Cameron et al. (2003) reported that over 60% of the Australian population were overweight or obese. They also found that the overall prevalence rate of overweight and obesity was higher in women (34.1%) than in men (26.8%). Mathers et al. (2001) noted obesity in men and women contributed 4.3% to the burden of disease in Australia. Jackson, Ball, and Crawford (2001) examined weight changes in the Australian population by examining data gathered from the 1995 Australian National Health and Nutrition Survey, which surveyed 10,624 adult men and women from urban and rural areas across Australia. They reported that 52% of males and 35% of females surveyed believed that the main reason for their weight change was a change in the amount physical activity undertaken and the amount of food and drink consumed. This is consistent with findings by

Cachelin and Stiegel-Moor (1998) who found, in a U.S. study, that the most important factors in weight gain were lack of exercise and eating too much.

The U.S. Surgeon General's report (USDHHS, 1996) stated that physically active people are less likely to gain weight compared to inactive people. Schmitz, Jacobs, Leon, Schreiner, and Sternfeld (2000) observed from their longitudinal study that a temporary increase in physical activity led to a decrease in weight gain. For this study, 5,115 black and white American men and women aged 18–30 were recruited for the Coronary Artery Risk Development Study. The study, conducted over a 10-year period, found that changes in physical activity were directly related to changes in body weight in both male and female participants in both racial groups. It was further noted that an increase in physical activity during the 2–3 year follow-up period was associated with a decrease in weight gain. This decrease was sustained through a 5-year follow-up, whether or not the physical activity increase was at year-5 level or baseline. In the first 2–3 years of follow-up, participants who increased their physical activity had a lower weight gain than those who decreased their physical activity. For those who engaged in stationary cycling for two hours per week for the previous six months, weight gain was reduced by 0.8 to 2.8 kg during the five year follow-up period. Ball, Owen, Salmon, Bauman, and Gore (2001) conducted an investigation into the association between leisure-time physical activity and occupational and domestic physical activity, BMI, and skin fold-derived index of body fat among normal weight and overweight men and women in Australia. For this study, 1,302 men and women aged 18–75 years were selected from metropolitan areas of Adelaide. The study reported that higher levels of leisure-time physical activity were associated with lower BMI and lower body fat range remaining normal in women compared to men. Unfortunately, neither the Schmitz et al. nor the Ball et al. studies extended to rural and regional settings.

Researchers have further investigated the relationship between inactivity, sedentary living and body weight (Jebb & Moore, 1999). Martinez-Gonzalez, Martinez, Gibney and Kearney (1999) examined the inverse association between sedentary living and BMI in the 15 member states of the European Union. For this study, 15,239 men and women aged 15 years and older were recruited, and their leisure-time physical activity was assessed using metabolic equivalents (METs) for each activity. The results suggested that obesity and higher body weight were strongly related to a sedentary lifestyle, but that this was predominantly due to a lack of physical activity. The authors further noted that prolonged time spent sitting was associated with higher BMI, obesity and overweight in both men and women. In addition, those men who were physically active had a lower BMI, but this did not apply to the women. A major limitation of this study is that it did not differentiate between levels of sedentary living and BMI and obesity in each country separately, and the authors themselves have noted that the results should be interpreted with caution due to the cross-sectional design of the study. However, the findings are consistent with the study of U.S. male health professionals by Fung et al. (2000), which noted that a lower level of physical activity and a higher level of television viewing contributed to weight gain and obesity.

Overweight and Premature Death

Researchers are continually examining the association between all-cause mortality premature death, overweight, and inactivity (Kujala, Kaprio, & Sarna, 1998; Manson et al., 1995), and sedentary living, overweight and obesity (Brown, Dobson, & Mishra, 1998; Kushi et al., 1997). Jebb and Moore (1999) reviewed current evidence for sedentary lifestyle, overweight and obesity. The reviewed evidence clearly showed that lower levels of physical activity led to increased weight gain and obesity. This is supported by data from DiPietro (1999). Blair and Brodney (1999) reviewed previous studies to address whether higher levels of physical activity or cardiorespiratory fitness decreased the health risk in overweight or obese individuals. They also investigated whether obese, but active, individuals had a lower mortality and morbidity than normal weight people who were sedentary, and provided evidence that regular physical activity decreased the health risks of overweight or obese people. The unfit men in the normal range of body habitus (BMI 19–25) had a more than two-fold higher mortality risk than fit men in the highest category of body habitus (BMI 27.8) who had lower morbidity and mortality compared to sedentary people who were normal weight. Inactivity and lower cardiorespiratory fitness were also shown to be important factors for overweight obesity and mortality. The authors concluded that the most important predictors of mortality were overweight and inactivity. Seidell, Visscher, and Hoogeveen (1999) further suggested that the lowest mortality range of BMI is between 18.5 and 25, and that a BMI of 30 or more tended to increase the mortality risk by up to 50–150% in North American and European populations.

Researchers have further examined the relationship between BMI, leisure-time physical activity, CVD mortality, and CHD mortality. A study conducted by Haapanen et al. (2000) did not prove any association between CVD and CHD mortality and BMI. Rainwater et al. (2000) investigated the association between CHD, CVD risk factors, physical activity, weight change and BMI. For this study, 539 Mexican-American men and women in San Antonio, Texas were involved in a five-year follow-up study. The study reported that the average weight increases were 4% against a decrease of physical activity by 2% during the 5-year period. In addition, during this period there was an 11.3% increase in mean glucose levels, a 4.6% and 3.1% increase in mean systolic and diastolic pressure respectively, a decline in HDL cholesterol levels of 3.7%, and non-HDL cholesterol levels declined by 2.7%. There were no significant changes in LDL cholesterol and HDL cholesterol distribution. Weight gain was noticeable predominantly in younger people, and weight loss tended to occur in older people. The researchers concluded that the increase in obesity worldwide is alarming for CVD risk profiles. These findings are consistent with Wei et al. (1999) who suggested that, among people who were inactive, having lower cardiorespiratory fitness and being overweight or obese were strongly and independently associated with NIDDM and other CVD risk factors. It should be noted that the study by Rainwater et al. involved only Mexican-Americans; researchers need to examine these problems with different ethnic groups in order to generalise these findings.

Obesity is one of the most serious health problems in industrialised countries (Motain, Antic, & Dullo, 2002) and is rapidly increasing in the rest of the world (Kopelman, 2000). Previous researchers have examined the inverse association between physical inactivity, obesity, and hypertension (Paffenbarger et al., 1983), and NIDDM (Helmrich, Ragland, & Leung, 1991). Sobngwi et al. (2002) compared the relationship between physical activity patterns, obesity, NIDDM, and hypertension in Cameroon. For this study, 1,183 urban and 1,282 rural males and females 15 years and over were recruited. The findings suggested that the prevalence of obesity was higher in urban women compared to men, and that NIDDM was prevalent among the urban women, but not the urban men. The prevalence of hypertension was higher in urban women. The study concluded that lower levels of physical inactivity increased rates of obesity, hypertension and NIDDM in urban women.

Obesity and Exercise

Obesity is a worldwide health burden, and the only treatment is weight loss and maintenance, which is a challenging and difficult strategy (WHO, 2000). Previous studies show that dietary restrictions plus exercise produces more initial weight loss than diet alone (Glenny, O'Meara, Melville, Sheldon, & Wilson, 1997). The key to the prevention and treatment of obesity is a long-term moderate physical activity program (Stefanick, 1993). Researchers have further examined diet, exercise and weight loss and maintenance (Grilo, 1995). Gordon-Larsen, Adair, and Popkin (2001) investigated the relationship between physical activity and inactivity patterns and overweight adolescents using one-year changes of activity and inactivity. For this study, 12,759 non-Hispanic white, non-Hispanic black, Hispanic, and Asian adolescents were recruited from a nationally representative sample. Data were gathered on moderate, vigorous, and low-intensity physical activity; TV and video viewing; and computer and video game use. The findings suggested moderate to vigorous physical activity was associated with decreased risk of overweight except among non-Hispanic white female and Asian adolescents. The overall findings suggested that overweight prevalence in the U.S. is higher in adolescents due to high levels of inactivity and low levels of moderate to vigorous physical activity. The study concluded that increases in moderate to vigorous physical activity and other potentially successful strategies are necessary for reducing overweight among U.S. adolescents. Although these findings are consistent with previous research reporting the association of TV viewing with increased overweight in U.S. children and adolescents (Andersen, Crespo, Bartlett, Cheskin, & Pratt, 1998), its major limitation is that it did not examine the types and intensity of moderate or vigorous physical activity in detail.

Borg, Kukkonen-Harjula, Forgelholm, and Pasanen (2002) researched whether walking or resistance training improved weight maintenance after weight loss when used together with dietary counselling. For this study, 90 healthy men and women aged 35–50 were recruited from Finland. The participants were divided into control groups to follow either a walking program or a resistance training program. The control groups were given a very low energy diet for weight reduction over two months, followed by six months of an exercise program and 23 months unsupervised follow-up. One walking group and one resistance training group were advised not to increase physical activity. The study found that during very low energy diets the average body weight of the men reduced from 106 kg to 91.7 kg. During the follow up period, their weight averaged from 99.2 kg to 102.3 kg. Exercise training did not improve short-term or long-term weight maintenance; however, resistance training decreased the regaining of body fat mass during the weight maintenance period. The study reported that, during the maintenance period, participants were poor adherents to the prescribed exercise program. These findings are in contrast to previous findings (Jeffery et al., 2000; Lappalainen, Tuomisto, Giachetti, D'Amicis, & Paquet, 1999; Perri, 1998); however, high dropout rates reduced the sample size and, therefore, decreased the power of the statistics, which may explain this inconsistency.

Alfano, Klesges, Murry, Beech, and McClanahan (2002) investigated the relationship between adult obesity, dietary intake, and current and past physical activity. For this U.S. study, 209 African-Americans and 277 Caucasian women aged 18–39 were recruited. The authors reported that a history of sports participation predicted lower adult body mass index in both ethnic groups. Alfano et al. (2000) concluded that the best foundation for maintaining a healthy weight in adulthood, and preventing obesity in girls, was sports participation—even more so than diet. As this study examined only women, future studies should be extended to include male participants.

Physical Activity and Diabetes

Diabetes has been recognised as a major public health burden in developed countries (Disdier-Flores, Rodriguez-Lugo, Perez-Perdomo, & Perez-Cardona, 2001) and developing countries (Ramachandran et al., 2001). It is a severe burden on the public health system in industrialised countries (Disdier-Flores et al.). Diabetes is an illness where there are excessive levels of glucose in the blood and incapacity of insulin to metabolise glucose (Sallis & Owen, 1999). The reason for insulin resistance is not clear, but it is probably related to both genetics and a diversity of environmental factors, such as obesity, diet and physical inactivity. Diabetes is categorised into two groups: type 1 and type 2 (Creviston & Quinn, 2001). Type 2 diabetes is known as non-insulin-dependent diabetes mellitus (NIDDM) (Disdier-Flores et al.). Physical activity has been used in the recent past as a mode of prevention and treatment for NIDDM (Creviston et al., 2001), whereby the mechanism of physical activity reduces blood glucose (by using it for fuel) and increases the sensitivity of receptors to insulin. Physical activity reduces central obesity as well (Sallis & Owen 1999). According to a report issued by the Australian Institute of Health and Welfare (AIHW, 1999), 350,000 Australians (2% of the population) were reported as having either type 1 or type 2 diabetes in 1995. In Victoria, 1.3% of women and 1.8% of men are reported as having diabetes (ABS, 1991). In Ballarat, diabetes was responsible for 3% of the burden of disease (DHS, Victoria, 2000).

DIABETES AND SEDENTARY LIFESTYLE

The relationship between physical inactivity and diabetes has been examined for nearly one hundred years. C. L. Bose conducted the first published study in 1907, in India. He found that diabetes was more prevalent in the upper classes of the Indian community, and among members of the judicial service and executive service. He also found that diabetes was associated with people who had an aversion to exercise, who worked in overcrowded offices performing sedentary tasks requiring mental concentration, and who consumed foods high in fat, starch and saccharin (cited in Creviston et al., 2001). This association of physical inactivity and diabetes was documented in a classic study of Australian Aboriginals (O'Dea, 1991.) Australian Aboriginals were traditionally hunter–gatherers, their lifestyles were active and their diet was low in fat. When they made the transition to a western lifestyle, they were particularly vulnerable to obesity and type 2 diabetes. Powell and Blair (1994) also suggested that physical inactivity had a significant effect on type 2 diabetes.

Kriska, Hanley, Harris, and Zinman (2001) examined the relationship between physical activity, physical fitness, and insulin resistance and glucose intolerance in isolation in sub-arctic native Canadian populations. The findings suggested a beneficial effect from physical activity and fitness on insulin sensitivity that is separate from any influence of physical activity on body composition. However, these results were compromised by 28% of men and 39% of women participating being unable to perform the sub-maximal step test due to obesity and lack of experience with fitness testing.

DIABETES PREVENTION AND TREATMENT

Given the relationship between sedentary lifestyles and glucose intolerance (Kriska et al., 2001; Wareham, Wang, & Nicholas, 2000), along with the ability of exercise to lower glucose and improve insulin action, ongoing physical activity has been proposed as a means of delaying and preventing the onset of type 2 diabetes in men (Wei et al., 1999) and women (Haapanen, Miilunpalo, & Vuori, 1997). The evidence of the role of physical activity in the prevention of type 2 diabetes has been demonstrated in previous studies (Hu et al., 1999; Ivy, Zderic, & Fogt, 1999; Wareham et al., 2000). More recently, Wareham et al. investigated the association of glucose intolerance and diabetes with physical inactivity. For this study, 775 men and women aged 45–70 were recruited from Cambridge, UK. It was suggested that energy expenditure had a major effect on glucose tolerance. Similarly, Helmrich et al. (1991) found that with every 500 kcal of additional leisure-time physical activity per week there was an associated 6% reduction in the risk of developing type 2 diabetes. In addition, men who engaged in moderate or vigorous physical activity had a 35% decreased risk of type 2 diabetes compared to their sedentary counterparts, and the risk further decreased with increasing frequency of exercise.

It has been estimated that 30–50% of type 2 diabetes could be prevented by the undertaking of sufficient levels of physical activity (Manson & Spelsberg, 1994). Most exercise can be divided into low, moderate, or strenuous categories of activity. Low activity produces only a mild elevation of heart rate and has a low effect on blood glucose concentration, unless the exercise is conducted for more than 10 minutes. Moderate activity increases the heart rate to more than 100 beats per minute and, if done for over 10 minutes, may decrease blood glucose levels. Strenuous activity increases the heart rate from approximately 125 to 160 beats per minute and, as with moderate activity, may raise glucose levels if done for more than 10 minutes. However, even 10 minutes of strenuous activity will decrease blood glucose levels for a continued period of time (ACSM, 2000; American Diabetes Association, 2001; Horton, 1998).

Hu et al. (1999) examined the effects of walking and vigorous activity on the diabetes risk of 70,102 participants in the Nurses Health Study Cohort. The results suggested that walking and vigorous physical activity reduced the risk of type 2 diabetes in women, emphasising the preventative role of moderate physical activity; however, data on the intensity, frequency and duration of the exercise was limited. Wareham et al. (2000) suggested that overall energy expenditure had an effect on cardiopulmonary fitness by preventing glucose intolerance

Physical Activity and Cancer Risk

Previous research has consistently shown that physical activity may be associated with a decreased risk of developing some forms of cancer (McTiernan et al., 1998). Cancer is a major cause of mortality in industrial nations (Sallis & Owen, 1999). Within Australia, an average of one in every three men and one in every four women are likely to develop cancer before the age of 75. The most common cancers found in the Australian male population are cancers of the prostate, colon, rectum, lung, skin, and bladder. In the female population, the most common cancers are of the breast, colon, rectum, skin, and lung (DHS, Victoria, 1999). Annually, in Victoria, 16,500 individuals suffered from cancer, and nearly 5000 male and 4000 female deaths were attributable to cancer (Department of Health and Community Services, Victoria, 1995).

According to the 1996 Burden of Disease study of local government areas of Victoria (DHS, Victoria, 2000), cancer is the second largest disease burden in the Grampians region, with 20% of deaths attributed to cancer. Within Ballarat, 18% of the DALYs were attributable to cancer. Further to these findings, DALYs in Ballarat attributable to cancer amounted to 19% for males and 18% for females. Of the male population, DALYs in Ballarat were reported as 5% from lung cancer, 3% from colon and rectal cancers, and 2% from prostate cancer. For females, DALYs were 4% from breast cancer, 3% from colon and rectal cancers, and 2% from lung cancer. Overall, for both sexes, all forms of cancer increased after the age of 45, and for females the risk of breast cancer increased after the age of 35. In Ballarat, female deaths from cancer were at a lower rate (24.82%) than the Victorian average (25.94%); however, the percentage of male deaths from cancer (the second largest cause of male deaths) was higher (30.51%) than the Victorian average (28.87%) (DHS, Victoria, 2000).

PHYSICAL ACTIVITY AND PROTECTIVE EFFECT ON CANCER

Numerous studies have shown that participation in physical activity has protective effects for men from lung cancer (Lee & Paffenbarger, 2000), rectal cancer (Cordain, Latin, & Behnke, 1986), colon cancer (Tavani, Braga, & La Vecchia, 1999), and prostate cancer (Thune & Lund, 1994). There is also evidence to show a relationship between physical activity and cancer among women with breast cancer (Verloop, Rookus, van der Kooy, & van Leeueen, 2000), uterine cancer, and ovarian cancer (Zheng et al., 1993). There is clear and consistent evidence to show that 32% of cancer deaths in the U.S. can be attributed to physical inactivity (Powell & Blair, 1994). Further, Fraser and Pearce (1993) found that men in New Zealand who engaged in sedentary type jobs had a 30% higher risk of rectal cancer.

In summary, physical activity has been shown to afford possible protective effects from the risk of colon cancer (Colditz, Cannuscio, & Frazier, 1997; McTiernan et al., 1998). Giacosa, Franceschi, Vecchia, Favero, and Andreatta (1999) reviewed recent Italian, English, and Scandinavian studies to examine the relationship between energy intake, weight, physical exercise, and colorectal cancer risk. The authors concluded that physical activity protects individuals from colon cancer. These findings are consistent with the Nurses Health Study Cohort, which found that physical activity was associated with a decreased risk of colon cancer in women (Martinez et al., 1999).

BREAST CANCER

According to Mathers et al. (2001) the estimated DALYs due to breast cancer in Australia was 2.2% (2001). The 1996 Victorian Burden of Disease Study reported the average DALYs in Victoria from breast cancer as 4%. There was a remarkable increase in breast cancer among women over the age of 35 in Ballarat, with the number of cases increasing from 41 to 47 up to the age of 75 and over (DHS, Victoria, 2000). The burden of disease of breast cancer in Victoria attributable to inactivity was 0.6% (DHS, Victoria, 1999).

Many researchers have investigated the association between physical inactivity and breast cancer. Jasienska, Thune, and Ellison (2000) suggested that 25–30% of breast cancer cases could be reduced in active (compared to inactive) women. Friedenreich, Courney, and Bryant (2000) examined the relationship between physical activity before and after menopause and the risk of breast cancer among different age groups. The study found that postmenopausal women who had engaged in moderate intensity activity (predominantly occupational and household activity) throughout their life, had an approximately 30% decreased risk of breast cancer later in their life. Bernstein, Henderson, Hanisch, Sullivan-Halley, and Ross (1994), and Carpenter, Ross, Paganini-Hill, and Bernstein (1999), found that those who continued physical activity throughout their life decreased their overall risk of breast cancer. Drake (2001) carried out a longitudinal study to examine the association between physical activity and breast cancer. For this study, of the 4,520 healthy women recruited (from an aerobics centre) there were 150 cases of breast cancer. The study concluded that women who were involved in a regular physical activity such as jogging were less likely to develop breast cancer compared to those who did not jog. Gilliland, Yu-Fen, Baumgartner, Crumley, and Samet (2001) conducted a population–based control study to investigate the breast cancer risk in Hispanic and non-Hispanic white women, and found that higher levels of vigorous physical activity resulted in a reduction in risk of breast cancer. Further findings suggested that Hispanic women who expended 25 or more MET-hours per week performing vigorous activity experienced a 66% decreased risk of breast cancer, compared with non-Hispanic white women who performed no vigorous activity. However, Gilliland et al. further noted that while vigorous activity was associated with the greatest decrease in the risk of breast cancer, non-vigorous physical activity levels also reduced the breast cancer risk. The authors concluded that increasing the total amount of vigorous physical activity decreased the overall risk of breast cancer among pre-menopausal non-Hispanic white women. Further support was provided by Verloop et al. (2000) and McTiernan et al. (1998) who reported that women who participated in vigorous physical activity substantially reduced their risk of breast cancer.

COLORECTAL CANCER

Mathers et al. (1999) estimated that the colorectal cancer risk in Australia was 2.7% of DALYs; in Victoria, 2.9% of DALYs were due to bowel cancer (DHS, Victoria, 1999). The DALYs attributable to colon and rectal cancers in Ballarat was 3% in males and 3% in females, and both male and female colon and rectal cancer risks rapidly increased after the age of 45 years (DHS, Victoria, 2000). The burden of colorectal cancer due to inactivity was 0.9% of DALYs in Victoria (DHS, Victoria, 1999).

Numerous studies have found a connection between physical inactivity and colorectal cancers (Colditz et al., 1997; McTiernan et al., 1998). Slattery, Edwards, Ma, Friedman and Potter (1997) suggested that exercise may protect against colon cancer by contributing to decreased bowel transit time and improving overall energy balance. There is clear and consistent evidence that physical activity is inversely related to colorectal cancer in a dose-response manner (Colditz et al., 1997), and considerable evidence to suggest that a higher level of vigorous leisure-time physical activity during the previous 20 years is mostly protective of colon cancer risk in both men and women (Colditz et al., 1997; Slattery et al., 1997). Colbert et al. (2001) examined the occupational, leisure-time physical activity of a colorectal cancer cohort of male smokers. The study found that both rectal and colon cancer cases were likely to be higher among those who were not working and those with sedentary jobs. The authors also suggested that active workers had a lower risk of both colon and rectal cancers, and that moderate and heavy regular activity at work decreased the colorectal cancer risk. Unfortunately, these studies did not focus on women and men from different ethnic groups. Levi, Pasche, Lucchini, Tavani and La Vecchia (1999) examined the association between occupational physical activity and leisure-time physical activity in a case control study of 223 male and female Swiss patients. They suggested that increased physical activity could reduce the incidence of colorectal cancer by one-fifth to one-third. These findings are consistent with the Colbert et al. study; however, the study was limited because it used case control design and the sample size was too small.

PROSTATE CANCER

The 1996 Victorian Burden of Disease study of morbidity highlighted that an estimated 2.7% of DALYs in Victoria for men was due to prostate cancer (DHS, Victoria, 1999). In Ballarat, 2% of DALYs was attributed to prostate cancer, predominately in the 55 years and older age group. This study did not estimate the population attributable risk factors of prostate cancer and physical activity.

The findings from the research in regard to prostate cancer are inconsistent (Albanes, Blair, & Taylor, 1989; Giovannucci, Leitzmann, & Spiegelman, 1998; Paffenbarger, Hyde, & Wing, 1987). Previous case control and cohort studies of physical activity and prostate cancer show mixed results (Brownson, Chang, Davis, & Smith, 1991; Dosemici, Hayes, & Vetter, 1993; Ilic, Vlajinac, & Marinkovic, 1996). Liu et al. (2000) carried out a cohort study to examine the relationship between physical activity and prostate cancer in U.S. male physicians. Physical activity levels of 22,071 male physicians aged 40–84 were assessed through a self-report mail survey. The study, conducted over 11 years, found the relative risk was only 1%, and the authors concluded that there was no association between physical activity and prostate cancer. These findings are consistent with previous studies, which demonstrated that there was no overall effect from physical activity on the risk of prostate cancer (Lee, Paffenbarger, & Hsieh, 1991; West, Slattery, Robison, French, & Mahoney, 1991).

Research has been undertaken to identify the type and amount of physical activity required in order to decrease cancer risk, since this was not clear in relation to prostate cancer (Cerhan, Tornear, & Lynch, 1997) and lung cancer (Lee, Sesso, & Paffenbarger, 1999). Wannamethee and Shaper (2001) investigated the association between physical activity and cancer risk in middle-aged men, focusing on sight-specific cancers, by assessing the type and amount of activity required to decrease the risk of cancer, particularly colorectal cancer, prostate cancer, lung cancer, bladder cancer, and other cancers. For this study, 7,588 men aged 40–59 were recruited from 24 towns in the England. The level of physical activity was categorised as either none, occasional, light, moderate, moderate-vigorous, or vigorous. A significant relationship was noted between physical activity and all cancers in men who engaged in moderate- to vigorous-intensity physical activity, but not in those men who engaged in low-intensity physical activity. The authors further stressed that prostate cancer significance (p=0.06) was only marginally significantly lower in those who engaged in vigorous levels of physical activity. The participation in sports at a moderate or vigorous level marginally decreased the risk of upper-digestive tract cancer. There was no association with participation in vigorous physical activity and colorectal cancer, but there was an association with an increase in bladder cancer. Walking was not shown to significantly reduce cancer risk. The results further highlighted that the connection between lung and lymphatic cancers and physical activity was not statistically significant.

These findings are consistent with studies conducted by Liu et al. (2000) who found no association between physical activity and a reduced risk of prostate cancer. In their Harvard Alumni study, Lee and Paffenbarger (1994) reported that those who were extremely active decreased their risk from prostate cancer risk, but that the decrease was not significant. However, a study by Thune and Lund (1994) did find that regular physical training reduced the risk of prostate cancer among Norwegians.

Overall findings into the association between cancer and physical activity are inconsistent, except for colon cancer and breast cancer. The findings of the previous studies, which are predominantly Scandinavian-based, have shown that physical activity leads to a decrease in overall cancer risk, although this is not supported by studies from other countries. The results vary across different countries and different socioeconomic and ethnic groups. Previous research in Ballarat did not examine the relationship between physical activity and cancer in detail; yet, according to the report on disease burdens of local government areas and regions of Victoria (DHS, 2000), cancer was estimated to be the second biggest disease burden in Ballarat next to cardiovascular disease. Future research clearly needs to be undertaken to examine this major issue.

Physical Activity and Mental Health

> Mental disorders, mental illness, mental health, and psychological well-being relate to such factors as mood or affect, personality, cognition, and perception. Psychological construction about these factors are interrelated with a person' psychological health status and quality of life.
>
> (USDHHS, 1996, p. 135)

Mental disorders are one of the leading disease burdens in the world; in fact, depression is a greater worldwide burden than cardiovascular disease (Murray & Lopez, 1997). According to Mathers et al. (2001), mental disorders are the third leading cause of burden in Australia, accounting for 14% of overall burden next to cardiovascular disease. Mental health disorders in Victoria were reported as 21.4 DALYs per 1,000 of population (DHS, Victoria, 1999), and in Ballarat as 13% for females and 12% for males, with an overall rate of 13% (DHS, Victoria, 2000). It should be noted that several overseas studies, which are addressed below, have suggested that physical activity is positively associated with reducing depression (Penninx et al., 1999), and improving health and well-being (Fontaine, 2000) and cognitive function (Dishman, 1994).

DEPRESSION

Mental health disorders, such as depression, affect millions of people worldwide (Fontaine, 2000). Mathers et al. (2001) reported that in Australia in 1996, out of ten top causes of years of life lost to disability (Years Lost to Disability: YLD), depression was reported as the leading cause of non-fatal burden in both men and women, accounting for 8% of the total. Depression was also reported to account for 2.9% and 4.7% of DALYs for males and females respectively, and 0.4% of DALYs were attributed to physical inactivity (DHS, Victoria, 1999). Depression was reported in Ballarat among males to be 3%, and among females at 5% of DALYs, and the highest rate of depression was reported in middle-age in both males and females in the 15–44 age group (DHS, Victoria, 2000).

Previous studies have consistently shown that men and women who are physically inactive are more likely to be depressed compared to active people (Kivela & Pahkala, 1991; Weyerer, 1992). Physical activity also appears to improve the symptoms of depression, and regular participation in physical activity of moderate to high intensity decreases depression (Krause, Goldenhar & Liang, 1993).

POPULATION SETTING

Epidemiological studies suggest that physical activity improves the mental health of both non-clinical and clinical populations (Simons & Birkimer, 1988; Wilfley & Kunce, 1986), and that those who are inactive are twice as likely to have symptoms of depression as those who are active (USDHHS, 1996). Lampinen, Heikkinen, and Ruoppila (2000) examined the relationship between the intensity of physical activity and symptoms of depression among older adults in the Finnish population. For this study, 663 males and females aged 65 and over were recruited from central Finland. The symptoms of depression were assessed by the Finnish modified version of Beck's 13-item depression scale. The authors concluded that an age-related decrease in the intensity of physical exercise increased the risk of depressive symptoms among older adults. The limitations of this study were that the age group was confined to those aged over 65 years, and the sample was a homogeneous group. Other research has also suggested that a lower level of physical activity was a predictor of depressive symptoms (Hassmen, Koivula, & Uutela, 2000).

CLINICAL SETTING

Researchers further investigated a different approach to examining the association between clinical depression and physical activity. Dimeo, Bauer, Varahram, Proest, and Halter (2001) evaluated the effect of a short-term aerobic training program on patients with major depression, recruiting 5 men and 7 women aged 28–65 with major depressive symptoms. The authors found that aerobic exercise improved clinical depression in the short term. These results are supported by Penninx, Rejeski, Pandya, and Miller (2002) who in comparing the effect of aerobic and resistance exercise on the emotional and physical functions of older adults with higher and lower depressive symptoms, found that aerobic exercise significantly reduced both higher and lower depressive symptoms.

Research has further investigated the issues related to dose-response and depression. Kesaniemi et al. (2000) suggested that there was no evidence for a dose-response relationship between physical activity, depression and anxiety. Dunn, Trivedi, O'Neal (2001) reviewed the scientific evidence for dose-response relationship between physical activity and depressive symptoms. Observational studies suggested that physical activity decreased depressive symptoms, but not anxiety. Future researchers need to examine the gaps in the literature, such as the association between physical activity and depression, particularly among men and women in the age group of 15–45 years.

HEALTH AND WELL-BEING

Kaplan and Bush (1982) introduced health-related quality of life (HRQL) to the health care system. HRQL was seen as a construct with many dimensions representing the extent of a person's sense of satisfaction with their own life, where health should "not be defined simply as the absence of disease and disability, rather…as a positive state of physical, mental, and social well-being" (USDHHS, 1996, p. 41).

HRQL includes the following dimensions: cognitive, social, and emotional (Shumaker, Anderson, & Czajkowski, 1990). Physical activity has a direct influence on psychological well-being, in such areas as self-concept, self-esteem, mood and HRQL (Rejeski, Brawley, & Schumarker, 1995). Studies have consistently demonstrated that physically active people have a higher self-esteem than those who are sedentary (McAuley, 1994).

Sedentary Lifestyle

Psychological research has examined the relationship between physical activity and symptoms of well-being. Kull (2002) investigated the association between leisure-time physical activity, health status and psychological well-being in a study of Estonian women aged 18–45, using Goldberg's General Health Questionnaire (Goldberg, 1978) to estimate well-being symptoms. The results indicated that physically-active women had a positive attitude towards their life, a better perception of their role, felt they deserved their families and friends, experienced less moodiness, handles serious situations more easily, needed less rest, and had less health complaints compared to those who were sedentary. This is a classic study because not many researchers have examined this problem. Taylor, Sallis, and Needle (1985) and Kuoppasalmi (1998) also found physical activity inversely associated with people with positive self-esteem.

Moderate-Intensity Activity

Brown, Mishra, Lee, and Bauman (2000) researched the association between moderate levels of physical activity, health well-being and medical conditions such as tiredness, back pain, and constipation. For this Australian cross-sectional study, 14,502 young women aged 18–23 years, 13,609 middle-aged women aged 45–50 years, and 11,421 older women aged 70–75 years were recruited Australia-wide. The instrument used was SF 36, which was devised by Weyerer (1992) to measure general physical and mental health and well-being. Brown et al. suggested that a steady increase could be seen because the mental health score increased in all age groups where there was an increase in physical activity scores. The study further compared a sedentary group with a more active group and found that the more active women in all three age groups were less likely to report tiredness, back pain and constipation, and the more active women in the older group were less likely to report sleep disturbances and stiff joints. In addition, premenstrual symptoms and period pain were lower among the more active women in the younger age group. The more active older age group was less likely to report hypertension or osteoporosis, particularly among those who engaged in moderate to high intensity activity. This study contributes valuable knowledge to the research culture, and its findings can be generalised as it was conducted with such a big sample size and was Australia-wide. Previous research confirms its findings: that physical activity protects elderly bone mineral loss (Kelly, 1998), morbidity and functional status (King, Oman, Brassington, Bliwise, & Haskell, 1997) and improves mood and cognitive functions (Williams, 1997).

COGNITIVE FUNCTION

Researchers have observed the association between cognitive function and physical activity. Spirduso and Cronin (2001) defined cognitive function as memory, attention, concentration, comprehension and problem-solving ability. Physically active people have better cognitive function than physically inactive people (Christensen et al., 1996). Physical activity has also been shown to improve cognitive performance. Some studies have shown physical activity to be inversely associated with cognitive function

(USDHHS, 1996). Yaffe, Barnes, Nevitt, Lui, and Covinsky (2001) investigated whether physical activity is associated with the risk of cognitive decline among elderly women in the U.S. This study recruited 5,925 women aged 65 or more from four clinical centres. Physical activity was measured by a self-report questionnaire. Cognitive performance was measured by Mini-Mental state examination. The cognitive functions were tested for concentration, language, and memory components designed to screen for cognitive impairment. The findings suggested that women with higher levels of baseline physical activity were less likely to develop cognitive decline, and that moderate and strenuous physical activity was associated with a decreased risk of cognitive decline. Further, Albert et al. (1995) found that people who engaged in strenuous daily physical activity prevented cognitive decline.

Physical Activity and Population Attributable Risk (PAR)

The relationship between a sedentary lifestyle and the estimated number of deaths attributable to inactivity is termed a population attributable risk (PAR) (Bauman, 1998; Berlin & Colditz, 1990; Powell & Blair, 1994; Stephenson et al., 2000). The PAR due to physical inactivity is associated with disease in the population. It has been estimated, using data from the National Physical Activity Survey conducted in 1997 (Australian Sports Commission [ASC], 1998), that 18% of CHD, 16% of stroke, 13% of type 2 diabetes, 19% of colon cancer, 9% of breast cancer, and 10% of depressive symptoms were attributable to physical inactivity (Stephenson et al., 2000). This public health burden is directly or indirectly related to ill health.

It is important to examine the consequences of sedentary living or physical inactivity and their direct or indirect relationship to the public health burden (Powell & Blair, 1994). The measurement of the public health burden associated with disease and health can be defined as incidence rates, prevalence rates, and mortality rates. The PAR is a common measurement of the percentage of disease in the population that can highlight the prevalent rates of risk factors (Galgali, Beaglehole, Scragg, & Tobis, 1998). The calculation of the PAR can be expressed as a percentage (PAR %) that reflects the estimation of incidence and prevalence for a particular disease or condition related to exposure with the population (Kesaniemi et al., 2000). The percentage of specific mortality or morbidity that is attributable to physical inactivity can then be calculated using this approach. The PAR% for CVD (Kesaniemi et al.); colon cancer, type 2 diabetes (Powell & Blair, 1994), hypertension, depression and breast cancer (Galgali et al.) have been established. In order to calculate the PAR, an understanding of current risk factors and relative risks of a disease from exposure is necessary (Macera & Powell, 2001). The relationship between physical activity and most health outcomes is usually expressed as relative risk (RR), which is calculated as the ratio of outcome rates of inactive individuals compared with outcome rates of individuals who are more active (Bauman, 1998). Even though there may be improvements in estimates of relative risks, the 'true' RR does not change due to its (assumed) biological basis (Powell & Blair, 1994). The PAR assessment has been used to identify physical inactivity, contributory factors and an estimation of prevention, predominantly for CVD, diabetes, some form of cancers, and anxiety and depression (USDHHS, 1996). A stronger relationship between inactivity and a specific health issue increases the PAR %. Through this concept, if a population becomes physically active, the number of deaths due to CHD could decrease (Bauman). These estimations of PAR provide useful information for public health policy makers to design, plan and implement effective intervention programs. Such programs might then reflect more realistic and potentially achievable goals (Macera & Powell, 2001). PAR estimates are important from a public health point of view because they highlight risk factors that may lead to a change in behaviours and, potentially, decrease mortality rates (Bauman). The formula for the calculation of Population Attributable Risk (PAR) (Stephenson et al., 2000) is shown below.

$$\textbf{POPULATION ATTRIBUTABLE RISK} = \frac{\textbf{P (RR–1)}}{\textbf{1 + P (RR–1)}}$$

P = Prevalence of inactivity in the population
RR = Relative risk (of the outcome) in the sedentary/low active group compared with the active group

Previous researchers have administered the PAR concept in the U.S, New Zealand, Canada, and Australia. Interestingly, different results for different countries have been found. Powell and Blair (1994) examined the association between sedentary living, physical inactivity and PAR in the U.S. In this study, the estimated number of deaths due to CHD, colon cancer, and diabetes was established. The relative risk (RR) for CHD was 2.2 for sedentary individuals, 1.5 for those who were irregularly active, 1.1 for the regularly active, compared with the reference group of those who were vigorously active. The RR for colon cancer was 1.8 for the sedentary, 1.5 for the irregularly active, 1.1 for the regularly active, and 1.0 for the vigorously active. The RR for diabetes was 1.8 for the sedentary, 1.6 for the irregularly active, 1.3 for the regularly active, and 1.0 for the vigorously active. The prevalence of sedentary individuals was 24%, irregularly active 54%, and regularly active 10%. This study reported that the overall PAR was 35% for CHD, 32% for colon cancer, and 35% for diabetes mellitus. The study further noted that, theoretically, if everyone had been vigorously physically active, 178,000 deaths from CHD, 15,000 deaths from colon cancer and 14,000 deaths from NIDDM could have been prevented.

Galgali et al. (1998) investigated the potential for preventing major causes of premature death, disease and injuries in New Zealand. This study employed an RR for CHD as 2.0 (both male and female), diabetes as 1.7 (both male and female), and cancer as 1.8 (both male and female), and fractured neck of femur as 3.3. The study reported that PAR due to physical inactivity was 35% for CHD, 30% for diabetes mellitus, 33% for colorectal cancer, and 65% for fractured neck of femur. Overall, 303 deaths were attributed to physical inactivity. The authors concluded that reducing the prevalence of smoking, hypertension and physical inactivity, and decreasing serum cholesterol levels would prevent 1,228 deaths per year. Katzmarzyk and Shephard (2000) reported that the PAR due to physical inactivity for CHD was 35.8% in Canada, but the other PAR data provided by Galgali et al. (such as diabetes and cancer) were not comparable with the Canadian study or the Australian and U.S. studies. The major limitation of this study was the calculations were made using RRs from international data. Therefore the application of different data to different populations would result in disparities in the validation of the study.

Stephenson et al. (2000) investigated the cost of illness attributable to physical inactivity in Australia. The prevalence of inactivity data was gathered from the 1997 National Physical Activity Survey 1997 (ASC, 1998). The sample size in the survey was 4,824 Australians aged 18–75 years. The results suggested that the prevalence of physical inactivity was 44% of the Australian adult population. The RR estimated for physical inactivity and all-cause mortality was 1.4 for CHD; 1.5 for stroke; 2.0 for type 2 diabetes; 1.3 for colon cancer; 1.5 for breast cancer; 1.1, for falls; and 1.3 for depression. The PAR due to physical inactivity for all-cause mortality was 18% for CHD, 16% for stroke, 13% for type 2 diabetes, 19% for colon cancer, 9% for breast cancer, 18% for falls, and 10% for depression. The authors calculated the mortality attributable to inactivity that could theoretically be prevented if all Australians were physically active to be: CHD (5,335), type 2 diabetes (380), colon cancer (680), stroke (2,049), breast cancer (228), and all-cause deaths (23,556). In a comparable study in the U.S., Colditz (1999) reported that falls were 18% of PAR, which is similar to the PAR reported in Australia. The reported PAR (18%) of type 2 diabetes was also close to the Stephenson et al. study.

The major limitation of most of these studies is that they have not estimated the prevalence of physical inactivity in the data gathered from different studies and authors. In addition, none of the studies, including the Australian studies, has specifically investigated rural or regional PARs. It is therefore necessary to examine the prevalence of inactivity and PAR with a larger sample in the regional setting.

Cost of Illness Attributable to Physical Inactivity

Estimates of the health burden of physical inactivity with respect to various conditions can be used to calculate equivalent economic burdens in terms of 'cost of illness' (COI). In this way, the direct health care cost that is attributable to physical inactivity can be calculated for heart disease stroke, colon cancer and diabetes (Smith et al., 1999). However, it is difficult to calculate the cost of inactivity because disease is multi-factorial; for example, the interplay of poor diet, smoking and inactivity dramatically increases both the risk of disease and the use of health service resources (Smith et al.).

The cost of illness can be estimated as a *direct cost* or an *indirect cost*. Calculation of the direct cost involves disaggregating the total cost of illness between classifications based on age, gender and disease (Mathers, Stevenson, Carter, & Penm, 1998). It measures the cost of prevention, diagnosis, treatment, ambulance transportation, inpatient, nursing home, outpatient, rehabilitation, allied health, community health and medical service, and pharmaceuticals. The direct cost measures the cost of premature death, loss of human life, loss of productivity, and reduction in quality of life to individuals and their families (Stephenson et al., 2000).

In the last six years, 189 COI studies have been conducted around the world on primary prevention (Stephenson et al., 2000). The economic cost of inactivity has been measured in a number of countries, such as the U.S., Canada, New Zealand and Australia.

Colditz (1999) examined the cost of the burden of physical activity and obesity in North America, using population attributable risk (PAR) to estimate the direct health care cost of illness. The study estimated the PAR of CHD, NIDDM, osteoporosis, colon cancer, breast cancer and hypertension attributable to physical inactivity to be US$24 billion—2.4% of the total US health care expenditure.

Pratt, Macera, and Wang (2000) observed the direct health care cost of physical inactivity in the U.S. in 1987. Moderate or strenuous physical activity three or more times a week was classified as physically active; anything less than this was classified as physically inactive. The study reported that the average direct health care cost was US$12,019 for those who were regularly physically active and US$12,349 for those who were physically inactive, and that the benefit per person was US$330. An increase in regular participation in moderate-intensity physical activity in those aged 15 and over (88 million Americans) would reduce the annual medical cost in 1987 by US$29.2 billion, and by US$76.6 billion in 2000.

Katzmarzyk and Shephard (2000) estimated the direct health care cost attributable to physical inactivity in Canada, using population attributable fraction (PAF), similar to PAR. They concluded that the cost of CHD, stroke, colon cancer, breast cancer, osteoporosis and type 2 diabetes that was attributable to physical inactivity was C$2.1 billion—2.5% of Canada's health expenditure. The study further reported that about 21,000 lives were lost due to physical inactivity, and that a 10% reduction in physical inactivity would reduce the direct health care cost by C$150 million. These findings are consistent with Colditz (1999), who provided evidence that US$24 billion (2.4% of total health expenditure) was attributable to physical inactivity in the U.S.

Roberts (1987) observed the economic benefits of regular participation in physical activity in Australia. He estimated that increasing the proportion of the adult population who were sufficiently active to gain health benefits would result in a cost saving of 10–20% to 50%; however, the overall potential saving was estimated at $274 million per year. Stephenson et al. (2000) estimated the direct health care cost due to physical inactivity in Australia using PAR and found that half of the Australian adult population was insufficiently active. The annual direct health care cost attributable to physical inactivity was found to be $400 million. Stephenson et al. further suggested that a 1% increase in physical activity over the population would result in a gross saving of $8 million each year. These findings are consistent with those of Colditz (1999).

It is important to note that Roberts et al. (1987) and Stephenson et al. (2000) examined the health care cost attributable to inactivity in Australia. There is no literature available on the regional or rural health care cost due to physical inactivity. These research gaps need to be examined in detail if targeted and effective physical intervention programs are to be designed and implemented.

Physical Activity Measurements

The measurement of physical activity is a complex task, particularly in a community setting. Despite the complexity, it is essential to measure levels of activity in order to obtain baseline data to promote community physical activity by planning exercise programs and sports and recreation facilities (Bauman et al., 2000). The data collected can also be used gauge the success or otherwise of intervention programs, and investigate the association between levels of activity and specific areas of health (Sallis & Owen, 1999).

Physical activity assessment can be used to estimate the number of people in the population who follow the Department of Health and Ageing (DHA, 1999) guidelines. These guidelines suggest 30 minutes or more of daily moderate physical activity most days of the week, or vigorous-intensity physical activity 3 to 4 times per week at 30 minutes or more. Using these guidelines, an individual can be rated as sedentary, infrequently physically active, moderately active, or vigorously physically active (Bauman et al., 2000).

Health related surveys are usually conducted via self-administered questionnaires, telephone interviews, or face-to-face interviews (Gordis, 1979). Although the assessment of physical activity is a complex task, there is a place for simplifying the measurement of behaviour through the recall of ‘usual’ or ‘typical’ activity patterns (Sallis & Owen, 1999).

SELF-REPORT QUESTIONNAIRES

Recall memory questionnaires can be administered through telephone, personal interview, paper and pencil, or self-administered by mail (Paffenbarger, Blair, Lee, & Hyde, 1993). Levels of physical activity in a population have traditionally been measured through the self-reporting method, which allows participants to self-report via interview questionnaires and/or activity diaries. These questionnaires and diaries often vary significantly depending on the level and complexity of detail being sought by the investigators (Carron, Hausenblas, & Estabrooks, 2002). Self-report physical activity surveys have advantages, but they also have limitations. The advantages lie mainly in the areas of cost, administration, scoring, and their ability to assess a large sample (Carron et al.). The limitations are that participants tend to over-report their levels of physical activity; some participants (such as children or the elderly) may find the cognitive aspects of the questionnaire prohibitive; and the accuracy of recalled physical activity varies according to how long ago is the time period being recalled (Carron et al., 2002). The other major limitation to self-report questionnaires is that they often contain technical words and terms, which could be misunderstood—or not understood at all—by the participants, resulting in unreliable data (Sallis & Saelens, 2000).

The questionnaire is, without doubt, a very simple and useful tool for the measurement of physical activity, but not all questionnaires are equally reliable or valid. It has been found that the shorter, less-detailed questionnaires generally elicit more accurate responses (Wolf, Hunter, & Coldtiz, 1994), although some highly-detailed recall questionnaires have been used successfully—for example, the Minnesota Leisure-time Activity Survey, which measured leisure-time physical activity (Minnesota Physical Activity Manual, cited in McTiernan et al., 1998). Questionnaires that typically require participants to recall memory of specific periods of physical activity from up to 12 months prior (Sallis & Owen, 1999) often do not produce highly-accurate information (Jacobs et al., 1993).

MAIL AND TELEPHONE SURVEYS

Telephone surveys are widely-used in marketing and general social research (Steel, Vella, & Harrington, 1996), and are regarded to be superior to mail surveys in terms of response rates (Lehmann, 1989). Mail surveys are preferred in epidemiological research, and are generally seen as more affordable and practical. They are also considered to be more accurate, as the participants are self-reporting and, thus, are unaffected by pressure to provide the true response, or any interviewer/participant bias (Kohl, Blair, Paffenbarger, Macera, & Kronenfeld, 1988), and recall memory is higher than in telephone and face-to-face surveys (Frazer & Lawley, 2000).

Comparison

It is useful to look at the efficacy of these different methods in different contexts (Groves, 1989). Brogger, Bakke, Eide, and Gulsvik (2002) compared the quality of data (completeness and reproducibility) collected through telephone and mail surveys in a Norwegian study investigating respiratory symptoms and risk factors. A questionnaire (based on a British Medical Research Council chronic bronchitis questionnaire) was mailed to 25,000 people in two different areas. Six months later, 171 respondents from this larger sample were surveyed over the telephone by trained interviewers using the same questions as in the mailed questionnaire. Although the mail survey produced a higher rate of 'incomplete' questionnaires than the telephone survey, reproducibility of data was good for continuous variables across the two survey methods. The telephone survey was found to provide more precise information. Brogger et al. concluded that generally there was not a lot of difference between the quality of data collected from the two survey modes, although this depended on the specific questions asked. These findings are supported by Wilson, Edwards, Fiddes, Stewart, and Teasdale (2002), who compared responses to mail and telephone surveys in a UK study of participants with head injuries. It was found that the two survey modes produced fairly similar data, although the responses to the mail survey were deemed to be more reliable. Other comparative studies have been conducted by O'Toole, Battistutta, Long & Crouch (1986), who compared telephone, mail and personal (home) interviews for cost and data quality, and Brambilla and McKinlay (1987), who compared telephone and mail surveys for response rates. Unfortunately, to date, there has been no research into the comparison of different survey methods used in studies of physical activity levels.

Cost

A mail survey would be more cost-effective for a study using a lengthy questionnaire and covering a large sample size (Frey, 1983). If a telephone survey were to be used in this instance, the expense would be prohibitive, once telephone charges and the wages of interviewers and supervisors were taken into account (Lockhart & Russo, 1994). A brief survey to be carried out in a short period of time would be ideally suited to a telephone survey (Frey).

Representativeness

The validity of survey results depends on how representative the respondents are of the population being sampled. Telephone surveys can result in bias due to non coverage of households without phones. In Australia, 5.6% of households do not have a telephone; in Victoria the figure is 3.4%, with the highest non-coverage reported by the unemployed (13.6%), one-adult households (10.2%) and single parent with dependant children-households (10.4%) (ABS, 1994). Steel & Boal (1988) suggested that telephone surveys were likely to be unrepresentative of individuals with lower incomes, young people, or people in rented accommodation. Both mail and telephone surveys are more likely to be responded to by women and people in older age groups than men and people in younger age groups, and it is not always possible to balance this out, particularly in regard to mail surveys (Sellers, 2000).

Response Rate

The response rate of mail surveys compared with telephone surveys has increased over the last decade (Frey, 1983). This is due, in part, to the now common practice of screening calls through answering machines, allowing individuals to answer only personal calls. Mail surveys are also more suitable for respondents with busy schedules (Pearson NCS, 1994). It has been shown that it is possible to increase both response rates and return rates by employing such enhancement techniques as general survey promotion (Green & Kreuter, 1999) and, in the case of mail surveys, reminder notices (Lockhart & Russo, 1994). In telephone surveys, the tone or mood of the interviewer can affect response rates; if interviewers are ‘encouraging’, response rates are likely to be increased (DSS Research, 2003). Interviewers need careful training so that they do not cause the respondents to believe they have to answer in an ‘acceptable’ or ‘correct’ way. Mail survey respondents are less susceptible to feeling such pressure because they are in the situation of reading the questions alone and, more importantly, being able to re-read the questions and respond in their own time (Frey). Not surprisingly, in view of this, the response rates for the answering of ‘sensitive’ questions are higher in mail surveys than in telephone surveys (Pearson NCS, 1994).

Confidentiality

Confidentiality in mail and telephone surveys is compromised by using the participant’s name and, in the case of mail surveys, their address. Anxieties in this respect can be allayed somewhat in mail surveys by using a separate cover letter and leaving the actual survey form unaddressed (Pearson NCS, 1994).

In summary, the choice of whether to use a mail survey or a telephone survey will depend on the importance of each individual determinant: cost, time, confidentiality, sample size, response rate, number of questions, and the quality of data being sought. Mail surveys are preferable when costs are a concern; intended respondents have busy schedules; questions are sensitive or of a personal nature; or when the survey is lengthy or complex. Telephone surveys are preferable when results are needed quickly; respondents need to qualify; or when the survey population is small.

WEB-BASED AND IVR SURVEYS

Web-based surveys and interactive voice recognition (IVR) are also used in epidemiological and social science research to collect data. Bason (2000) compared IVR, web-based, telephone and mail surveys for representativeness, response rates, and quality of data in a U.S. study of alcohol and drug use among students from the University of Georgia. The sample reached by the telephone survey was found to be the most representative of the population, while the mail survey had a higher proportion of female respondents than the other modes. Although, overall response rates were highest in the mail survey, Bason found web-based and IVR technology better at producing reduced non-response bias, as well as being lower in cost.

AUSTRALIAN SURVEYS OF PHYSICAL ACTIVITY

The instrument is based on a set of core questions developed by the AIHW expert working group on physical activity measurement. It assesses the physical activity performed during the previous week according to the following categories: walking; moderate-intensity sports such as lawn bowls, golf, and gentle swimming; vigorous intensity activities such as jogging, cycling, aerobics, competitive tennis, and vigorous intensity gardening and yard work. In addition to this, a demographic profile of survey respondents is attained.

The Australian national standards for measurement of physical activity are coordinated by the Australian Institute of Health and Welfare. Three national surveys have been conducted in association with the AIHW: in 1997 (ASC, 1998), 1999 (Armstrong et al., 2000), and 2000 (Bauman et al., 2001). These surveys were carried out using a new and standard instrument developed by the expert working group chaired by Professor Adrian Bauman and his colleagues. The validity and reliability of the capacity of participants to recall the questions relating to moderate intensity physical activity was assessed by Bull (2000). She reported that the instrument displayed moderate to high Intra Class Correlations (ICC) for each of walking, gardening, vigorous and moderate intensity activities. Unfortunately, the validity study was only reported as having low to moderate ICC's. Therefore, this instrument was determined to be reliable by Dr Fiona Bull, who suggested that the questionnaire could be used as a population level physical activity instrument (Bull, 2000). Unfortunately no reliability measures were reported in this study.

The participants in the 1997 survey, commonly known as the Active Australia Survey, were selected from eligible adults (aged 18 to 75 years) in households that were randomly telephoned Australia-wide. The final sample size was 6,803. The interviews were conducted through computer-assisted telephone interviews and were based on the questionnaire developed by the AIHW Active Australia Survey expert working group (ASC, 1998). The survey investigated the level of physical activity and inactivity in the previous week; knowledge of the moderate intensity physical activity message; intention to be more active; recall of the *Active Australia* message (a physical activity promotional campaign that had run in New South Wales); and the demographic profile of survey respondents. The results reported that, out of the Australian adult population, 13.4% were sedentary and 62% were sufficiently active. The 1997 survey noted that 38% of the Australian population did not meet the guidelines of sufficient physical activity (ASC, 1998).

Armstrong et al. (2000) examined the data on the physical activity patterns of Australian adults gathered by the 1999 National Physical Activity Survey. The study recruited 3,841 male and female participants aged 18–75 years from several states. The same methodology and instrument were used as in the 1997 survey to assess the level of physical activity (ASC) but questions on frequency and duration of participation in vigorous-intensity household and domestic chores and hours of television watching were omitted. The study reported that 14% of Australian adults were sedentary, 28.7% insufficiently physically active and 56.6% sufficiently physically active. These findings are consistent with those of Bauman et al. (2001), who found that fewer people (56.6%) were reported as sufficiently active in 1999 compared to the 1997 survey respondents (62.2%). Unfortunately, this study did not extend to examining the levels of physical activity and inactivity using a large sample in a regional setting.

Bauman et al. (2001) reported on the 2000 National Physical Activity Survey. The survey was conducted to monitor the levels of physical activity and trends in Australia. Adult men and women aged 18–75 were recruited in a sample of 3,590. The same method and instrument were used as in the 1999 survey to assess levels of physical activity. The findings further suggested that there was no increase in sufficient levels of physical activity compared to 1999. These findings were consistent with the findings of Armstrong et al. (2000). The limitations of the 1997, 1999 and 2000 studies are that they did not contain any questions relating to barriers and facilitators that might affect levels of physical activity.

In addition to assessing levels of physical activity in Australia nationally, researchers have also been concerned with examining the levels of physical activity on a state-wide basis, such as in Victoria (Smith et al., 1999); South Australia (DHS, South Australia, 1999); and Western Australia (Bull, 2000).

Smith et al. (1999) examined levels of physical activity and health impacts in Victoria in 1998. For this study, data from the 1997 and 1998 national surveys were analysed. The two sets of data were merged to form a total sample size of 3000. The findings suggested that, in Victoria, 12% of the population were sedentary, 31% had low levels of activity, 30% were moderately active, and 27% were highly active. The findings were not consistent with previous findings because the methodology used to estimate adequate physical activity was based on energy expenditure, rather than the amount of time spent on physical activity. Therefore, for future comparisons to be made there needs to be consistency in the use of instruments.

In 1998, the South Australian Department of Human Services carried out a physical activity survey to assess levels of physical activity and barriers among the adult population in South Australia (DHS, South Australia, 1999). For this survey, 3000 adults were selected randomly through the telephone directory. The survey was based on telephone interviews. The results showed that 44% of adults were sufficiently active. The study also found that the major barriers to being active were perceived health, and limited availability of time and social supports. To be more physically active, participants required a better environment, and the support of family and friends.

Bull (2000) examined the level of physical activity in Western Australia. For this survey, 3,178 adult men and women were randomly selected from the telephone directory, and interviewed over the telephone. The survey achieved a response rate of 46%. The findings indicated that 58% of Western Australians were sufficiently active to achieve health benefits, and that the major barrier to being more physically active was ‘lack of time’. The main purpose for being active was reported to be improved fitness and enjoyment. Respondents believed that if they had better facilities and a more conducive exercise environment, they would be more active.

The major limitation of earlier studies is that levels of physical activity were measured using a variety of instruments and methods. Due to this lack of conformity and compatibility in the methodology, it is very difficult to interpret the data. With regard to state-wide physical activity surveys, different states have used different instruments; therefore, any interpretation of results or comparisons with other states is difficult. In addition, the studies did not examine levels of physical activity in Australian regional and rural populations with a sufficiently large sample size. (An exception is the 1997 *Active Australia* Baseline Survey, which was carried out with a sample of 6,803.) There is a clear metropolitan bias in these studies in terms of the sample selection process. Moreover, the barriers to participation in physical activity and required facilities to increased participation of physical activity need to be explored in more detail.

Barriers and Facilitators Affecting Participation in Physical Activity

Over the past few decades, the health benefits of physical activity have been well documented (USDHHS, 1996). Mathers et al. (2001) highlighted that the major risk factors attributable to the burden of disease are smoking and physical inactivity. According to the 1997, 1999, and 2000 National Physical Activity surveys, nearly half of Australian adults were physically inactive (Bauman et al., 2001). In order to make the population more active, it is necessary to understand the existing barriers to participation in exercise (Napolitano & Marcus, 2000). In addition, it is very important to clearly identify the target groups, their barriers, and their required facilities if government policy planning is to tailor physical activity programs according to their needs (Booth, Owen, Bauman, & Gore, 1995). Dishman (1994) classified the determinants of physical activity participation into three categories: personal, environmental, and exercise-specific. Napolitano and Marcus further classified the determinants and consequences to becoming and remaining physically active into five broad perspectives: environmental, psychosocial, health, physicians' lack of emphasis, and program accessibility. This review is based on these classifications.

ENVIRONMENTAL FACTORS

Environmental determinants are important influences on physical activity participation. They can be broadly classified into neighbourhood safety, convenience, proximity, and accessibility of facilities (Napolitano & Marcus, 2000). Previous investigators examined the relationship between environmental determinants and regular participation in physical activity (King, Jeffery, et al., 1995; Sallis & Owen, 1999). Booth, Bauman, Owen, Clavisi, and Leslie (2000) observed the perceived social, cognitive, and environmental influences among the older population of Australia. The study randomly recruited 449 adults aged 60 years and over from the southern states of Australia. The findings noted that a significant amount of those who were physically inactive had access to recreational centres—cycle tracks, golf courses, parks and swimming pools—but did not use them. An insignificant number of physically inactive people used facilities such as exercise halls, gyms, tennis courts and bowling greens. However, active people reported difficulty with using uneven footpaths, hills, and a fear of dogs.

Bauman et al. (1999) noted that those who lived in coastal locations had higher levels of physical activity compared to those who lived inland. Ball, Bauman, Leslie, and Owen (2001) found that aesthetic environment was an important correlate of walking for exercise. It is therefore important to note that physical environment may be a determinant of physical activity participation.

PSYCHOSOCIAL FACTORS

Psychosocial factors such as work and family demands, and lack of time—particularly for women—have been reported as barriers to participation in adequate levels of physical activity (Ainsworth, 2000). Marcus, Pinto, Simkin, Audrain, and Taylor (1994) noted that women who were employed and had young children were less likely to be physically active compared with women who did not have children. Early behavioural studies reported that the major reason for participation in physical activity and dropping out of exercise programs was lack of time (Dishman, Sallis, & Orenstein, 1985). Booth, Bauman, Owen, and Gore (1997) examined the 1990–91 pilot survey of the fitness of Australians (Department of the Arts, Sport, Environment, and Territories, 1992), and investigated perceived barriers and facilitators relating to participating in physical activity Australia-wide. A South Australian survey (DHS, South Australia, 1999), selected 2,298 respondents through random sampling from the metropolitan area of Adelaide in South Australia. The findings suggested that the younger age group who were inactive cited barriers of insufficient time, lack of motivation, and childcare responsibility. The older age group highlighted that the barriers to their participation in physical activity were injury or poor health. These findings are consistent with Cody and Lee (1999), who found a similar association with women who had children, who were too tired to exercise because of looking after their children, and who found it difficult to find time unless childcare facilities were provided. With regard to the perceived benefits, the women cited regular exercise as the link to feeling healthier; improving their fitness, having more energy, overcoming tiredness, feeling more positive in general, and improving body tone. Both the South Australian survey and the Western Australian physical activity survey (Bull, 2000) showed lack of time to be a barrier to participating in physical activity in general. However, none of these recent Australian has examined the barriers or facilitators affecting increased participation in physical activity in regional populations of Australia.

Researchers have displayed further interest in investigating the association between physical activity and personal barriers, such as lack of interest and enjoyment factors (Sallis et al., 1989). Brownson, Baker, Housemann, Brennan, and Bacak (2001) identified the relationship between environmental, policy determinants, and physical activity behaviour. This cross-sectional study was conducted among U.S. men and women in different socio-economic levels of the population. The instrument was based on the Behavioural Risk Factor Surveillance System, and focused on social and personal barrier questions. The study found six personal barriers with an inverse association to physical activity participation: having too little time, being too tired, not being in good health, lacking in energy, lacking in motivation, and not liking the exercise demonstrator. Brownson et al. further stressed that personal barriers and behaviour vary by gender. Consequently, lack of energy is strongly associated with women, and not being in good health is mostly associated with men. In addition, only one personal barrier—not being in good health—is significantly associated with low-income respondents. Conversely, six personal barriers—having too little time, being too tired, not being in good health, lack of energy, lack of motivation, and not liking exercise—showed an inverse association with activity among those with higher incomes. Wilcox, Castro, King, Housemann, and Brownson (2000) noted that barriers such as knowledge, self-motivation and enjoyment are directly associated with physical activity participation. The findings of Brownson et al. contribute greatly to the body of knowledge. However, future studies need to examine different sociocultural variables within ethnic groups and different geographical locations.

HEALTH FACTORS

Napolitano and Marcus (2000) suggested that ill health is a barrier to participating in physical activity. Brown (1999) examined the barriers to physical activity in people at risk of coronary heart disease, and investigated the actual level and desired level of physical activity and looked into the minimisation of barriers. For this study, 16 males and 15 females were recruited from the regional lipid clinic in Scotland. The data was gathered from a self-report questionnaire. It reported that the most important barriers to implementing changes in physical activity as a group were time, ill health, preferring to do other things, lack of money, having no one with whom to participate, and lack of confidence. The study further noted that barriers also varied from different age groups and genders, as well as those who did and did not work. A similar association was found in barriers to exercise, which varied for men and women (Wardle & Steptoe, 1991). Dishman (1990) noted that finding time was a barrier to exercise participation for working men. However, in order to generalise the findings of Brown, similar studies need to be conducted in a high-risk population group (such as those with CHD, diabetes, osteoarthritis, cancer, mental illness) in a large sample size that includes different socio-economic groups and wider age ranges.

LACK OF EMPHASIS FROM PHYSICIANS

According to Napolitano and Marcus (2000), medical professionals could play a leading role in contributing to barriers to physical activity participation. In the past, researchers have examined the association between the promotion of participation in physical activity by physicians and the barriers to health promotion in Australia (Bauman, Mant, Middleton, Mackertich, & Jane, 1989; Bull, Schipper, Jamrozik, & Blanksby, 1995, 1997). The findings of these studies suggest that the main barriers to physicians promoting physical activity are lack of time, lack of knowledge, lack of experience of physical activity, and lack of financial incentive.

Abramson, Stein, Schaufele, Frates and Rogan (2000) investigated the relationship between patterns of personal exercise among primary care physicians in the U.S. and their rates of exercise counselling to patients. For his study, 298 physicians were randomly selected. The findings suggested that physicians who participated regularly in aerobic exercise were more likely to counsel their patients on exercise benefits. Similarly, physicians who engaged in strength-training programs were more likely to counsel on the benefits of strength training for their patients. The study further suggested that inadequate time, knowledge, and experience were barriers to counselling their patients. These findings are consistent with those of Bull et al. (1995) and Bauman et al. (1989). Bauman et al. (2002) suggested that knowledge of physical activity promotion could be implemented through continuing medical education of general practitioners. Moreover, Garry, Diamond, and Whitley (2002) noted that physicians' barriers to counselling on physical activity could be minimised through exercise or physical activity curricula introduced in medical schools. As indicated in the above literature, barriers to promoting physical activity counselling among rural and regional physicians have not been studied extensively in Australia.

PROGRAM ACCESSIBILITY

The exercise program itself can be a barrier; some programs do not cater to community requirements because of time, work, transport or family demands (Napolitano & Marcus, 2000). Access and cost are also common barriers to participation in physical activity (Dunlap & Barry, 1999). Access to exercise facilities positively influence physical activity participation in the community (King, 1991). Previous authors have consistently shown program access, transportation, and cost as significant barriers to minority groups (Jones et al., 1996; Chinn, White, Harland, Drinkwater, and Raybould (1999) examined the association between physical activity and socio-economic position in the UK. For this study, 6,448 adults aged 16–74 years were selected. This study was conducted through a self-report mail survey. The instrument included socio-economic position and barriers such as lack of motivation, lack of leisure-time, lack of money, lack of transport, and illness or disability. The results suggested that barriers to participating in physical activity varied according to age, social class, and marital status. Lack of motivation and lack of time were positively associated with the high-income group; lack of money and lack of transport were significantly associated with lower income groups. The authors further suggested that promotion of physical activity in poor (low income) populations might require a different approach compared to affluent populations. Lower income groups may need incentives, subsidies or alternatives stratified to promote physical activity. These findings are consistent with those of Brownson et al. (2001), who suggested that both men and women in higher income groups have greater access to indoor or outdoor exercise facilities; whereas men and women in lower income groups have better access to less expensive facilities such as shopping malls, and that only men reported better access to neighbourhood streets.

DEMOGRAPHICS

Participation in, and barriers to, physical activity vary across demographics (Zunft et al., 1999).A targeted physical activity intervention approach has been shown to be more effective than a blanket approach (Bull, Kreuter, & Scharff, 1999). Wilcox et al. (2000) focused on leisure-time physical activity and urban-rural differences among socio-demographic factors, determinants and patterns to leisure-time physical activity in the United States. Female respondents aged 40 and over were recruited from different ethnic groups such as African American, American Indian, and Alaskan natives. The sample was drawn from rural areas (1,242) and urban areas (1,096). The study was carried out through a telephone survey using the Behavioral Risk Factor Surveillance Survey. The findings suggested that the top three barriers to exercise reported for urban women were lack of time, lack of energy, and being too tired. In contrast, rural women reported that the barriers to physical activity were caring duties, lack of time, and lack of energy. The findings were consistent with similar associations found by Zunft et al. (1999) on the perceived benefits and barriers to physical activity in the European Union, suggesting that barriers to participation in physical activity varied significantly between countries. Particularly prominent barriers were work or study commitments (46% of Italian respondents), not the sporty type (33% of German respondents), looking after children or elderly (22% of Luxembourg respondents), not needed (18% of German respondents), poor health (26% of Spanish respondents), no energy (19% of Finnish respondents), and too old (21% of Spanish respondents). The findings of Wilcox et al., and of Zunft et al., show a new approach to physical inactivity, focusing on actual target groups and the specific barriers to designing the right intervention programs. However, the Wilcox study was confined to females of certain age groups; future research needs to extend to men and women, and include the age group of 18 and over.

Australian studies, generally, have not distinguished between barriers and facilitators to physical activity participation in the one instrument. Moreover, regional settings have not been the focus in any of the studies thus far. Instead, the focus has been predominantly on different age groups and genders. In addition, similar studies conducted in other countries have not classified the barriers according to systematic classification. Therefore, it is necessary to develop a new instrument according to barriers such as environment, psychosocial, patient perception, personal, health, physicians' lack of emphasis, and program accessibility.

The findings of Booth et al. (2000) could be generalised if this study had used regional and rural samples with similar variables. Furthermore, Booth et al., Bauman and Owen (1999) and Ball, Bauman, Leslie, and Owen (2001) have not examined barriers to physical activity participation in different geographical locations in Australia. These research gaps need to be examined in detail if effective and successful intervention programs are to be designed to address the needs of Australian regional and rural communities.

Physical Activity Models

As the advantages of moderate intensity physical activity have became widely recognised and understood, there is a need to concentrate on interventions that might effectively promote such activity (USDHHS, 1996). Although there has been considerable social science research into issues surrounding physical activity participation, this has, in the past, focused more on developing theories and models to understand the behaviour, rather than to serve as an intervention (USDHHS, 1996). This review investigates the following models: the Ecological Model (McLeroy et al., 1988), Social Cognitive Theory (Bandura, 1986), the Transtheoretical Model (Prochaska &

DiClemente, 1982, 1984), (Other theories and models developed around this subject include Classical Learning Theory, Relapse Prevention, and Social Support.)

ECOLOGICAL MODEL

Ecological and socioecological models (see Figure 3) arose from the sociological, psychological, educational, and public health fields (Green, Richard, & Potvin, 1996). Ecological models are defined by their acknowledgment of physical environments, interpersonal variables, and interpersonal and cultural factors as mediators of intervention effects (Sallis & Owen, 1996). The use of the term 'ecological' is a reference to this transaction between the individual and their sociocultural and physical environments (Sallis & Owen). McLeroy et al. (1988) identified five areas of influence that affect an individual's participation in physical activity: individual, interpersonal, organisational, community, and public policy.

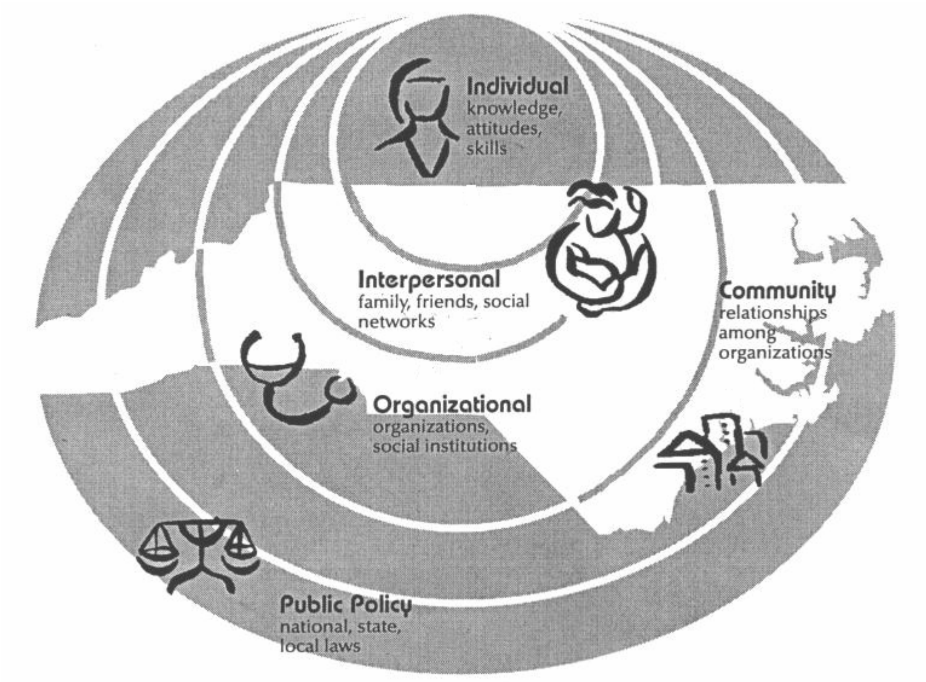


Figure 3
Socioecological Model

From: *WISEWOMAN Manual*, University of North Carolina (2002).

(Retrieved September, 2003, from http://www.hpdp.unc.edu/WISEWOMAN/chapter6.pdf)

Individual

A great deal is already known about the influences on an individual's participation in physical activity associated with adopting and maintaining regular exercise (Baker, Brennan, Brownson, & Housemann, 2000). Individual influences are the individual's own knowledge, attitudes, behaviour, self-concept, and skills regarding physical activity. This incorporates Bandura's Social Cognitive Theory (1998), which shares some features with the ecological models and has been at least as influential as any other theory in health behaviour research (Sallis & Owen, 1996). This is discussed later, in detail, under the social cognitive theory section.

Interpersonal

Interpersonal factors are the strongest determinants influencing adult physical activity, and are found in social supports from family, friends, work and social networks, and program staff (Sallis & Owen, 1996). Previous studies have examined the relationship between social supports and physical activity participation (Booth et al., 1997; Eyler et al., 1999). Eyler et al. have shown the importance of social support in enhancing physical activity. Booth et al. examined the effect of social support from family and friends on participation in physical activity. The study found that women (rather than men) preferred to exercise with a group of people. In addition, younger respondents (up to age 39) were much more likely than older respondents (aged 60 years and older) to prefer group exercise. Eyler et al. investigated physical activity patterns and social support in a United States study. They found that social support from friends and family significantly influenced physical activity participation. The findings also showed that family support was a stronger influence than support from friends.

Organisational

Organisational influences come from institutions and organisations such as workplaces, schools, and health care settings. These have the ability to affect large numbers of people, and to use interventions that promote an environment that is more conducive to physical activity to greater potential (King et al., 1995). Access to exercise facilities such as walking trails, swimming pools, and gyms have shown positive effects on physical activity behaviour pattern (Brownson, 1998; Sallis et al., 1989). Brownson et al. (2000) investigated environment and policy approach to physical activity such as walking trail construction and promotion. This study was conducted in twelve rural counties in the state of Missouri. The study concluded that community walking trails may be beneficial in promoting physical activity among those segments of the population most at risk for inactivity, in particular women and people in lower socioeconomic groups.

Community

The level of an individual's participation in physical activity can be affected by community influences, such as existing community norms and expectations, and the mass media (Will, 1998), as well as the network of organisational, institutional, and social relationships (Sallis, Bauman, & Pratt, 1998).

Public Policy

Public Policy (legislative, regulatory, or policy-making actions on a local, state, or national level) is considered to be a sociocultural influence because it is often framed to respond to the perceived needs or desire of their constituents (Sallis et al., 1998).

Previous studies have investigated the application of the socioecological model to health promotion behaviour. Will (1998) conducted a theory-based intervention program using this model in the North Carolina Cardiovascular Health Program. For this program, to prevent heart disease and stroke, low-income females aged 65 years and over were recruited from North Carolina between 1999 and 2003. The program addressed a range of policy and environment conditions that influence an individual's dietary, physical activity, and tobacco-related behaviour. Intervention strategies were used, such as face-to-face counselling, behaviour change focused media, established community and neighbourhood walking groups, walking trails, and helping worksites to provide for physical activity (e.g. the provision of showers and exercise rooms).

SOCIAL COGNITIVE THEORY

The framework of social cognitive theory, devised by Bandura in 1986, rests on the behavioural determinants of self-efficacy, outcome expectation, observational learning, reciprocal determinants, reinforcement, and behavioural capacity (USDHHS, 1996), with the three basic cognitive mediating processes, according to Bandura, being self-efficacy, outcome expectancy, and outcome value (Buckworth & Dishman, 2002).

Self-efficacy is the level of confidence possessed by an individual about their ability to perform the required exercise behaviour (Buckworth & Dishman, 2002). Sources of self-efficacy are mastery of experience (the experience of carrying out a task successfully), vicarious experience (modelling or observation of others' activities), verbal persuasion (encouragement of positive feedback), and physiological or psychological arousal (perceived exertion) (Buckworth & Dishman).

McAuley and Mihalko (1998) identified four basic operational definitions of self-efficacy: exercise efficacy, barriers efficacy, disease-specific efficacy, and health behaviour efficacy. *Exercise efficacy* is the individual's belief in their ability to undertake (successfully) increasing bouts of physical activity; for example, the respondent could be asked about their efficacy for engaging in physical activity at varying intensities and for different durations. *Barriers efficacy* is an individual's belief in their ability to overcome any obstacles—such as social (e.g., lack of encouragement), personal (e.g., reduced motivation), or environmental (e.g., bad weather)—that deter them from undertaking the physical activity. (A specific type of barriers efficacy is *scheduling efficacy*, which reflects the confidence the individual has in being able to fit physical activity into their regular routine.) *Disease-specific efficacy* is the assessment of efficacy beliefs within a specific population engaged in disease prevention or treatment through exercise rehabilitation, such as an arthritis program. *Health behaviour efficacy* is the individual's belief in their capability to engage in health promoting behaviour.

Many studies have been applied to and support self-efficacy as a predictor of physical activity participation among various population groups and in various interventions (e.g., Brassington et al., 2002; McAuley, 1992; McAuley, Jerome, Marquez, Elavsky, & Blissmer, 2003; McAuley & Mihalko, 1998). In an Australian study, Booth et al. (2000) found that active older adults showed greater self-efficacy (48%) compared to inactive respondents (26%). In addition, in a review of over 300 studies on the determinants of physical activity participation, Sallis and Owen (1999) reported that self-efficacy was consistently associated with overall physical activity behaviour. In a series of studies, McAuley and his colleagues (Courney & McAuley, 1994; McAuley, 1990; McAuley, 1993; Rudolph & McAuley, 1995) observed that an individual's belief in their personal capacity to successfully engage in incremental bouts of physical activity (i.e., exercise self-efficacy) is related to frequency of participation as well as adherence to exercise programs and/or a more physically active life. In addition, Marcus and colleagues (Marcus & Owen, 1992; Marcus, Pinto et al., 1994; Marcus, Selby, Niaura, & Rossi, 1992) have found that barriers efficacy varied across the stages of change, and that individuals at later stages (maintenance, termination), exhibited higher levels of self-efficacy. Exercise efficacy and barriers efficacy also seem to be related to not just the behaviour of physical activity, but also the intention to increase the physical activity (Biddle, Goudas, & Page, 1994; DuCharme & Brawley, 1995; Fruin, Pratt, & Owen, 1991; Poag-DuCharme & Brawley, 1993).

TRANSTHEORETICAL MODEL

The transtheoretical model describes the adoption and maintenance of health behaviour as a process that occurs through a series of behavioural and motivationally-defined stages: precontemplation, contemplation, preparation, action, and maintenance.

Individuals are usually considered to be in the *precontemplation stage* when they are inactive, have no intention of starting exercising, are not seriously thinking about changing their level of exercise within the next six months, or are denying the need to change. In this stage, people do not want to change their behaviour, and often focus on barriers such as lack of time. Prochaska and Marcus (1994) further defined precontemplation as 'I won't' or 'I can't'. They suggested that the most valuable action in this stage is to educate individuals about the problem behaviour and encourage them to start them thinking about becoming healthier. Reed (1999) suggested that, in this stage, it is important that non-believers be made aware of and learn to appreciate the advantages or benefits of physical activity. In the *contemplation stage*, although individuals are inactive, they intend to start regular exercise within the next six months. In the *preparation stage*, individuals are not exercising at the criterion level (typically defined as at least three times per week for 20 minutes or longer), but they do intend to become more active in the near future (within 30 days). The *action stage* sees individuals engaging in regular exercise at the criterion level, but for a period of less than six months. However, although their motivation and investment in behaviour change are sufficient, and the perceived benefits are greater than the perceived cost, they are at the greatest risk of a relapse in this stage. Individuals in the *maintenance stage* have been exercising regularly for more than six months. Their exercise behaviour is more established than in the other stages, and so the risk of a relapse is low.

Across these stages, behavioural change is influenced by three constructs: *self-efficacy* (incorporated from the social cognitive theory), *decisional balance* (evaluation of the pros and cons of the target behaviour), and *processes of change* (strategies used for changing the behaviour). *Self-efficacy* is generally lowest in the early stages (predominantly, the precontemplation stage), and higher in each subsequent stage, with the highest exercise self-efficacy seen in the maintenance stage (Buckworth & Dishman, 2002). It has been reported that exercise self-efficacy increases as an individual progresses from an entrenched sedentary lifestyle to long-term maintenance of regular exercise (Marcus et al., 1994; Sallis, Hovell & Hofstetter, & Barrington, 1992). In an Australian study of adults aged 50–60, Gorel and Gordon (1995) found that self-efficacy to overcome exercise barriers increased in an ordered process from precontemplation, to contemplation, to preparation, to action, and, finally, to maintenance. *Decisional balance*, based on the decision theory of Janis and Mann (1977), is a construct whereby changes in behaviour are influenced by perceived costs and benefits to oneself and significant others. This is also applicable to exercise behaviour, where the relationship between the costs and benefits of exercise and stages of exercise generally shows that the pros increase and the cons decrease with the progression to each stage, particularly during the precontemplation and contemplation stages (Buckworth & Dishman). The strategies used for changing the behaviour as the individual progresses through the various stages are termed the *processes of change*. These can be divided into cognitive/experimental and behavioural processes. Cognitive/experimental processes (more common in the preparation stage) are the way in which relevant information is gathered on the basis of an individual's action or experience; for example, re-evaluating the cost of inactivity. Behavioural processes (more common in the action and maintenance stages) are the way in which information is produced by environmental events and behaviour; for example, stimulus control and reinforcement control (Berger, Pargman, & Weinberg, 2002).

In the U.S. project *Physical Activity for Life,* Pinto et al. (2001) examined theory-based interventions for behavioural change using the transtheoretical model, social cognitive theory, constrictive decisional balance, self-efficacy, and behavioural and cognitive process of changes. For this study, 181 women aged 50 years and over were recruited as participants for intervention, with 174 as a control group. The study was conducted through community-based primary care practices, which were randomly assigned to the intervention or control condition. Intervention was carried out through counselling by primary care physicians, through transtheoretical theory, incorporating principals of social cognitive principles, and health education theory. Intervention baseline assessments were carried out at 6 weeks and 8 months. The findings suggested that among older adults intervention of greater intensity and duration may be necessary for sustained changes in mediators and motivational readiness for physical activity. Similar studies conducted by Marcus, Bock, and Pinto (1998) and Dunn, Marcus, and Kampart (1999) showed a positive effect on the stage of motivational readiness based on the transtheoretical model.

Limitations of the Transtheoretical Model

The framework of the transtheoretical model has been applied frequently in health promotion research, but often without proper validation. Culos-Reed, Gyurcsik, and Brawley (2001) noted a willingness by researchers to apply this model without having the evidence that would usually be required in the field of behavioural sciences. In addition, Joseph, Breslin, and Skinner (1997) identified five limitations of TTM (see Culos-Reed et al.):

- Research does not support six of the changes as a robust construct.
- Support for the relationship between the processes of change and the stages of change is equivocal.
- The transtheoretical model is mostly descriptive, as opposed to explanatory—for example, the characters within the stage are described but causal processes are not tested.
- The transtheoretical model fails to include the influence of moderator variables—for example, gender, age, and ethnicity.
- The integrating of various theories—for example, self-efficacy, decisional balance—to develop the transtheoretical model places these theories at odds with each other within the transtheoretical model.

Summary

From the literature review, it is evident that researchers have examined in detail the many important issues surrounding the relationship between levels of physical activity and CHD in Australia. The research has also identified and investigated the factors that promote or inhibit increased participation in physical activity, although the number of studies examining issues of population attributable risk (PAR) and public health care cost attributable to inactivity have been limited.

Unfortunately, most of the literature has focused on these issues from a state or national perspective. What is seriously lacking in the research is data on levels of physical activity, the barriers and facilitators affecting participation in physical activity, and the population attributable risk and public health care cost attributable to this physical inactivity in regional and rural populations. The theoretical framework of this study has been designed to address these research gaps by concentrating on the psychological, psychosocial, and physical environment variables that underlie these barriers and facilitators, and investigating the PAR and public health care cost of inactivity attributable to CHD and overall morbidity reduction in an Australian regional setting.

The present study has developed a mail survey based on the instrument used for the Active Australia Baseline Survey (ASC, 1998). That survey was carried out through computer-assisted telephone interviews (CATD) and face-to-face interviews. The instrument developed for the present study provides a cost effective way of measuring self-reported physical activity in a population setting.

Further research will not only assist in reducing the research gaps evident in the literature, but it will also provide the means to bring about an increase in physical activity participation. The data collected will be of vital importance in the design and implementation of regional-specific physical activity programs, with the aim of decreasing CHD related conditions and overall morbidity, and improving the general health and well-being of the targeted communities.

METHODOLOGY

Research Aims

This study aims to investigate physical activity participation by adults in the regional city of Ballarat by examining: the current levels of physical activity and how these compare with the overall Australian adult population; the PAR for physical inactivity and CHD, NIDDM, colon cancer, stroke, breast cancer and all-cause mortality; the current cost of CHD, and stroke, attributable to physical inactivity; the major determinants of physical activity participation; and the theoretical models most relevant for the design and implementation of any targeted intervention programs.

Research Approach Overview

Quantitative data collection methods were used to meet the objectives of the study as they are more deductive and provide data that is reliable, outcome-oriented and more able to be generalised (Steckler, McLeroy, Goodman, Bird, & McCormick, 1992). The particular instrument used by previous researchers to investigate physical activity participation rates (Armstrong et al., 2000) was administered through a telephone survey. Due to the higher cost of the telephone survey technique (Lewis-Beck, 1994, p. 68), the current study used a mail survey. The advantages of the mail survey are that the cost is low, and the ability to reach geographical components is very high. Most importantly, however, compared to other data collection techniques (such as personally-administered questionnaires and telephone questionnaires), mail questionnaires rate well in regard to obtaining the hard-to-recall data this survey was aiming to collect (Frazer & Lawley, 2000, p. 3).

Selection of Participants

POPULATION

For the survey, 3,600 residents aged 18 and over were randomly selected from the Ballarat East and Ballarat West listings of the Victorian state electoral roll. The electoral roll was made available in CD-ROM format at the City of Ballarat. A random sample was drawn from a random number list generated by Microsoft Excel. A return rate of 33% was estimated to obtain 95% confidence interval of ±3% (Mendenhall, Beaver & Beaver, 1999). The stratified random sampling methodology ensured that each person 18 years and over in the population had an equal chance of being selected to participate in the study (Anderson, 1989). The survey was conducted in the regional city of Ballarat, between 25 March 2002 and 14 May 2002. This particular time of the year (autumn) was chosen to reduce any weather bias that might affect response rates.

Instrument and Procedure

CONSTRUCTION OF THE INSTRUMENT

This survey was constructed from the instrument that was developed for the 1997 Active Australia Survey (ASC, 1998) and used for the 1999 (Armstrong et al., 2000) and 2000 (Bauman et al., 2001) national physical activity surveys. The 'Understanding of the physical activity message' question was omitted from the instrument. The intention to be physically active (self-efficacy); Knowledge of physical activity recommendations; Confidence in being physically active, and Social support for physically active questions have been adapted from Active Australian Survey(ASC, 1998) and used for the 1999 (Armstrong et al., 2000) and 2000 (Bauman et al., 2001) national physical activity surveys. Two additional questions from the Canadian Fitness Survey were included to assess barriers and facilitators for physical activity (Canadian Fitness and Lifestyle Research Institute, 1983, cited in Pereira et al., 1997). The 'Work related physical activity' question was adapted from the Physical Activity Health Branch, Division of Nutrition and Physical Activity Survey (USDHHS, 2001). In general, however, questionnaires are considered to be moderately reliable for most measures of physical activity (Weller & Corey, 1998). The *Active Australia* survey has been shown to have moderate to very good test-retest agreement, with the intra-class correlation coefficients ranging from 0.6 to 0.8; therefore, this instrument was judged to be appropriate in meeting the objectives of the entire study (Bull, 2000, cited in Armstrong et al., 2000).

The survey (see Appendix 1) was administered as a booklet, and was divided into 14 major sections to meet the research objectives by examining the following areas:

- Walking undertaken in the previous week for recreation, exercise or transport (section 1)
- Vigorous household chores undertaken in the previous week (section 2)
- Vigorous gardening or yard work undertaken in the previous week (section 3)
- Vigorous physical activity (section 4)
- Moderate physical activity (section 5)
- Physical activity undertaken in the previous six months (section 6)
- Physical activity undertaken as part of respondent's occupation (section 7)
- Television/video watching and recreational computer use (section 8)
- Intention to be physically active (section 9)
- Knowledge of physical activity recommendations (section 10)
- Confidence in being physically active (section 11)
- Barriers and facilitators affecting increased participation in activity (section 12)
- Social support available for participation in physical activity (section 13)

- Demographic information (gender, age, marital status, weight and height, household composition, education levels, occupational status (section 14)

EXTERNAL INPUT INTO THE QUESTIONNAIRE

The telephone survey was converted into a mail questionnaire design with administration based on Frazer and Lawley (2000, pp. 35–40), and a structure similar to the 1983 Canadian Fitness Survey published in *A Collection of Physical Activity Questionnaires* (Pereira et al., 1997, pp. S153–S161).

Once the instrument was ready, it was forwarded to key subject matter experts for their critical appraisal. The subject matter experts included the Health Promotion Coordinator for the Central Highlands Primary Care Partnership; the Manager of Primary Care for the Department of Human Services, Victoria, Grampians Region; and Prof. Adrian Bauman, chair of the Active Australia Survey Expert Working Group. The research project was approved by the University of Ballarat Human Research Ethics Committee (Project Number 02/04).

PILOT STUDIES

Because the instrument was originally designed to be used as a telephone survey, three pilot studies were conducted to test its efficacy.

For the first pilot study, 12 questionnaires were distributed randomly to males and females through student administration and the accommodation service at the University of Ballarat. Thirteen draft questionnaires were also distributed randomly to selected non-academic and other academic staff through the payroll office. Three completed questionnaires from students and 10 from non-academic and academic staff were returned with suggestions.

The second pilot study was undertaken within the School of Human Movement and Sport Sciences, with 25 staff members participating in, completing, and critiquing the survey. Ten surveys were returned with comments, and modifications were undertaken accordingly.

The third pilot study was undertaken in Ballarat. Actual surveys were sent to 50 participants, who were randomly selected from 3,600 East and West Ballarat) in order to assess the likely response rate. The response rate was 55%.

Data Collection

ADMINISTRATION AND PROCEDURES

A total of 3,600 surveys with return envelopes were mailed to potential participants. The distribution of the survey was carried out from 18–25 March 2002.

SURVEY PROMOTION

The promotion of the survey was conducted in three phases: (1) during the period of distribution; (2) while participants filled in the survey; and (3) the week prior to the closing date of the survey. In addition to this, reminders were sent during the media intervention.

In the first phase, promotion was conducted through ABC regional Victorian radio. Radio interviews were undertaken, where the objectives of the survey and the issues surrounding confidentiality were outlined. Ten days following the radio promotion, recipients were mailed a postcard (see Appendix 2). The second phase of promotion was conducted through the print media. The local Ballarat newspaper, *The Courier*, was selected to publish a detailed article on the survey, which explained background information, the value of the data, and future expectations of results. The third and final promotional phase was carried out through television media. WIN Television (Ballarat) provided news coverage by interviewing the researchers extensively about the physical activity survey. The network also promoted the survey on several occasions prior to their main news bulletin. A final reminder card was sent to recipients immediately after the television coverage in order to ensure maximum possible participation and return rate. Figure 4 shows the effects of different models of media and return rates.

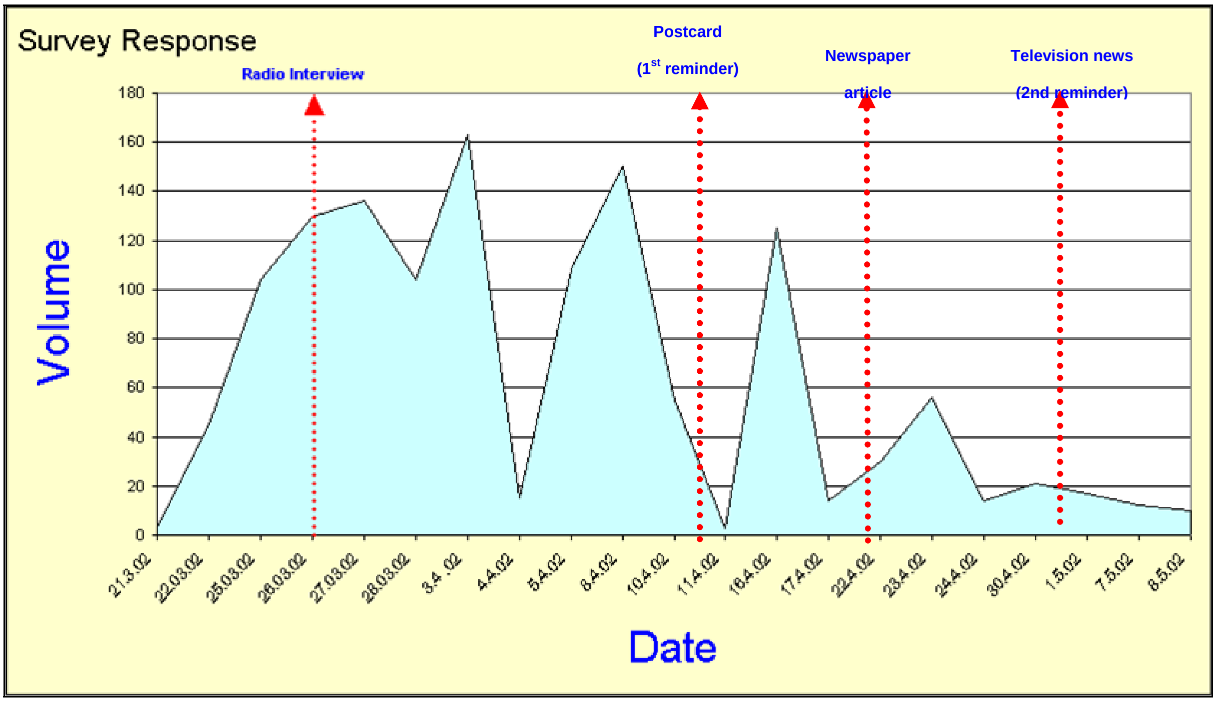


Figure 4
Survey Response Pattern

RESPONSE RATE

Of the 3,600 surveys sent out, 244 surveys were returned uncompleted; 181 were discounted because the addressee no longer lived at the address or declined participation due to medical or personal reasons; and 101 surveys were identified as incomplete in the data analysis phase. After removing those surveys which were discounted due to unknown address, the sample was reduced to 3,419. Of these, 1,344 were returned, giving a return rate of 39.3%.

RECRUITMENT OF DATA ENTRY PERSONNEL AND ENTERING OF DATA

The names and addresses of potential data entry personnel were obtained from the Human Resources section at the University of Ballarat. To ensure the most accurate data recording, two experienced data entry personnel were tested with a speed and accuracy test using Microsoft Word and Microsoft Excel. The applicant who obtained 98% accuracy was recruited for this project.

Data entry was completed as the surveys were received to avoid unnecessary delay and to keep within the time frame. To ensure confidentiality, the data entry was completed at a place designated by the School. Data were entered using an Excel format template according to the variable labels. To ensure the accuracy of the data entry, the initial 100 surveys were randomly re-examined. Once the data entry was concluded, every fifth survey was randomly assessed for accuracy. A level of accuracy of 99% was achieved.

Data Management

Results obtained from each question of the survey were coded into an acceptable form suitable for the SPSS statistical package. The data were then cleaned, recoded as prescribed by the *Active Australia* manual published by the Australian Institute for Health and Welfare (AIHW, 2003). For numerical variables that were categorised into ranges (e.g., 1-10 mins, 11-20 mins), the midpoints of the ranges were used in the following calculations.

- Total time in activity overall was calculated by adding the time spent in walking and moderate activity and double the time spent in vigorous activity (not including gardening and yard work).
- The time spent in vigorous activity was doubled because vigorous activity is more intense and so confers greater health benefits than moderate activity (Armstrong et al., 2000).
- A sufficient level of physical activity was defined as at least 150 minutes of activity over at least five sessions per week; anything less was defined as insufficiently active.
- The overall analysis of the numerical variables were analysed in descriptive statistics and the important categorical variables were analysed using cross-tabulation and chi–square tests.
- Logistic regression identified the important factors that distinguished between insufficient and sufficient activity.
- Body mass index (BMI) is a measure of a person's weight in relation to their height (calculated as weight in kilograms divided by height in metres squared) (WHO, 1998).

Data Analysis

The data entered using the Microsoft Excel template was transferred to SPSS version 10, and data analysis was undertaken. In the initial stage, screening and cleaning of data were carried out to avoid errors in the analysis (Pallant, 2001). The survey information was summarised through the production of descriptive statistics in order to gain an overall understanding of the data for quantitative inquiry (Thomas & Brubaker, 2000, p. 194). In the initial analysis, percentage mean and percentiles were measured to identify ‘the sort of research questions the statistic is designed to answer’ (Thomas & Brubaker, p. 194). It can be seen that total number of responses for each question differ. This is because some respondents did not answer all questions. In the analysis stage, the SPSS statistics package automatically removed these respondents from the analysis.

The data have being analysed according to the methodology and physical activity patterns of Australian adults used in the 1999 National Physical Activity Survey by Armstrong et al. (2000). The data were then cross-tabulated with frequency analysis carried out and chi-square tests undertaken (Taylor, 2000). The chi-square tests were applied to insufficiently active, sufficiently active, demographic profiles, intention to be physically active, knowledge of physical activity recommendations, barriers to participate in more physical activity, facilitators to physical activity participation, family support and friends support. In addition, these elements were compared across each of the nine electoral wards in the City of Ballarat. Due to the large number of chi-square tests, the Bonferroni correction factor was employed. This meant that the level of significance for all chi-square tests was a P value equal to .000. For the purposes of comparing the BPAS with the NPAS, the 75+ age group was removed because the NPAS did not include such an age group in their analysis. The results were further analysed using logistic regression and odds ratios to determine which of the variables were most significant in order to distinguish insufficient and sufficient levels of activity.

Calculation of PAR and Public Health Cost of Inactivity

The current study was carried out to estimate the PAR based on the method used by Stephenson et al. (2000). The cost of illness attributable to physical inactivity was calculated using methodology based on Stephenson et al. (2000) and Mathers et al. (1998).

In order to establish the number of inpatient hospital episodes for each of the clinical specialties—cardiology, cardiothoracic surgery, and vascular surgery—the Victorian Admitted Episodes Data (VAED) for FY 2000/2001 were analysed. The VAED includes all inpatient hospital cases performed in public and private hospitals. The sample was confined to the Local Government Area of (the City) of Ballarat.

In order to establish the average cost of each case, the data from the Victorian Casemix Cost Weight study for the 2000/2001 financial year were used. This study is based on the average cost of around 400,000 inpatient cases performed in public hospitals for that period. Details of the Casemix methodology relevant to this cost weight study are reproduced in Appendix 4.

Using the information on the number of cases for the particular specialists and the average cost estimate for each of these cases, the total cost of inpatient episodes was calculated. The estimates for outpatient cost, paramedical cost and so on were calculated (using information available from Mathers and Penm [1998, Table 3]) by considering these costs as a proportion of total costs. In a similar way, the total cost for coronary heart disease information was determined using information available from Stephenson et al. (2000, Table 6) and stroke (Table 9).

RESULTS

This section presents the results of the 2002 Ballarat Physical Activity Survey (BPAS). These results have been compared, where relevant, with the 1999 National Physical Activity Survey (NPAS) reported by Armstrong et al. (2000). The data presented cover six main areas:

- Demographic profiles of BPAS and NPAS respondents
- Physical activity patterns of BPAS and NPAS respondents
- Physical activity levels of BPAS respondents
- Population attributable risk (PAR) and the cost of inactivity in Ballarat
- Physical activity barriers and facilitators of BPAS respondents
- Factors predicting physical activity participation in Ballarat

Demographic Profiles of BPAS and NPAS Respondents

AGE AND GENDER

Table 1 shows BPAS and NPAS respondents by age group and gender, together with related population figures from the Australian Bureau of Statistics (ABS). The BPAS respondents were not fully representative of the Ballarat population (see note to Table 1), so the data have been weighted to accurately represent the age distribution of the adult Ballarat population. The data have also been corrected—the corrected values are shown in brackets—to enable comparison with the Australia data, which did not include the 75+ age group.

The major differences between the BPAS and the NPAS are that the BPAS included a substantially larger number of older females, a lower proportion of males and females in the 30–44 age group, fewer younger males, and a larger number of older males than the NPAS.

Table 1
Age and Gender, BPAS & NPAS

Age (Years)	2002 BPAS*	2002 BP+	1999 NPAS#	1999 AP†
18-29				
Male	15.0 (16.3)	24.8 (26.5)	25.7	25.8
Female	15.0 (16.5)	23.5 (25.1)	26.0	25.5
30-44				
Male	28.0 (30.4)	29.3 (31.4)	33.2	32.7
Female	29.0 (31.9)	27.7 (29.5)	33.1	32.8
45-59				
Male	25.0 (27.2)	24.5 (26.3)	24.6	25.7
Female	30.0 (33.0)	22.5 (24.0)	25.0	25.4
60-75				
Male	24.0 (26.1)	14.0 (15.0)	16.5	15.8
Female	17.0 (22.5)	22.5 (24.0)	15.9	16.3
75+				
Male	8.0	6.7	–	–
Female	9.0	6.2	–	–
Total				
Male	100.0	100.0	100.0	100.0
Female	100.0	100.0	100.0	100.0

Note: Data in brackets have been corrected to exclude the 75+ age group surveyed in the BPAS to allow comparison with the NPAS, which did not survey this age group.

*BPAS = Ballarat Physical Activity Survey; +BP = Ballarat population (ABS, 2002) #NPAS = National Physical Activity Survey; †AP = Australian population (ABS, 1999)

CHILDREN IN HOUSEHOLD

Table 2 shows the percentage of children in respondents' households. There were fewer children (in both the under 5 years and under 18 years age groups) in the households of BPAS respondents than households of NPAS respondents.

Table 2
Number of Children in Household, BPAS & NPAS

	BPAS (%)	NPAS (%)
Children (aged 5 years or under)		
Nil	85.4	80.9
1 or more	14.6	19.1
Total	100.0	100.0
Children (less than 18 years)		
Nil	66.0	56.9
1 or more	34.0	43.1
Total	100.0	100.0

LANGUAGE, MARITAL STATUS, EDUCATION, OCCUPATION

Table 3 reveals more BPAS respondents than NPAS respondents used English as their main language. The marital status of respondents to both surveys was not noticeably different. BPAS respondents had less formal education—21% had completed VCE or equivalent, and approximately 36% continued on to tertiary education. The BPAS data show a slightly higher student population. This could be explained by the presence of a number of tertiary institutions in Ballarat. Substantially more BPAS respondents (25%) were blue-collar workers compared to the NPAS (8%), and fewer BPAS respondents (13%) were managers/administrators compared to NPAS respondents (33%).

Table 3

Main Language, Marital, Educational, Occupational Status, BPAS & NPAS

	BPAS (%)	NPAS (%)
Main language spoken at home		
English	100.0	94.4
Other	0.0	5.6
Total	100.0	100.0
Marital status		
Never married/single	28.2	27.8
Married/de facto	66.8	69.1
Widowed	4.6	3.0
Total	100.0	100.0
Education level		
Less than 12 years	43.2	37.0
VCE	20.5	38.0
Tertiary	36.5	25.0
Total	100.0	100.0
Occupational status		
Manager/Administrator	12.8	32.6
While collar*	17.2	25.0
Home duties	19.3	14.1
Retired	15.5	11.9
Blue collar+	24.5	8.5
Student	6.8	4.6
Unemployed	4.0	3.2
Total	100.0	100.0

*White collar: Professional, Para-professional

+Blue collar: Tradesperson, Clerk, Salesperson, Personal service worker, Plant & machine operator/driver, Labourer

BODY MASS INDEX (BMI)

A greater number of BPAS respondents were underweight, overweight, or obese. The percentage of respondents in the healthy weight range was lower for BPAS respondents across all categories. The BMI data in Table 4 are based on self-reported weight and height.

Table 4
BMI Categories by Age, Gender, Education Level, BPAS & NPAS

	Underweight* (%)		Healthy Weight+ (%)		Overweight# (%)		Obese† (%)	
	BPAS	NPAS	BPAS	NPAS	BPAS	NPAS	BPAS	NPAS
Gender								
Men	4.5	1.7	40.0	46.9	40.7	39.5	14.8	11.9
Women	9.6	4.2	40.5	59.0	27.6	24.0	16.3	12.7
Age Group (Years)								
18-29	5.8	7.5	53.1	65.9	28.5	19.8	12.6	6.8
30-44	6.9	1.9	45.2	53.1	33.5	32.9	14.4	12.2
45-59	7.6	0.8	39.4	46.0	35.4	36.9	17.7	16.3
60-75	10.2	1.5	34.7	42.8	36.1	40.5	19.0	15.2
Education level								
Less than 12 yrs	8.2	2.5	36.4	46.9	37.7	35.5	17.7	15.2
VCE or equivalent	8.7	3.7	49.5	55.6	26.1	28.1	15.6	12.7
Tertiary	4.9	2.9	49.4	57.7	32.7	31.8	13.0	7.7

Note: For purposes of comparison with the NPAS, the 75+ age group surveyed in the BPAS is not included here.

*Underweight: BMI 18; +Normal weight: BMI 18.5 to 25; #Overweight: BMI 25 to 30; †Obese: BMI >30 (WHO, 1998)

Physical Activity Patterns in BPAS and NPAS

The physical activity patterns of respondents in both surveys were compared across the following areas:

- Sessions of physical activity by gender (Table 5)
- Sessions of physical activity by age (Table 6)
- Total time (minutes) of physical activity (Table 7)
- Mean minutes of physical activity by age and gender (Table 8)
- Categories of physical activity by gender, age and education (Table 9)

SESSIONS OF PHYSICAL ACTIVITY BY GENDER

Table 5 shows the number of sessions for each category of physical activity participation by male and female respondents during the previous week. The BPAS respondents reported a higher incidence of walking (three or more times a week) compared to the NPAS average, within both male and female groups.

A higher proportion of the BPAS respondents, both male and female, participated in more than one session of vigorous-intensity physical activity in comparison to the NPAS average. Lastly, BPAS respondents engaged in more sessions of vigorous-intensity-gardening than NPAS respondents, and this applied to both males and females (see Table 8).

Table 5

Sessions of Physical Activity in Previous Week by Gender, BPAS & NPAS

	Men		Women		Total	
	BPAS	NPAS	BPAS	NPAS	BPAS	NPAS
Walking						
Nil	14.3	31.5	8.1	24.2	10.7	27.8
1-2	19.1	17.7	17.9	19.3	18.4	18.5
3-4	23.1	16.6	28.3	20.5	26.3	18.6
5 or more	43.1	34.2	45.7	36.0	44.6	35.1
Total	100	100	100	100	100	100
Moderate-intensity*						
Nil	65.7	67.2	74.1	75.6	70.6	71.4
1-2	19.2	22.0	19.2	14.9	19.2	18.4
3-4	9.9	6.1	4.9	5.2	7.0	5.7
5 or more	5.2	4.7	1.7	4.3	3.2	4.5
Total	100	100	100	100	100	100
Vigorous-intensity#						
Nil	38.8	59.1	48.7	65.4	44.6	62.3
1-2	24.2	19.1	22.3	19.0	23.1	19.1
3-4	17.0	10.6	15.4	9.2	16.1	9.9
5 or more	20.0	11.1	13.5	6.4	16.3	8.7
Total	100	100	100	100	100	100
Vigorous-intensity gardening/yard work						
Nil	38.8	54.0	44.9	60.5	42.3	57.3
1-2	37.7	32.8	38.1	30.0	38.0	31.4
3-4	14.1	7.3	10.9	5.4	12.2	6.3
5 or more	9.3	5.9	6.1	4.1	7.5	5.0
Total	100	100	100	100	100	100

Note: For purposes of comparison with the NPAS, the 75+ age group surveyed in the BPAS is not included here.

* Examples of moderate-intensity activities: gentle swimming, social tennis.

Examples of vigorous-intensity activities: jogging, cycling, aerobic exercises, competitive tennis

TOTAL SESSIONS SPENT IN ACTIVITY BY AGE GROUP

Table 6 details physical activity levels of respondents according to age group. BPAS respondents reported spending more time on walking across all age groups except for the 45–59 year age group. BPAS and NPAS respondents reported similar levels of moderate-intensity activity, although levels of vigorous-intensity and vigorous-intensity gardening/yard work were higher among BPAS respondents across all age groups.

Table 6

Sessions of Physical Activity in Previous Week by Age, BPAS & NPAS

	18-29		30-44		45-59		60-75	
	BPAS	NPAS	BPAS	NPAS	BPAS	NPAS	BPAS	NPAS
Walking								
Nil	7.5	20.0	11.9	31.6	10.5	10.3	13.3	30.2
1-2	20.1	20.5	18.3	19.8	17.4	17.0	17.1	13.6
3-4	32.8	19.3	26.3	17.9	23.2	23.4	21.9	19.1
5 or more	39.6	40.2	43.4	30.8	48.9	49.3	47.6	37.1
Total	100.0	100.0	100.0	100.0	100	100	100	100
Moderate-intensity+								
Nil	63.2	69.9	74.0	72.7	75.0	75.4	70.1	65.3
1-2	22.4	21.3	18.7	19.2	15.9	15.7	19.9	16.6
3-4	9.7	4.8	3.9	4.8	6.9	3.9	8.1	11.3
5 or more	4.7	4.0	3.3	3.3	2.2	4.9	1.9	6.9
Total	100	100	100	100	100	100	100	100
Vigorous-intensity#								
Nil	22.4	40.9	40.8	60.6	52.2	72.0	68.8	84.4
1-2	26.7	26.4	27.4	21.7	20.7	14.8	14.9	8.7
3-4	23.5	17.3	17.1	9.2	15.2	7.3	6.0	3.8
5 or more	27.4	15.5	15.1	8.5	12.0	5.8	10.2	3.0
Total	100	100	100	100	100	100	100	100
Vigorous-intensity gardening / yard work								
Nil	57.6	68.5	39.6	52.2	34.8	52.1	35.8	57.9
1-2	26.6	26.7	45.6	37.5	41.7	33.6	35.8	23.3
3-4	11.2	2.9	7.3	6.3	17.4	8.0	15.1	9.1
5 or more	4.7	1.9	7.6	4.4	6.2	6.2	13.2	9.7
Total	100	100	100	100	100	100	100	100

Note: For purposes of comparison with the NPAS, the 75+ age group surveyed in the BPAS is not included here.

+ Moderate-intensity activities examples are gentle swimming, social tennis.

Vigorous-intensity activities examples are jogging, cycling, aerobic exercises, and competitive tennis.

TOTAL TIME SPENT IN PHYSICAL ACTIVITY DURING PREVIOUS WEEK

Table 7 shows that BPAS and NPAS respondents reported that they spent more time walking than in any other activity. This was followed by vigorous-intensity gardening, vigorous-intensity activity, and moderate-intensity activity. The respondents to the BPAS spent more time participating in the majority of the physical activity categories, except for moderate-intensity physical activity, which was half the NPAS average. This applied to both the male and female populations (Table 8).

Table 7

Total Minutes Spent on Physical Activity in Previous Week, BPAS & NPAS

	Mean		75^{th} percentile		95^{th} percentile	
	BPAS	NPAS	BPAS	NPAS	BPAS	NPAS
Walking	142	114	210	170	390	420
Moderate-intensity	26	54	25	30	130	360
Vigorous-intensity	75	65	125	60	295	360
Vigorous gardening	125	77	170	90	455	420

Note: For purposes of comparison with the NPAS, the 75+ age group surveyed in the BPAS is not included here.

Adapted from *Physical activity patterns of Australian adults*, p. 27 (Table 6.3), by T. Armstrong, A Bauman, & J. Davies, 2000, Canberra: AIHW.

PHYSICAL ACTIVITY DURING PREVIOUS WEEK (MEAN MINUTES) BY AGE AND GENDER

Table 8 shows the mean minutes of physical activity undertaken by respondents during the previous week, by age group and gender. A general finding was that BPAS respondents (both male and female) walked for longer than the NPAS average. Although the male and female BPAS respondents in all age groups reported walking for longer periods than the NPAS average, they participated in less moderate-intensity physical activity than NPAS respondents. Apart from the 18–29 year age group, male and female BPAS respondents reported time spent participating in vigorous-intensity physical activity compared to NPAS respondents.

Table 8

Mean Minutes of Physical Activity in Previous Week by Age & Gender, BPAS & NPAS

	Male		Female	
	BPAS	NPAS	BPAS	NPAS
18-29				
Walking	147.6	111.3	141.3	132.1
Moderate-intensity	46.4	95.3	16.8	29.5
Vigorous-intensity	123.7	148.8	109.1	91.7
Vigorous-gardening	89.0	53.7	102.0	29.8
30-44				
Walking	142.4	98.1	137.6	110.4
Moderate-intensity	28.7	58.2	17.2	24.2
Vigorous-intensity	100.5	74.2	65.2	49.8
Vigorous-gardening	110.0	95.7	128.0	67.4
45-59				
Walking	141.6	98.0	160.1	122.5
Moderate-intensity	27.7	59.5	16.1	37.0
Vigorous-intensity	73.0	47.2	50.0	36.6
Vigorous-gardening	118.0	107.2	159.0	76.3
60-75				
Walking	148.8	146.1	126.0	112.5
Moderate-intensity	45.5	132.3	27.1	79.6
Vigorous-intensity	40.0	23.5	29.9	16.3
Vigorous-gardening	157.0	139.0	153.0	65.3
All Ages (excluding 75+)				
Walking	142.5	109.2	140.0	119.2
Moderate-intensity	36.5	70.6	18.2	38.1
Vigorous-intensity	77.7	78.8	56.9	51.1
Vigorous-gardening	116.0	94.5	125.8	59.6

Note: For purposes of comparison with the NPAS, the 75+ age group surveyed in the BPAS is not included here.

PHYSICAL ACTIVITY LEVELS OF SUFFICIENTLY AND INSUFFICIENTLY ACTIVE RESPONDENTS

Table 9 compares the patterns and trends of physical activity of respondents of both surveys, examining sedentary, insufficient, and sufficient physical activity according to gender, age and education. A larger percentage of BPAS respondents undertook sufficient physical activity, and this was consistent across categories of gender, age and education. The number of sedentary respondents was higher for the NPAS than the BPAS. Sedentariness increased as age increased for respondents of both surveys, and this was consistent across gender, age, and education categories. The percentage of BPAS respondents who participated in insufficient levels of physical activity was approximately the same as for the NPAS respondents, although the insufficient levels decreased for respondents to both surveys according to education level attained.

Table 9

Physical Activity Levels in Previous Week by Gender, Age and Education, BPAS & NPAS

	Sedentary (%)		Insufficient Activity (%)		Sufficient Activity (%)	
	BPAS	NPAS	BPAS	NPAS	BPAS	NPAS
Gender						
Men	5.0	14.6	25.0	25.9	70.0	59.6
Women	4.4	14.7	30.6	31.5	65.0	53.8
Persons	4.6	14.6	28.3	28.7	67.1	56.6
Age Group (yrs)						
18-29	2.3	6.3	18.4	25.0	79.1	68.7
30-44	3.4	16.9	30.1	29.6	66.4	53.5
45-59	6.2	18.2	29.8	31.9	63.9	50.0
60-75	8.8	17.9	34.5	28.1	56.6	54.1
Education						
Less than 12 yrs	7.7	19.5	32.8	30.9	59.5	49.6
VCE or equiv.	2.3	12.5	27.3	27.9	70.4	59.7
Tertiary	2.6	10.9	23.8	26.7	73.6	62.3

Note: For purposes of comparison with the NPAS, the 75+ age group surveyed in the BPAS is not included here.

MOTIVATIONAL READINESS

Table 10 displays motivational readiness to exercise. 'Do not intend' or 'Intend in next six months' was reported by 66% of NPAS and 62% of BPAS respondents. 'Intend next month' was reported by 37% of BPAS compared to 34% of NPAS respondents.

Table 10
Motivational Readiness to Exercise, BPAS & NPAS

	BPAS (%)	NPAS (%)
Intention to exercise		
Do not intend	38.7	37.1
Intend next month	37.5	34.4
Intend in next six months	23.8	28.5

Note*:* For purposes of comparison with the NPAS, the 75+ age group surveyed in the BPAS is not included here.

OCCUPATIONAL AND EDUCATIONAL LEVEL

Table 11 shows occupational physical activity and educational levels of BPAS respondents. (There was no corresponding NPAS question.) While respondents with the VCE were distributed equally across the occupational activity categories, those with less than 12 years education were more likely to have physically-demanding jobs, and the tertiary educated were more likely to have 'mostly sitting and standing' occupations.

Table 11
Occupational Physical Activity and Educational Level, BPAS

	Number	Level of Education %		
		<12 yrs	VCE	Tertiary
Mostly sitting or standing	351	26.5	22.2	51.3
Mostly walking	192	36.5	25.0	38.5
Mostly heavy labour/physically demanding work	152	45.5	21.7	32.9
Don't know/Not sure	120	75.0	8.3	16.7
Total	707	34.1	22.6	43.3

Physical Activity Levels of BPAS Respondents

Tables 12–17 summarise the results of the 2002 BPAS using chi-square analysis tests, which examined the relationship between physical inactivity, activity, and the following associated factors:

- Demographic characteristics (Table 12)
- Television/VCR watching and recreational computer usage (Table 13)
- Confidence in being physically active (Table 14)
- Knowledge of physical activity (Table 15)
- Motivational readiness (Table 16)
- Social support (Table 17)

The data have been presented as percentages, as suggested by McClave and Sincich (2000), in order to view the pattern of dependence more clearly. BPAS respondents were more likely to be sufficiently than insufficiently active, demonstrated by the higher percentage for all dependent variables examined. However, as the main focus of this study is the insufficiently active population and the reason for their insufficient activity level, the significant differences between the insufficiently and sufficiently active respondents across the various categories are presented in the following analysis.

DEMOGRAPHIC CHARACTERISTICS

The demographic characteristics of respondents and a summary of the interpretation of the chi-square results are presented in Table 12.

Gender ($p=0.097$): There were no significant differences shown in the proportion of males and females who participated in sufficient levels of physical activity; however, it was noted that a greater proportion of females than males were insufficiently active.

Age (P=0.000): A difference in activity levels can be seen between age groups. Of significance is the variation between the 18–29 years age group (20% insufficiently active) and the 75+ age group (65% insufficiently active), indicating that inactivity increased with age.

Marital status (P=0.001): There was an identifiable difference between levels of physical activity and marital status (although with Bonferroni correction it is not statistically significant). Of the widowed population, 53% were insufficiently active compared to 35% of married and de facto respondents, and 29% of those who were single.

Education (P=0.000): Forty two percent of respondents with less than 12 years education were insufficiently active, compared to 30% of respondents with tertiary education, showing an association between higher levels of insufficient activity and lower levels of education.

Occupation (P=0.000): Levels of insufficient activity were higher among blue-collar employees (48%) than white-collar workers (26%). In this case, the lower status occupation groups reported a lower level of physical activity indicating that as occupational status declines levels of physical activity also decrease.

Body mass index (BMI) (P=0.002): The level of insufficient activity reported for obese respondents was 43%, compared to 28% for those who were underweight (although this is not statistically significant with Bonferroni correction). Healthy weight individuals were less likely to be inactive. There were similar results for the underweight and overweight populations, with approximately 38% of respondents insufficiently active.

Table 12

Demographic Characteristics, Chi Square Comparisons, BPAS

	Number	Insufficiently Active (%)	Sufficiently Active (%)	P value
Gender				
Male	489	31.7	68.3	
Female	662	36.4	63.6	0.097
Total	1151	34.4	65.6	
Age				
18-29	274	20.4	79.6	
30-44	322	33.5	66.5	
45-59	269	35.7	63.3	0.000
60-75	210	44.8	55.2	
75 +	74	65.8	43.2	
Total	1149	34.5	65.5	
Marital status				
Married or de facto	753	34.7	65.3	
Single	310	28.7	71.3	
Widowed	81	53.1	46.9	0.001
Total	1144	34.4	65.6	
Education				
Less than 12 yrs	510	42.4	57.6	
VCE (or equivalent)	222	27.0	70.3	
Tertiary	385	29.7	73.0	0.000
Total	1117	34.6	65.4	
Occupation				
Manager/Administrator	120	30.0	70.0	
White-collar	159	25.8	74.2	
Home duties	198	38.4	61.6	
Retired	234	34.2	65.8	
Blue-collar	200	48.5	51.5	0.000
Student	64	21.9	78.1	
Unemployed	39	38.5	61.5	
Total	1014	35.4	64.6	
BMI				
Underweight	91	38.5	61.5	
Healthy Weight	510	28.2	71.8	
Overweight	370	38.1	61.9	0.002
Obese	174	43.1	56.9	
Total	1145	34.5	65.5	

TELEVISION/VCR WATCHING AND RECREATIONAL COMPUTER USE

As can be seen in Table 13, no relationship was found between television watching and physical activity levels. However, respondents who reported daily recreational computer use of more than 3 hours were more likely to be insufficiently active, while those reporting less than 3 hours use were more likely to be sufficiently active.

Table 13
Television/VCR Watching, Recreational Computer Use by Activity Level, BPAS

	Number	Insufficiently Active (%)	Sufficiently Active (%)	P value
Television/VCR watching				
None	20	45.0	55.0	
Less than 1 hour	173	34.7	65.3	
1-2 hours	357	32.2	67.8	
2-3 hours	305	39.0	61.0	0 .165
3-4 hours	170	38.2	61.8	
4-5 hours	75	36.0	64.0	
5 + hours	56	50.0	50.0	
Total	1156	36.6	63.4	
Recreational computer use				
None	663	38.3	61.7	
Less than 1 hour	337	26.1	73.9	
1-2 hours	87	40.2	59.8	
2-3 hours	25	16.0	84.0	0.002
3+ hours	23	43.5	56.0	
Total	1135	43.4	65.6	

PHYSICAL ACTIVITY CONFIDENCE (SELF-EFFICACY)

Table 14 displays the physical activity confidence of respondents. Eighty percent of the respondents who were confident to exercise when 'tired' were sufficiently active. Seventy-two percent of respondents who were confident to exercise when they were 'in a bad mood' were sufficiently active. Seventy-eight percent of respondents who were confident to exercise when they 'didn't have time' were sufficiently active. It is clear that a strong relationship exists between levels of confidence in being physically active and levels of physical activity.

Table 14

Physical Activity Confidence by Activity Level, Chi Square Results, BPAS

	Number	Insufficiently Active (%)	Sufficiently Active (%)	P Value
Statement 1: You could exercise when you are tired				
Not confident	593	44.7	55.3	
Confident	509	20.2	79.8	0.000
Total	1102	33.4	66.6	
Statement 2: You could exercise when you are in a bad mood				
Not confident	293	47.8	52.2	
Confident	785	27.9	72.1	0.000
Total	1078	33.3	66.7	
Statement 3: You could exercise when you feel you don't have time				
Not confident	656	40.4	59.6	
Confident	428	22.0	78.0	0.000
Total	1084	33.1	66.9	

PHYSICAL ACTIVITY KNOWLEDGE

Respondents were asked to agree or disagree with five statements (Table 15) to test knowledge on physical activity and health. The results for statements 1, 2, 3 and 5 show no knowledge difference between the insufficiently active and sufficiently active; however, more insufficiently active respondents correctly answered statement 4. As this is the only significant difference between the two groups, it suggests knowledge is not necessarily associated with participation in physical activity.

Table 15
Knowledge of Physical Activity and Health, All Respondents, BPAS

	Number	Agree (%)	Disagree (%)	Total (%)	P Value
1: Taking the stairs at work or generally being more active for at least 30 minutes each day is enough to improve your health.					
Sufficiently Active	724	82.9	17.1	100	0.044
Insufficiently Active	363	87.1	12.9	100	
Total	1087				
2: Half an hour of brisk walking on most days is enough to improve your health.					
Sufficiently Active	735	87.6	12.4	100	0.129
Insufficiently Active	365	90.1	9.9	100	
Total	1100				
3: To improve your health it is essential to do vigorous exercise for at least 20 minutes, 3 times a week.					
Sufficiently Active	725	59.4	40.6	100	0.024
Insufficiently Active	361	52.9	47.1	100	
Total	1086				
4: Exercise doesn't have to be done all at one time—blocks of 10 minutes are okay.					
Sufficiently Active	725	59.4	40.6	100	0.000
Insufficiently Active	366	72.7	27.3	100	
Total	1091				
5: Moderate exercise that increases your heart rate slightly can improve your health.					
Sufficiently Active	738	86.7	13.3	100	0.445
Insufficiently Active	376	87.2	12.8	100	
Total	1114				

MOTIVATIONAL READINESS

Sufficiently active respondents reported higher levels of motivational readiness to exercise. Only 31% of those intending to exercise next month were insufficiently active.

Table 16
Motivational Readiness to Exercise by Activity Level, BPAS

	Number	Insufficiently Active (%)	Sufficiently Active (%)	P value
Intention				
Do not intend	394	30.7	69.3	
Intend next month	379	31.1	68.9	
Intend next six months	241	41.9	58.1	0.007
Total	1014	33.5	66.5	

SOCIAL SUPPORT

Table 17 displays the social support available to respondents for physical activity participation. Support from friends, and support from family were examined separately. Both were reported at a significantly higher rate by the sufficiently active respondents, indicating an association between increased social support and increased levels of physical activity. Such support may be an important predictor of activity.

Table 17
Social Support for Physical Activity by Activity Level, BPAS

	Number	Insufficiently Active (%)	Sufficiently Active (%)	P Value
Support of friends				
Against	21	57.1	42.9	
Supportive	670	25.1	74.9	
Not applicable	446	46.6	53.4	0.000
Total	1136	34.1	65.9	
Support of family				
Against	28	53.6	46.4	
Supportive	799	27.9	72.1	
Not applicable	315	48.3	51.7	0.000
Total	1142	34.2	65.8	

Population Attributable Risk (PAR) and Cost of Inactivity

This section discusses the population attributable risk (PAR) in Ballarat for physical inactivity, and presents cost estimates for illness and mortality.

The PAR was calculated using data obtained from the 1996 Victorian Burden of Disease study, Local Government Authorities (DHS, Victoria, 2000). Cost estimates were calculated for the total cost of each component of CVD using the cost estimates of hospital inpatient treatment taken from the Victorian Casemix Cost Weight study 2000/2001 FY (DHS, Victoria, 2002) (See Appendix 4). This estimate of hospital inpatient care is a proportion of the total cost of CVD treatment and prevention. In order to estimate the total cost of CVD treatment and prevention, data presented in Mathers and Penm (1998, Table 3) were used as a basis for proportions allocated to each segment of CVD treatment.

The resulting data are presented in the following tables:

- PAR, relative risk and mortality attributable to physical inactivity (Table 18)
- Direct health care cost of CVD (Table 19)
- Direct health care cost of CHD attributable to physical inactivity (Table 20)
- Direct health care cost of stroke attributable to physical inactivity (Table 21)

RELATIVE RISK, PAR AND MORTALITY

Table 18 presents the effects of physical inactivity on mortality and illness in Ballarat, 94 deaths per year can be attributed to adults participating in insufficient activity.

Table 18

Relative Risk, PAR and Mortality Attributable to Physical Inactivity, Ballarat, 1996

Disease	Relative risk* (moderate activity)	PAR (%)+	Total Deaths, 1996	Deaths Attributable to Physical Inactivity
CHD	1.5	15.4	204	31
Stroke	2.0	26.7	75	20
NIDDM	1.3	9.9	18	2
Colon cancer	1.5	15.8	30	5
Breast cancer	1.1	3.5	12	4
Falls	1.4	12.7	5	1
All causes	1.4	12.7	739	94

*Source: *Burden of Disease 1996: Local government areas and regions of Victoria,* DHS, Victoria, 2000; *The cost of illness attributable to physical inactivity in Australia*, J. Stephenson, A. Bauman, B. Smith, & B. Bellew, 2000, Canberra, DHAC, ASC.

+This number also indicates the potential number of deaths that could be prevented if the inactive population adopted regular moderate physical activity.

DIRECT HEALTH CARE COST OF CVD

Table 19 shows the estimated direct health care cost for prevention and treatment of CVD in Ballarat 2000/2001 to be $20 million (the cost nationally was $3,719 million).

Table 19

Direct Health Care Cost of CVD, Ballarat, 2000/2001

Cost Description	Cost of Disease ($)	Table Ratios	Proportion of Total CVD Cost (%)	Estimate for Ballarat ($)
Hospital inpatient	8,280,289	1513	41	8,280,289
Outpatient		143	4	782,605
Nursing home		587	16	3,212,511
Medical		503	14	2,752,799
Allied Health		40	1	218,910
Pharmaceutical		715	19	3,913,025
Others		218	6	1,193,062
Total Cost		3719	100	20,353,202

Note: These figures are taken from Mathers and Penm (1998), Table 3: Health care cost of all cardiovascular disease by sex and sectors of expenditure, Australia, 1993-94 ($m), and have been used as the basis to determine the ratio of cost in the Ballarat study. As only one cost was estimated for the inpatient area in the Ballarat Study, all other costs have been calculated using these ratios (and the known inpatient cost). This same methodology was applied when using the Ratios in Table 19, Table 20 and Table 21.

DIRECT HEALTH CARE COST OF CHD

Table 20 shows the direct health care cost in Ballarat 2000/2001 of CHD ($9,410,445), and the proportion attributable to physical inactivity ($1.5 million). The CHD cost in Australia attributable to physical inactivity was $161 million.

Table 20

Direct Health Care Cost of CHD, Ballarat 2000/2001

Cost Description	Cost of Disease($)	Table Ratios	Proportion of Total CHD Cost (%)	Estimate for Ballarat ($)	Cost Attributable to Physical Inactivity
Total hospitals	6,042,053	574	64	6,042,053	
Total medical		88	10	926,308	
Pharmaceutical		105	12	1,105,254	
Allied health		5	1	52,631	
Research		11	1	115,788	
Other, nursing homes		111	12	1,168,411	
Total cost		894	100	9,410,445	1,449,209

Note: Adapted from *The cost of illness attributable to physical inactivity in Australia*, J. Stephenson, A. Bauman, B. Smith, & B. Bellew, 2000, Canberra: DHAC, ASC.

DIRECT HEALTH CARE COST OF STROKE

Table 21 shows the direct health care cost of stroke in Ballarat, 2001/2002 ($2,640,842), and the cost attributable to physical inactivity ($705,105). The cost of stroke attributable to physical inactivity in Australia was approximately $101 million.

Table 21

Direct Health Care Cost of Stroke, Ballarat 2001/2002

Cost Description	Cost of Disease ($)	Table Ratios	Proportion of Total Strokes Cost (%)	Estimate for Ballarat	Cost Attributable to Physical Inactivity
Total hospitals	1,186,283	283	45	1,186,283	
Total medical		31	5	129,946	
Pharmaceutical		13	2	54,494	
Allied health		5	1	20,959	
Research		6	1	25,151	
Nursing home		292	46	1,224,009	
Total cost		630	100	2,640,842	705,105

Note: Adapted from *The cost of illness attributable to physical inactivity in Australia*, J. Stephenson, A. Bauman, B. Smith, & B. Bellew, 2000, Canberra: DHAC, ASC.

Barriers and Facilitators Associated with Physical Activity, BPAS

This section will examine and analyse barriers and facilitators associated with participation in physical activity among BPAS respondents. The data are presented as follows:

- Barriers for all respondents (Table 22)
- Barriers for insufficiently active by gender (Table 23)
- Barriers for insufficiently active by age (Table 24)
- Barriers for insufficiently active by education level (Table 25)
- Chi Square analysis of barriers for all respondents: (Table 26)
- Facilitators for all respondents (Table 27)
- Facilitators for insufficiently active by gender (Table 28)
- Facilitators for insufficiently active by age (Table 29)
- Facilitators for insufficiently active by education level (Table 30)
- Chi square analysis of facilitators for all respondents (Table 31)

The barriers and facilitators questions were derived from the 1983 Canadian Physical Activity Survey (Pereira et al., 1997).

BARRIERS FOR ALL RESPONDENTS

Table 22 shows the barriers to physical activity participation for all respondents. The findings suggest that lack of time due to work or study (44%), lack of energy (23%), and financial expense (21%) were key barriers to participation in increased levels of physical activity.

Table 22

Barriers to Participation in Physical Activity, All Respondents, BPAS

Barrier	Overall Response (%)
Don't want to participate more	18.3
Ill health	18.7
Lack of energy	23.5
Lack of time due to work or study	44.5
Lack of time due to other leisure activities	13.0
Costs too much	21.3
Concern about crime	4.0
No facilities nearby	6.6
Available facilities are inadequate	2.8
Requires too much self-discipline	15.3
Lack of necessary skills	4.3
Poor access to transport	2.4
Poor weather conditions	10.4
No time	16.7

Note: The overall response includes both insufficiently active and sufficiently active respondents. Respondents were able to indicate more than one barrier

BARRIERS BY GENDER

Table 23 shows the barriers for participation for males and females separately. About 30% of both males and females reported ill health as a barrier to participation in physical activity. Approximately 36% of males and females reported work or study as a barrier to being physically active. The most notable difference between males and females was that 33% of females noted lack of energy as a barrier to participation in comparison to 27% of males. Twenty-four percent of female respondents reported 'no time' as a barrier compared to only 13% of males.

Table 23

Barriers to Physical Activity by Gender, Insufficiently Active Respondents, BPAS

Barrier	Male (%)	Female (%)	Row Average
Don't want to participate more	18.8	12.2	14.8
Ill health	29.4	30.1	29.9
Lack of energy	26.9	32.7	30.4
Lack of time due to work or study	38.5	34.9	36.3
Lack of time due to other leisure activities	8.5	7.9	8.1
Costs too much	15.9	28.3	23.4
Concern about crime	0.7	6.5	4.2
No facilities nearby	5.2	6.0	5.7
Available facilities are inadequate	3.7	1.3	2.3
Requires too much self-discipline	17.6	19.6	18.8
Lack of necessary skills	4.2	6.6	5.6
Poor access to transport	2.1	4.0	3.2
Poor weather conditions	7.7	12.9	10.8
No time	13.4	23.8	19.7

BARRIERS BY AGE

Table 24 shows the barriers to physical activity across five age groups. The results indicate that different barriers for participation exist in each age group. Respondents in the 18–29, 30–40 and 45–59 year age group reported that the greatest barrier to participation was ‘lack of time due to work or study’, whereas the 60–75 year age group reported that their greatest barriers was ill health. For respondents in the 75 years and over age group, the major barriers to increased physical activity were inadequate facilities and ill-health.

Table 24
Barriers to Participation by Age, Insufficiently Active Respondents, BPAS

Barrier	Age Group (%)					
	18-29	30-44	45-59	60-75	75+	Row Average
Don’t Wish to Exercise	15.6	8.9	10.3	22.6	23.1	14.8
Ill health	9.2	20.8	28.1	39.9	68.1	29.9
Lack of energy	43.6	24.9	30.7	28.7	30.8	30.4
Lack of time due to work or study	59.4	56.0	42.4	7.6	0.0	36.3
Lack of time due to leisure activities	6.1	7.0	6.7	33.3	9.3	8.1
Costs too much	40.3	27.8	18.8	19.0	4.6	23.4
Concern about crime	3.1	3.8	4.2	26.7	2.1	4.2
No facilities nearby	3.1	6.0	6.2	23.8	5.1	5.7
Available facilities are inadequate	3.2	3.8	1.1	0.0	5.1	2.3
Requires too much self-discipline	31.3	18.2	27.0	17.1	0.0	18.8
Lack of necessary skills	18.6	3.0	3.4	16.7	5.1	5.6
Poor access to transport	3.1	0.9	3.7	41.7	5.2	3.2
Poor weather conditions	15.6	8.7	7.3	32.4	6.7	10.8
No time	37.1	28.8	8.4	20.9	4.2	19.7

BARRIERS BY EDUCATION LEVEL

Table 25 shows barriers for insufficiently active respondents according to education level. The most noticeable barriers to participation in physical activity for insufficiently active respondents were ill health and lack of energy. One-third of respondents with less than 12 years education reported ill health as the main barrier to participation, compared to 22% of respondents educated to tertiary level. Both VCE (50%) and tertiary (59%) educated respondents reported work or study as a barrier, compared to 21% of those with less than 12 years of education. A higher proportion of people nominating ill health as a barrier were in the less-educated population.

Table 25

Barriers to Participation by Education, Insufficiently Active Respondents, BPAS

Barrier	Education Level (%)			
	< 12 years	VCE	Tertiary	Row Average
I don't want to participate more	19.9	9.4	8.9	15.0
Ill health	32.9	25.9	22.2	28.7
Lack of energy	31.6	34.9	26.7	30.9
Lack of time due to work or study	21.0	50.4	59.1	36.6
Lack of time due to other leisure activities	8.9	8.8	6.1	8.1
Costs too much	17.5	33.3	28.7	23.4
Concern about crime	3.6	2.6	6.8	4.3
No facilities nearby	5.1	7.7	6.2	5.8
Available facilities are inadequate	3.2	0.0	2.1	2.3
Requires too much self-discipline	12.1	27.0	25.8	18.7
Lack of necessary skills	6.4	10.0	1.6	5.8
Poor access to transport	3.4	4.5	2.6	4.5
Poor weather conditions	9.8	11.4	12.4	11.4
No time	16.2	17.4	28.4	17.4

Note: The average percentage for Table 23 and Table 24 in the Barriers were not identical due to missing values.

BARRIERS FOR ALL RESPONDENTS (IN DEPTH ANALYSIS)

Table 26 shows the Chi square results of barriers to participation in physical activity for insufficiently active and sufficiently active respondents. Interestingly, the greatest barrier to participation for insufficiently active respondents was ill health. In comparison, the sufficiently active respondents reported 'lack of time due to other leisure activities' to be their most significant barrier.

Table 26

Barriers to Participation by Activity Level, Chi Square Analysis, BPAS

Variable	Number	Insufficiently Active (%)	Sufficiently Active (%)	P Value
I don't want to participate more	197	27.4	72.6	0.021
Ill health	201	53.7	46.3	0.000
Lack of energy	244	45.1	54.9	0.000
Lack of time due to work or study	478	27.6	72.4	0.000
Lack of time due to leisure activities	138	21.7	78.3	0.001
Costs too much	288	37.3	62.2	0.308
Concern about crime	43	34.9	65.1	0.947
No facilities nearby	72	29.2	70.8	0.331
Available facilities are inadequate	28	28.6	71.4	0.510
Requires too much self-discipline	163	41.7	58.3	0.035
Lack of necessary skills	46	43.5	56.5	0.188
Poor access to transport	26	46.2	53.8	0.208
Poor weather conditions	112	34.8	65.2	0.933
No time	181	39.2	60.8	0.135

FACILITATORS FOR ALL RESPONDENTS

Table 27 shows the overall facilitators to improving physical activity participation among all respondents. The most important facilitators reported were 'more leisure time' (43%), and 'people with whom to participate' (36%). There were an equal proportion of respondents (almost 34%) who reported inexpensive facilities and common interest friends to be important facilitators.

Table 27
Facilitators for Increased Physical Activity Participation, All Respondents, BPAS

Facilitator	Overall Response %
Nothing	17.3
Closer facilities	13.0
Different facilities	4.9
Less expensive facilities	34.5
More information on benefits of physical activity	6.7
Employer sponsored activities available	10.6
Organised fitness classes available	3.8
Better facilities	4.7
People with whom to participate	35.6
Common interests of friends	34.5
Fitness test with personal activity program available	15.4
More leisure time	43.4
Organised sports available	6.6
Total	100

Note: The overall response included both insufficiently and sufficiently active respondents.

Respondents were able to indicate more than one facilitator

FACILITATORS BY GENDER

Table 28 shows the potential facilitators for participation in increased physical activity among insufficiently active respondents according to gender. Approximately 40% of females reported that they required 'less expensive facilities' in order to participate, compared to 32% of male respondents. 'People with whom to participate' was a facilitator for 39% of the females, compared with 28% of the males, while 43% of females, compared with 31% of males, reported that they needed 'more leisure time' to participate.

Table 28

Facilitators for Participation by Gender, Insufficiently Active Respondents, BPAS

Facilitator	Male (%)	Female (%)	Row Average
Nothing	22.8	17.5	19.6
Closer facilities	12.0	11.4	11.6
Different facilities	6.0	2.4	3.8
Less expensive facilities	30.6	39.6	36.0
More information on benefits of physical activity	10.1	5.0	7.0
Employer sponsored activities available	11.0	7.1	8.6
Organised fitness classes available	4.5	10.8	8.3
Better facilities	2.6	1.1	2.1
People with whom to participate	27.8	39.3	43.8
Common interests of friends	23.7	38.2	32.5
Fitness test with personal activity program available	22.0	13.0	16.6
More leisure time	34.2	43.2	43.2
Organised sports available	7.5	4.8	4.8

FACILITATORS BY AGE GROUP

Table 29 highlights the facilitators associated with participation in physical activity for the insufficiently active respondents across five age groups. 'More leisure time' was required by 62% of respondents in the 18–29 year age group, 51% of the 30–44 year age group and 47% of the 45–59 year age group compared with only 5% of the 75 years and over age group. Thirty-two percent of the 60–75 years age group needed 'common interest friends' and 'people with whom to participate', while 21% of those aged 75 and over required 'common interest friends'. The data clearly show that facilitators differ dramatically according to age.

Table 29

Facilitators for Participation by Age, Insufficiently Active Respondents, BPAS

	Age Group (Years) (%)					
Facilitator	18–29	30–44	45–59	60–75	75+	Row Average
Nothing	14.7	7.8	12.0	29.6	70.0	19.6
Closer facilities	14.7	11.5	11.7	10.5	8.5	11.6
Different facilities	6.1	2.9	3.8	4.8	0.0	3.8
Less expensive facilities	37.9	47.4	37.7	26.4	11.6	36.0
More info on benefits of physical activity	8.8	4.9	5.1	10.3	8.5	7.0
Employer sponsored activities available	5.9	15.4	12.0	0.7	0.0	8.6
Organised fitness classes available	11.7	6.6	6.0	9.9	11.0	8.3
Better facilities	0.0	2.9	2.7	2.4	0.0	2.1
People with whom to participate	32.2	34.0	45.6	31.6	18.5	34.8
Common interests of friends	26.1	36.7	35.4	31.9	21.0	32.5
Fitness test/activity program available	11.8	15.5	23.1	16.7	8.5	16.6
More leisure time	61.8	51.0	46.6	17.1	5.0	39.6
Organised sports available	11.7	11.6	1.9	0.7	0.0	0.0

Note: The average percentage for Table 27 and Table 28 in the Facilitators were not identical due to missing values.

FACILITATORS BY EDUCATION LEVEL

Table 30 shows the facilitators for participation in physical activity among insufficiently active respondents according to education level attained (less than 12 years, VCE or equivalent, and tertiary). The findings show that 34% of respondents with less than 12 years of education required ‘people with whom to participate’, compared to about 35% of the tertiary-educated respondents. Similarly, about 59% of VCE educated respondents required ‘more leisure time’, compared to 54% of those who were tertiary educated. ‘Less expensive facilities’ were identified across all three education levels, with the highest requirement (45%) by the VCE-educated respondents.

Table 30

Facilitators for Participation by Education, Insufficiently Active Respondents, BPAS

Facilitator	Education Level (%)			
	<12 years	VCE	Tertiary	Row Average
Nothing	28.1	7.7	9.6	19.2
Closer facilities	11.5	13.4	11.5	11.8
Different facilities	6.0	0.0	2.5	3.9
Less expensive facilities	32.8	44.9	36.9	36.2
More information on benefits of physical activity	6.9	5.0	8.6	7.0
Employer sponsored activities available	5.3	11.0	14.0	8.8
Organised fitness classes available	7.3	14.3	6.9	8.5
Better facilities	1.8	3.2	2.1	2.1
People with whom to participate	33.9	36.6	34.7	34.6
Common interests of friends	28.6	34.4	37.8	32.3
Fitness test with personal activity program	13.3	15.7	23.6	16.6
More leisure time	25.9	58.8	54.6	40.0
Organised sports available	4.2	7.1	7.5	5.6

FACILITATORS BY ACTIVITY LEVEL (CHI SQUARE ANALYSIS)

Table 31 presents the facilitators associated with increased physical activity. The results show that the significant facilitators were better facilities and more leisure time.

Table 31

Facilitators to Participation by Activity Level, Chi Square Analysis, BPAS

Facilitator	Number	Insufficiently Active (%)	Sufficiently Active (%)	P value
Nothing	186	37.6	62.4	0.303
Closer facilities	138	29.7	70.3	0.221
Different facilities	52	26.9	73.1	0.243
Less expensive facilities	367	35.1	64.9	0.675
More info on benefits of physical activities	72	43.7	65.3	0.958
Employer sponsored activities availability	115	27.0	73.0	0.077
Organised fitness classes available	96	31.3	68.8	0.493
Better facilities	49	14.3	85.7	0.002
People with whom to participate	378	32.8	67.2	0.448
Common interests of friends	364	31.9	68.1	0.213
Fitness test with personal activity program	164	36.0	64.0	0.630
More leisure time	464	30.6	69.4	0.028
Organised sport available	69	30.4	69.6	0.471

In summary, although not statistically significant using Bonferroni correction, the results suggest that better facilities and more leisure time are the only recognisable facilitators required by the respondents to the BPAS.

Factors Associated with Participation: Statistical Analysis

The major statistical analysis undertaken was to determine the factors that predicted participation in physical activity. All of the variables from the survey were input into a logistic regression (multivariate logistic regression analysis) to identify significant predictors of insufficient activity levels. The results of this analysis are presented in Table 32.

The major predictors identified were confidence level to participate in exercise when tired; confidence level to participate in exercise when there was a perceived lack of time; health status; level of education; and motivational readiness.

Those who were not confident to exercise when tired were 2.570 (p=0.000) times more likely to be insufficiently active; those who were not confident to exercise when there was a lack of time were 1.883 (p=0.000) times more likely to be insufficiently active; those reporting ill health were 2.307 (p=0.000) times more likely to be insufficiently active; those with less than 12 years of schooling were 1.610 (p=0.009) times more likely to be insufficiently active; and those who intended to exercise in 6 month time were 1.302 (p=0.143) times more likely to be insufficiently physically active.

Table 32

Factors Associated With Participation, Multivariate Logistic Regression Analysis, BPAS

	Odds Ratio	P Value	95% Confidence Level
Confidence level to exercise when tired			
Confident	1.000		
Not confident	2.570	0.000	1.838–3.597
Confidence level to exercise when lack of time			
Confident	1.000		
Not confident	1.883	0.000	1.333–2.659
Health Status			
No ill health	1.000		
Ill health	2.307	0.000	1.555–3.424
Education			
Tertiary	1.000		
Less than 12 years	1.610	0.009	1.085–2.392
VCE (or equivalent)	0.950	0.806	0.632–1.426
Motivational readiness			
Don’t want to exercise	1.000		
In 6 months time	1.302	0.143	0.915–1.853
Next month	1.975	0.000	1.350-2.888

DISCUSSION

Introduction

This is the first extensive study specifically undertaken to examine physical activity levels in an Australian regional setting. Previous Australian studies have examined levels of physical activity: nationally, the 1997 Active Australia Survey (ASC, 1998), the 1999 National Physical Activity Survey (Armstrong et al., 2000) and the 2000 National Physical Activity Survey (Bauman et al., 2001), and state-wide, the 1998 Physical Activity Patterns and Health Impacts in Victoria (Smith et al., 1999).

The current study conducted a mail-out survey—(the 2002 Ballarat Physical Activity Survey (BPAS)—to establish levels of physical activity in the city. This survey was based on the one used for the 1999 National Physical Activity Survey (NPAS), a telephone survey. The results of the BPAS and the NPAS were compared to determine any similarities and differences in regional and national physical activity levels.

Using the concept of Population Attributable Risk (PAR), the current study investigated the effect of physical inactivity on such conditions as coronary heart disease, NIDDM, colon cancer, stroke, breast cancer, and all-cause mortality in Ballarat. In addition, the health care cost to a regional population that was attributable to physical inactivity was calculated, employing the methodology used by Stephenson et al. (2000) in their Australia-wide study on the cost of physical inactivity. Finally, the barriers and facilitators affecting participation in physical activity in an Australian regional setting were examined using the socio-ecological model of McLeroy et al. (1988).

Physical Activity Levels in Ballarat

The first research question in this study was to determine the current level of physical activity undertaken by adults in Ballarat. The data indicated that 65.6% of BPAS respondents were sufficiently active to obtain health benefits, compared to 34.4% who were insufficiently active. When the data from the members of the community aged over 75 years were excluded (to permit comparison with the NPAS), it was evident that 67.1% of the population were sufficiently active, compared to 56.6% of the Australian population. Although the levels of physical activity in Ballarat were greater than in the Australian population, the higher rate of CVD present in Ballarat (and the known relationship between physical inactivity and CVD) indicates that physical inactivity remains a substantial public health issue in Ballarat. It is necessary, therefore, to investigate this insufficiently active (inactive) population in detail.

The BPAS reported more insufficiently active females than males. These findings were consistent with those of Armstrong et al. (2000) who found that women in Australia were less likely to be physically active than men, and Smith et al. (1999) who found that women in Victoria were less likely to participate in sufficient levels of physical activity than men. It should be noted, however, that according to the latest Australian census (ABS, 2002), a disproportionately large number of elderly females responded to the BPAS.

The BPAS provided evidence that the number of insufficiently active respondents increased cross-sectionally with age, and these data are supported by a Victorian study conducted by Smith et al. (1999), which noted that in rural Victoria older age groups were more sedentary than younger age groups. The main reasons for physical inactivity highlighted by the BPAS were ill health and lack of energy. Other factors cited in the literature as reasons for physical inactivity are environmental, psychosocial, health, physicians' lack of emphasis and program accessibility (Neapolitan & Marcus, 2000).

The other notable finding of the BPAS was that a greater proportion of married and de facto couples were insufficiently active compared to respondents who were single, and more widowed respondents were insufficiently active compared to single adults. Levels of inactivity increased for adults over 35 years of age. A similar association was found on a national level in Australia where Armstrong et al. (2000) found that, in general, widowed and lone parents were less likely to participate in physical activity. This relationship was particularly apparent in Victoria, where Smith et al. (1999) found that single people were more sufficiently physically active than married people.

The BPAS revealed that a higher level of inactivity was associated with a lower level of education. This may be related to socioeconomic factors such as income, available time for leisure, social settings, neighbourhood, and access to facilities. A similar finding was reported in an Italian study (Sommaruga, Vidotto, Bertolotti, Pedretti & Tramarin, 2003), where a lower level of education was shown to be associated with a lower knowledge of healthy lifestyles and a higher risk of CHD. This association between lower education levels and higher levels of inactivity is supported by Armstrong et al. (2000) who found, on a national level, that less-educated respondents were less likely to participate in physical activity. In particular, the Victorian study conducted by Smith et al. (1999) found that women with less education were less likely to be sufficiently physically active to gain health benefits from physical activity. An international comparison was provided by Kilander et al. (2001) who found in the Swedish population that less-educated people were more vulnerable to cerebral and cardiovascular deaths, and that smoking, physical inactivity, and dietary factors explained half of the of cancer mortality rates in this group.

Results from the BPAS showed that more blue-collar employees were insufficiently active compared to white-collar employees. These findings are consistent with metropolitan data. Smith et al. (1999) found, in Victoria, that as the occupational status increased so did the levels of activity. It should be noted, however, that the higher numbers of insufficiently active respondents in the blue-collar occupational category could be related to the apparently physically-demanding nature of their occupations. Salmon, Owen, Bauman, Schmitz, and Booth (2000) also suggested that low-skilled workers in Australia were less likely to participate in leisure-time physical activity. These data are supported by Martinez-Gonzalez et al. (2001) who reported, in a European Union study, that those in more physically-demanding occupations tended to engage in lower levels of leisure-time physical activity. The BPAS findings also showed that people who had undertaken less than 12 years of education were most likely to be involved in heavy labour or physically-demanding work.

The present study found that a higher proportion of insufficiently active individuals were obese. Jackson et al. (2001) noted a similar association in the Australian National Health and Nutrition Survey, which covered urban and rural areas across the states and territories of Australia, and had a sample size of 10,624. The data from that survey showed that 52% of males and 35% of females believed that the main reason for weight gain was due to reduced levels of physical activity. The BPAS highlighted that levels of obesity in the population of the Ballarat region were higher in the older-aged and less-educated individuals. The Australia-wide study by Armstrong et al. (2000) supported this notion that the prevalence of obesity increases as age increases and education decreases.

The BPAS study did not show a significant relationship between television watching and levels of sufficient physical activity, but the number of adults who were insufficiently active tended to increase when computers were used as a form of recreation for more than three hours per day. No other published studies have been located that have examined the relationship between adult recreational computer use and adult physical activity levels. However, a range of studies have been published which have indicated that high levels of recreational computer use by children results in decreased participation in physical activity (Berkey, Rockett, Gillman, & Colditz, 2003). The data collected during the present study regarding television watching and physical activity levels are in contrast to recent Australian studies that reported that higher television viewing time was strongly associated lower physical activity time (Cameron et al., 2003). In the case of children and adolescents in the U.S., Gordon-Larsen et al. (2001) suggested that higher levels of television watching, video viewing, video game playing and computer use resulted in higher levels of inactivity and a tendency to be overweight.

In summary, although general levels of physical inactivity in Ballarat were lower than the Australian average, there were still 34.4% of adults classed as insufficiently active. Given that the rates of CVD were higher in Ballarat than nationally, there is a definite need to investigate this insufficiently active (inactive) population in detail to address the public health implications of this inactivity.

Physical Activity Levels Compared: BPAS and NPAS

This section, addressing research question two, compares the current levels of physical activity in Ballarat (as discussed in the previous section) with the physical activity levels of the Australian population. Data for the comparison are taken from the results of the 2002 Ballarat Physical Activity Survey (BPAS) and the 1999 National Physical Activity Survey (NPAS).

CHOICE OF INSTRUMENT

The Ballarat Physical Activity Survey is based on the 1997 Active Australian Survey (ASC, 1998) and used for the 1999 (Armstrong et al., 2000) and 2000 (Bauman et al., 20001) national physical activity surveys. It is the first time that these surveys have been conducted using a mail-out format. Previously, the telephone was used with these surveys to gather data. For example, the 1999 National Physical Activity Survey—upon which the Ballarat survey was based—was conducted using a telephone survey using a sample of 3,841 Australian adults and involved over-sampling from several states (Armstrong et al., 2000). Two issues arise from this decision to use a mail-out format: firstly, is it appropriate to use a mail-out survey to measure physical activity levels, and secondly, can the results of mail-out surveys be compared with results obtained from telephone survey methodology?

In response to the first issue, Paffenbarger, Blair, et al. (1993) indicated that is quite appropriate to measure physical activity levels using a mail-out format. In addition, the Australian Institute of Health and Welfare (AIHW, 2003) has recommended self-reported measures as a most appropriate methodology to be used for population surveys. Examples of major physical activity surveys that have been completed using the mail-out format include the Twin Cohort Leisure-time Physical Activity Survey (Kujala et al., 1998) and the Australian Bureau of Statistics Physical Activity Survey (Booth, 2000). Mail-out surveys do have limitations, however. Carron et al. (2002) noted that mail-out physical activity surveys had a tendency towards over-reporting of physical activity levels, and that responses may be affected by the potentially limited cognitive capacity of some respondents. Other disadvantages of mail-out surveys include low return rate, sample bias (mainly self-selective), little control over the return rate, high numbers of missing values, and no opportunity to explain the questionnaire (Frey, 1983; Lockhart & Russo, 1994; Pearson NCS, 1994; Seller, 2000). However, there are also advantages: low cost, ease of working with a large sample, and—since respondents can read and answer the questionnaire in their own time—the capacity to send long and complicated questionnaires. This particular aspect (of respondents being able to complete the mail-out survey in their own time) has resulted in mail-out surveys reporting a higher recall memory than telephone and face-to-face surveys (Frazer & Lawley, 2000).

On the second issue—the comparability of results of physical activity surveys using mail-out methodology with results of physical activity surveys using telephone methodology—there are no directly relevant data available. However, there are data on survey comparability in other areas, such as respiratory disease (Brogger et al., 2002) and head injury (Wilson et al., 2002). These studies indicated there was a high degree of data reproducibility between the two methods (Brogger et al., 2002), and that the data collected using the mail-out methodology were more reliable than those collected using the telephone survey technique (Wilson et al.). In general there was less agreement between telephone and mail-out surveys for open-ended questions, but a higher level of agreement for closed-end questions such as those used in the current study (Lockhart & Russo, 1994). Finally, O'Toole et al. (1986) noted that the quality of the data obtained was higher when the mail-out survey method was used in comparison to those obtained using the telephone survey technique.

Given the information presented above, and notwithstanding the obvious limitations caused by a lack of specific data comparing the two techniques, it was considered appropriate to compare and discuss the data obtained from the BPAS using the mail-out survey with those collected in the NPAS using a telephone survey.

DEMOGRAPHIC PROFILES OF BPAS AND NPAS RESPONDENTS

It is important to note in the data comparison that the BPAS survey included respondents aged over 75 years, but the NPAS did not. To enable a valid comparison with the NPAS, data have been corrected by excluding the over 75 age group. Specific demographic comparisons include those for age, gender, education, and body mass index (BMI).

The demographic data provided by respondents indicated that more elderly people lived in Ballarat, particularly aged between 60–75 years, and that both males and females were under represented in the 18–29 age group in Ballarat compared to the Australian census data (ABS, 2002). These data are examples of response bias and may reflect the tendency for older people to respond more often to mail and telephone surveys than the younger population (Seller, 2000). It is very difficult to overcome response bias but according to Seller (2000) and Green & Kreuter (1999) one must try to maximise response rates along with minimising response bias. This study attempted to address the need to have a high return rate by sending out reminders and using a variety of media interventions before and during the BPAS. No specific strategies were implemented to address the response bias noted above; however, data was statistically weighted to accurately represent the age distribution of the adult Ballarat population. It may also be postulated that the under representation of respondents in the 18–29 year age group may be due to this population not living full-time at their electoral roll address. The ABS (2001) report that younger people aged between 15–24 (about 41% of the total population) often leave rural areas for highly-populated urban and metropolitan centres to pursue greater opportunities for employment, education and training.

In comparison, the respondents to the BPAS and NPAS reported similar levels of education and overall marital status. It should be noted, however, that with respect to occupational status, the BPAS had more respondents involved in blue-collar occupations and less managers compared to NPAS. The difference in occupation reported in the two surveys may reflect the fact that Ballarat has an industrial profile that is different to the Australian average.

The body mass index (BMI) data show that the BPAS respondents were less likely to have a 'healthy' BMI than the NPAS respondents, with a larger proportion of adults from the Ballarat survey being underweight, overweight, or obese. The high proportion of overweight or obese individuals in Ballarat may be related to the lower (than NPAS) education levels. Cameron et al. (2003) supported these data when they suggested that lower levels of physical activity and lower levels of education are associated with increased rates of obesity in the Australian population. These findings are of particular concern, given the relationship between obesity and cardiovascular disease. Indeed, Rainwater et al. (2000), in a U.S. study, found an association between an increase in weight at a young age and mortality from CVD and CHD. There is no apparent explanation, except for a deliberate under-reporting of bodyweight (Nawaz, Chan, Abdulrahman, Larson, & Katz, 2001), for the high level of underweight adults who responded to the BPAS and who were insufficiently active.

From this data it is apparent that there are more elderly people, blue collar employees, and people classified as obese in Ballarat, compared to the overall Australian population. However, these results may not be entirely representative of the Ballarat population due to the possible response bias, although data was statistically weighted to accurately represent the age distribution of the adult Ballarat.

PHYSICAL ACTIVITY PATTERNS OF BPAS AND NPAS RESPONDENTS

The overall level of physical activity reported in the BPAS was 10.5 % higher than reported in the NPAS (67.1% versus 56.6% sufficiently active adults in Ballarat and Australia, respectively). It should be remembered, however, that the magnitude of this difference may have been inflated by the choice of instrument: mail-out survey for the BPAS versus telephone survey for the NPAS (Frazer & Lawley, 2000; Sellers, 2000). The lower proportion of the Ballarat respondents classed as sedentary appeared to be associated with more people being engaged in vigorous-intensity gardening or yard work, vigorous-intensity physical activity and a higher level of walking undertaken in the Ballarat community. However, it is important to note that the level of moderate activity, such as playing golf and lawn bowls, in Ballarat was less than the Australian average. It was also evident that a larger percentage of the people residing in Ballarat were motivationally prepared to exercise, and that they had a greater knowledge of appropriate physical activity than the overall Australian population. These data are supported by information presented by Armstrong et al. (2000) and Smith et al. (1999) who suggested that Victorians were significantly more likely to be physically active than has been previously reported in studies such as the 1989 National Heart Foundation Risk Factor Prevalence Survey and the 1989–1990 National Health Survey. Also, Smith et al. suggested that, on average, Victorians were significantly more likely to be physically active than the average adult population of many other Australian states.

As indicated above, the lower level of physical inactivity reported by the respondents to the BPAS was largely due to a higher involvement in walking. The high participation in walking across all age groups of BPAS respondents may be influenced by Ballarat's aesthetically pleasing environment, in particular the uniquely dominant place of Lake Wendouree and its environs within the community. The potentially positive impact of the physical environment on physical activity participation was highlighted by Bauman et al. (1999) who found that those living in coastal locations had a higher level of physical activity than those living inland. Ball, Bauman, Leslie, and Owen (2001) also suggested that environmental aesthetics are associated with participation in physical activity. This is further supported by King et al. (1999) and Corti, Donovan, and Holman (1997) who found evidence that an attractive environment contributes to increased self-efficacy for physical activity. It is possible that Lake Wendouree plays a similar role in facilitating physical activity in Ballarat to that played by the beach for those living in coastal locations. Like Lake Wendouree, the facilities of a coastal environment are provided free of charge, thereby decreasing any financial barriers to physical activity.

The importance of walking as a means of achieving sufficient levels of physical activity by Australian adults was highlighted by Booth et al. (1997). These authors reported that walking was the most popular activity in Australia, and that more than half of the Australian adult population preferred walking as their main form of exercise. Of note were the data presented by Ball, Bauman, et al. (2000) and Smith et al. (1999) who demonstrated that the level of walking was slightly higher in Victoria than for other Australian states. In addition to this, the data obtained in the BPAS indicated that other factors, such as lack of transport for those in the 60–75 year old age group, may have influenced the level of walking undertaken by the adult population of Ballarat.

As mentioned above, a further notable difference between the BPAS and NPAS respondents is the 28% lower level of moderate-intensity activity reported by the Ballarat adults when compared to the results from the NPAS. These data are somewhat surprising given the generally higher level of physical activity undertaken by adults in Ballarat in comparison to the national sample. The reason for this difference is not readily apparent, but it may be influenced by difficulties in interpreting the questionnaire by the Ballarat respondents or the potentially low validity of this question (Brown, Bauman, Timperio, Salmon, & Trost, 2002; Sallis & Saelens, 2000). In addition, Duncan et al. (2001) noted that sedentary middle-aged adults tended to overestimate the intensity of their physical activity because they were not able to perform any hard or very hard physical activity. This overestimation was particularly evident with self-report of moderate-intensity physical activity. Nevertheless, these data are somewhat consistent with those of Armstrong et al. (2000) and Smith et al. (1999) who found that almost 70% of the Victorian population over the age of 25 did not engage in moderate-intensity physical activity. Importantly, these data were the lowest for the middle-aged population.

The BPAS respondents reported a much higher involvement in vigorous gardening than the NPAS respondents. Further, the BPAS data provide evidence that there is an apparent linear relation between age and involvement in gardening. The reason for the higher level of vigorous gardening in Ballarat may be influenced by the higher proportion of retired and/or elderly people who live in Ballarat. It may be postulated that these people have more time to engage in gardening and yard work than younger adults.

The frequency of involvement in physical activity also appeared to be related to age, whereby older adults tended to participate in more sessions of physical activity per week than younger adults. These data are supported by those presented by Smith et al. (1999) who reported that a higher proportion of older people engaged in more than three or more sessions per week in Victorian than younger individuals.

In comparison to the NPAS data, BPAS respondents showed higher levels of physical activity, particularly in walking and vigorous exercise. In addition, a remarkable proportion of BPAS respondents participated in less moderate-intensity physical activity compared to NPAS respondents. Overall, the BPAS respondents are less sedentary than the national respondents.

PAR and Health Burden of Physical Inactivity

In the previous section, the characteristics of insufficiently active individuals were discussed. This section, in addressing research question three, will attempt to identify and discuss in detail the public health burden in Ballarat of physical inactivity, with a focus on coronary heart disease (CHD), stroke, non-insulin dependent diabetes mellitus (NIDDM), colon cancer, breast cancer, and all-cause mortality (excluding falls incidences). As previously mentioned, there are limited regional data that can be used to compare and contrast with the national data. According to the calculation of population attributable risk (PAR), the current study found that despite the high level of CHD reported in Ballarat, the higher physical activity rates resulted in Ballarat exhibiting a lower PAR (15.4%) and death rate attributable to insufficient physical activity than the Australian average of 18% (Stephenson et al., 2000). As noted above, the Burden of Disease Local Government Areas of Victoria Study (2000) showed that the overall death rate due to CVD is higher in Ballarat, for both men and women, than the overall

Victorian population; particularly within the older age categories. The higher levels of CHD in the older population groups living in Ballarat may simply reflect the relationship between age and CHD, but it was interesting to note that the BPAS data also indicated that there was a higher proportion of those in the 60–75 year age group who reported that they participated in insufficient levels of physical activity when compared to the national data. It is likely that those individuals who resided in Ballarat and reported insufficient levels of physical activity were disproportionately represented in the group reporting CHD. In a British regional heart study of men aged 40–59, Sharper et al. (1991) found that those who engaged in moderate to vigorous physical activity had a decreased rate of first heart attack. Similarly, Kushi et al. (1997), in a study of women from Iowa, reported that those who engaged in moderate activities four or more times a week had a 47% lower risk of CHD than those who did not engage, or rarely engaged, in such activity.

A total of 20 out of the 75 stroke deaths in Ballarat were estimated to have been attributable to physical inactivity. These deaths accounted for an estimated 26.7% of the deaths that occurred in Ballarat from stroke, which is higher than the Australian average of 16% or 2,049 out of 12,806 stroke deaths reported by Stephenson et al. (2000). The larger proportion of strokes attributed to physical inactivity in Ballarat compared to Australia may be explained by the data presented in the 1996 Victorian Burden of Disease study (DHS, 2000). This study reported that there was a substantially greater percentage of stroke deaths in Ballarat than in Victorian (7.25% and 6.57% respectively for males, and 9.65% and 7.82% respectively for females), and also that the death rate in Ballarat from stroke increased rapidly after the age of 45 years (DHS, 2000) It is apparent, therefore, that the benefit attributable to higher physical activity participation (particularly in the 45–59 year age group) exhibited by adult Ballarat residents on the incidence of stroke (Hu et al., 2000; Lindenstrom et al., 1993) was not sufficient to offset the impact of other causative factors for stroke.

The PAR for non-insulin dependent diabetes mellitus (NIDDM) attributable to physical inactivity in Ballarat was 9.9% and was estimated to result in two deaths annually. These data indicated that the PAR for NIDDM attributable to physical inactivity in Ballarat is lower than Australian average of 13% (380 deaths) reported by Stephenson et al. (2000). Despite the PAR for NIDDM attributable to physical activity in Ballarat being lower than the Australian average according to the Australian Institute of Health and Welfare (1999), the overall prevalence of NIDDM remains higher in Ballarat than for Australia overall. This finding is also supported by The Burden of Disease Study LGAs of Victoria (2000) and appears particularly to be the case for females residing in Ballarat, and may be related to the tendency for older females (over 75 years of age) residing in Ballarat to be insufficiently active. The importance of physical activity as a means of preventing or controlling NIDDM was highlighted by Helmrich et al. (1991) who suggested that men and women who engaged in moderate-intensity and/or vigorous physical activity decreased their risk of type 2 diabetes compared to sedentary individuals and thus decreased the risk of NIDDM. Further, leading professional associations such as The American College of Sports Medicine (2000) and the American Diabetes Association (2001) suggested that moderate-intensity activity which increases the heart rate to more than 100 beats per minute and is carried out over a 10-minute period may decrease blood glucose levels and reduce the risk of developing NIDDM.

The PAR for colon cancer and deaths attributable to physical inactivity in Ballarat was 15.4%, which was lower than the Australian average of 19% reported by Stephenson et al. (2000). However, the overall death rate attributable to colon and rectal cancer remained higher in Ballarat compared to the Australian population (0.58% versus 0.34% respectively) (DHS, Victoria, 1999; Stephenson et al.). Similarly, the 1996 Burden of Disease Study LGAs of Victoria (DHS, Victoria, 2000) also indicated that the overall colon cancer risk rate was higher in Ballarat than the Victorian average. Specifically, colon cancer and rectal cancer contributed to the second highest mortality rate for both males and females in Ballarat; particularly for those aged over 45 years (DHS, 2000). This finding may be linked to the findings of the present study, which found that after the age of 45, the proportion of adults participating in sufficient levels of physical activity decreased dramatically as Levi et al. (1999) found that increasing physical activity reduced the incidence of colon cancer and rectal cancer, by one-fifth to one-third respectively. Further to this, Colbert et al. (2001) also suggested that moderate and heavy regular activity at work decreased colon and rectal cancer risk.

In keeping with the data reported for CVD, NIDDM and colon and rectal cancer, the PAR for breast cancer (3.5%)—and the estimation that five deaths from this disease in Ballarat per year are attributable to physical inactivity—is lower than the Australian average of 9% (Stephenson et al., 2000). Nevertheless, the actual death rate due to breast cancer was greater in Ballarat compared to like data for Australia. The literature suggests that the incidence of breast cancer in Ballarat increased after the age of 35 (DHS, Victoria, 2000), and it may be reasonable to postulate that the incidence of breast cancer in Ballarat would be even higher if it were not for the higher levels of physical activity displayed by females residing in the city. This view is supported by Gilliland et al. (2001) who suggested that Hispanic women who expended 25 or more MET-hours per week performing vigorous activity had a 66% decreased risk of breast cancer compared with Hispanic white women who performed no vigorous activity.

Clearly, a major point of interest is to integrate the individual disease risk and physical activity data for Ballarat and to examine the PAR all-cause mortality attributable to physical inactivity. Overall the PAR for all-cause mortality attributable to physical activity in Ballarat is 12.7% and, as would be expected from an examination of the disease specific data presented above, is lower than the Australian average of 18% (Stephenson et al., 2000). The specific reasons for the lower all-cause mortality due to insufficient physical activity are likely to be varied. It is clear from the BPAS that adults in Ballarat engaged in more walking, and had more involvement in vigorous activity and gardening than the Australian reference population. The only area where the Ballarat population reported less activity than the Australian reference population was in the area of moderate physical activity. The available literature is quite clear in support of the positive impact of physical activity on all-cause mortality. For example, Hakim et al. (1998) suggested that those who engaged in walking decreased all-cause mortality and this applied particularly when the distance walked was increased. Further, Stessman et al. (2000) noted that individuals, particularly in the older age groups, who engaged in regularly lower-intensity physical activity reported lower overall mortality.

As mentioned previously, given that Ballarat has such high levels of participation in physical activity, it is readily apparent that physical activity is limiting the already high mortality rate due to diseases such as CVD, stoke, NIDDM and cancer. A simple substitution of the Australian all-cause mortality PAR (18% vs. 12.7%) into the Ballarat data reveals that the all-cause mortality in Ballarat is reduced by 39 deaths per year due to the higher physical activity participation rate.

Cost of Illness Attributable to Physical Inactivity

In the previous section, the effect of physical inactivity on the public health burden of Ballarat was discussed. In this section, addressing research question four, the cost of cardiovascular disease (CHD and stroke) that is attributable to physical inactivity in the city of Ballarat will be examined.

Since there is a lack of regional and rural-specific data, comparison will be made with national data. The financial calculations for the cost of CHD and stroke have been made using inpatient (hospital) costs from the Department of Human Services Victorian Cost Weight Study (DHS, Victoria, 2002) and the ratios of various components of cost taken from Mathers and Penm (1998).

The estimated direct health care costs for all CHD in Ballarat during the 2000–2001 financial year was approximately $9.41 million, or $109,418/1000 population. Stephenson et al. (2000) reported that the overall cost for CHD in 1993/1994 in Australia was $894 million in 1993/1994, or $49,670/1000 population. These data have not been adjusted for inflation (which is estimated to be 3% per annum). Therefore it needs to be acknowledged that the higher per capita cost of CHD in Ballarat may reflect both the overall higher incidence of CHD in Ballarat when compared to the Australian average (DHS, 2000), and the effect of inflation.

The CHD cost attributable to insufficient physical activity in Ballarat was $1.45 million while Stephenson et al. (2000) reported a figure of $161 million nationally in 1993/1994. These data correspond to a cost of CHD that is due to insufficient physical activity in Ballarat of $16,860/1000 population and in Australia of $8087/1000 population. The Australian Economic Indicators (ABS, 2003) showed that the

Consumer Price Index for Health increased by 21.97% over the period of 1993–1994 to 2000–2001. When the 1993–1994 national data are adjusted to take into account this inflation rate, the annual cost per 1000 population was increased to $9864/1000 population, which is still substantially less than the comparable figure for Ballarat.

An examination of the health care costs of stroke attributable to physical inactivity saw a similar pattern to that for CHD. The health care cost resulting from stroke in Ballarat during 2000/2001 that can attributed to insufficient physical activity was $705,105 per annum ($8,200/1000 population), compared with the 1993/1994 national cost of $101 million reported by Stephenson et al. ($5,610/1000 population or $6843/1000 after adjustment for inflation). As was evident for CHD, the higher per capita cost for stroke in Ballarat when compared to the Australian average reflects the overall higher incidence of CVD in Ballarat (DHS, Victoria, 2000).

The combined annual cost of CHD and stroke that can be attributed to physical inactivity was calculated to be $2.15 million. Therefore, it can be calculated using the approach used by Stephenson et al. (2000) that a one percent decrease in the proportion of adults residing in Ballarat who are insufficiently active would result in a $58,904 decrease in overall health care costs due to CHD and stroke.

In summary, although the proportion of PAR for CHD and stroke was lower in Ballarat than nationally, the actual proportion of death rate for CHD and stroke was higher, and the per capita cost for CHD and stroke was also found to be higher in Ballarat. The overall cost for CHD and stroke due to inactivity was $2.15 million per annum. If there were to be a one percent decrease in physical inactivity, it would be possible to bring about a reduction in the health cost of CHD and stroke of $58,904 annually.

Theoretical Models and Physical Activity Determinants

The previous section discussed the current cost of CHD and stroke that is attributable to physical inactivity in Ballarat. This section, addressing research question five, identifies the major determinants affecting levels of physical activity in Ballarat, and discusses the most relevant theoretical models that could be used in the design and implementation of any intervention programs. Knowledge of the major determinants will contribute to a clearer understanding of factors affecting physical activity in a regional setting within a range of theoretical contexts, and this, in turn, will facilitate the establishment of a strategic evidence-based framework as a guide for public health planners and policy makers. The findings are discussed in relation to published theories of physical activity participation and theory-based physical activity intervention strategies. Data have been obtained using a range of statistical techniques, including multivariate logistic regression (odds ratios), chi square and cross tabulations.

The proportion of adults in Ballarat who are physically inactive is low compared to the Australian average (39.9% vs. 43.4%, respectively). However, adult physical inactivity still remains high and contributes to 12.7% of the all-cause mortality within the community. The issue facing community health planners is whether this rate of physical inactivity and its consequent impact upon community health warrants the implementation of a series of integrated and well coordinated interventions in an attempt to reduce these diseases and increase the general physical and social well-being of the community.

The published research clearly shows that well-planned theory-based physical activity interventions successfully enhance physical activity behaviours (Bock et al., 2001; Dishman, 1990). In the following section, the results of the BPAS are discussed in the overall context of the socio-ecological model (McLeroy et al., 1988). This discussion will incorporate other well-accepted theories such as the Social Cognitive Theory (SCT) (Bandura, 1986). The socio-ecological model proposes that several constructs are important for behavioural change, including individual, interpersonal processes and primary groups, organisational (environmental), community, public policy. This discussion is mainly focused on the system levels of individual, interpersonal process and primary groups and organisational (environmental), as the BPAS did not explore community and public policy variables.

INDIVIDUAL LEVEL

The BPAS data indicate that the strongest individual predictor of physical inactivity in this regional city is a lack of confidence to exercise when tired, or when there is a perceived lack of time. Other individual factors include self-reported ill health and lower levels of formal education. These findings are supported, in general, by Bandura's social cognitive theory (1986), which suggests that self-efficacy, a specific form of confidence, influences behaviour adoption and maintenance. These data also support previous research and reviews that specifically address physical activity which have suggested that self-efficacy is a strong predictor of physical activity adoption and maintenance (Booth et al., 2000; Brassington et al., 2002; Sallis & Owen, 1999).

The detailed findings of the current study show that, overall, individuals are less likely to be confident about being physically active when they are tired or when they are in a bad mood. Also, respondents reported that they are less likely to be confident about being physically active when they lacked time or when they were tired. Confidence is also reflected in the individual component of the socio-ecological model devised by McLeroy et al. (1988). These data are further supported by the data that explored self-efficacy according to activity status. The Chi square results showed that insufficiently active adults residing in Ballarat were less confident in their ability to undertake physical activity when confronted by factors such as tiredness, being in a bad mood or lack of time than those who were sufficiently active. The findings are consistent with those published by Booth et al. (2000), who noted that 48% of very active adults aged 60 years and over reported high levels of confidence, compared to 26.6% of inactive adults in the same age group.

The link between physical activity and self-reported health status observed in the current study for both males and females was supported by Australian data presented by Booth, who reported that nearly 15% of insufficiently active males and females reported ill-health as a barrier to participation in physical. These data are also supported internationally by those reported by Brown (1999), who noted that people from Scotland at risk of coronary heart disease reported that they had less confidence in participating in exercise. Booth et al. (2000) further also noted that exercise participation decreased with ageing and was associated with a decline in health.

As outlined above, the results of the BPAS show that ill-health was perceived to be a significant barrier to participation in physical activity. McAuley and Mihalko (1998) identified four operational definitions of self-efficacy used in physical activity research. Of relevance to here is the concept of health behaviour efficacy, which is an individual's belief in their ability to engage in health prevention behaviour, such as physical activity. For instance, Brown (1999) found in a British study that those at risk of coronary heart disease reported that the major barrier to participation in an exercise program was lack of confidence to engage in such behaviour. This trend was also evident in the U.S. where Brownson et al. (2001) and Wilcox et al. (2000) also noted that poor health and lack of energy were general barriers to participation in physical activity. Wilcox et al. also reported that that lack of energy was a particular barrier to participation in physical activity among urban females aged 40 years and older.

This construct may explain the high rates of CVD and other conditions, such as colon cancer, breast cancer, NIDDM, and falls incidence, reported in Ballarat. Interestingly, the BPAS findings show that from the age of 45 years there is a remarkable increase in the reporting of ill health as a barrier to participation in physical activity. It is important to note that clinical intervention programs can be implemented to assist individuals with low self-confidence. For example, Will (1998) recruited individuals who suffered from either CHD or stroke and successfully instigated a face-to-face-counselling program to increase their confidence to participate in physical activity and change their behaviour.

The second individual factor explored in the BPAS was motivational readiness. Generally, motivation is considered to be an individual factor and an attitude determinant within the socio-ecological model (McLeroy et al., 1988). The specific construct of motivational readiness is based on personal factors as suggested in Bandura's (1986) social cognitive theory and the Transtheoretical model of Prochaska and Marcus (1984). The findings of the BPAS show that motivational readiness is an important indicator of physical activity participation. Respondents to the BPAS who did not intend to be more active were 1.9 times less likely to be physically active compared to those who intended to exercise in the next month. Further, those indicating that they did not intend to be more active were 1.5 times less likely to be physically active than those who were prepared to exercise in the next six months. Given the strong link between motivation and physical activity participation, it was heartening to observe that nearly one-third of insufficiently active respondents reported that they contemplated beginning exercise within the next six months.

The Transtheoretical model proposes that there are five stages of change that individuals go through in adopting regular physical activity behaviour. The early stages of the model are *pre-contemplation*, which refers to individuals who are inactive and do not intend to exercise ('I won't' or 'I can't') and *contemplation*, where individuals intend to exercise in the next six months. It is in contemplation, particularly, that most people assess the pros and cons of a particular behaviour. Self-efficacy is generally reported to be lowest in the pre-contemplation and contemplation stages (Marcus et al., 1994; Sallis et al., 1992). Self-efficacy was generally low in the BPAS respondents who were in the early stages of change (pre-contemplation or contemplation). As indicated above, individuals within these groups tended to have lower educational levels and suffer from ill health. The interrelated nature of these factors was highlighted by Brownson et al. (2001) who reported in an American study that low health status was significantly associated with lower income.

Studies have suggested that interventions that target particular stages of change and self-efficacy can be successful in moving people along these stages (Dunn et al., 1999; Gorel & Gordon, 1995; Marcus et al., 1992; Pinto et al., 2001). This suggests that strategies to encourage weighing up the pros and cons (decisional balance), as well as enhancing the self-efficacy of participants, might also help individuals progress through the stages of change and increase their motivational readiness participate in physical activity.

The BPAS respondents with less than 12 years of formal education were less likely to be physically active compared to those with a tertiary education. Education could be considered as a personal or an environmental factor according to Bandura’s (1986) social cognitive theory and within the socio-environmental model, education is defined as an individual determinant. There is a substantial amount of evidence to suggest that education levels have both a direct and an indirect influence on access to facilities, socio-economic status, income, peer group, and occupational status (Bennett et al., 1995; Chinn et al., 1999; King et al., 1991; Owen & Bauman, 1992). It should be noted, however, that physical activity sufficiency was based on the use of discretionary or non-occupational time in keeping with the method outlined by the NPAS. Importantly, the BPAS data indicated that those less-educated people were engaged in the most physically demanding jobs. Therefore, it is apparent that the survey tool is limited in its application to this particular population group. Despite this limitation, the link between education and insufficient levels of activity was identified as being ill health.

Overall, BPAS respondents reported the barriers to participation in physical activity to be lack of time due to work or study, lack of energy, and financial expenses. These data are in keeping with those published by Booth et al. (1995), who noted that 34.6% of the Australian adult population reported that the main barrier to participation was lack of time; however, other factors included lack of energy were also considered important. The negative impact of cost of participation on overall physical activity participation rates has also been reported by Chinn et al. (1999) who found that a lack of money was significantly associated with lower physical activity participation rates.

A somewhat different pattern of barriers to participation in physical activity was evident in those individuals who possessed high levels of formal education. The respondents to the BPAS who had undertaken tertiary education often reported that they lacked the time to exercise due to work or study. These findings are consistent with those reported by Bauman et al. (2001) who found that middle-aged educated people in Australia reported that lack of time due to work or study was a major barrier in their attempts to be physically active. International data such as that reported by Zunft et al. (1999), in a study from the European Union, also supported this finding. They reported that 46% of Italians males aged 15–34 suggested that lack of time due to work or study was a barrier to participation in physical activity. Further, Zunft et al. also reported the link between insufficient physical activity, education and ill health, by noting that 35% of people with less than 12 years of education reported ill-health as a barrier.

Knowledge of physical activity concepts is considered by the socio-ecological model (McLeroy et al., 1988) and social cognitive theory (Bandura, 1986) as an individual determinant. It was interesting to note that the BPAS respondents displayed a good level of knowledge of the recommended physical activity strategies and that their knowledge of these strategies was not a good discriminator or predictor of physical activity habits. When asked to give their opinions on physical activity recommendations, both insufficiently and sufficiently active respondents were in equal agreement for the statement, ‘Moderate exercise that increases your heart rate slightly can improve your health’ and the statement, ‘Half an hour of brisk walking on most days is enough to improve your health’. These findings are in agreement with those presented by Armstrong et al. (2000) who found a similar trend in the period 1997–99, where participation in physical activity had decreased although overall knowledge of physical activity had increased.

The BPAS respondents reported that barriers to participation in physical activity varied according to age. Those aged 18–29 years reported barriers to participation in physical activity to be lack of energy, lack of the self discipline required, and lack of time.

Ainsworth (2000) suggested that factors, such as demands of work and family and lack of time, were barriers to participation in physical activity for the 18–29 age group, particularly females. Similarly, Booth (1997) suggested that younger females who were insufficiently active cited barriers to participation in physical activity as insufficient time, lack of motivation, and childcare responsibilities. The BPAS findings reflect this: the females aged 18–29 who were insufficiently active reported lack of energy, lack of self-discipline required, and lack of time as barriers to participation in physical activity. These factors have been defined as 'individual determinants' by McLeroy et al. (1988), and 'barriers efficacy' in the social cognitive theory of Bandura (1986).

In general, the major organisational barriers to participation in physical activity were reported to be the lack of time due to work or study and a belief that exercise costs too much. Work and/or study commitments were a particularly issue for those respondents aged less than 44 years, whereas cost was a considered to be a major inhibitor to participation in physical activity by young adults aged 18–29 years and by those with less than 12 years of formal education.

INTERPERSONAL PROCESSES AND PRIMARY GROUPS

In the socio-ecological model of McLeroy et al. (1988), social support is considered to be a determinant of interpersonal processes and primary groups. Given the important role of social support within the model, it was important to note that support from friends and family either as an exercise partner or as a shared interest in exercise/physical activity were considered to be two of the four most important facilitators of exercise for all respondents. These factors were important to a large proportion of insufficiently active adults in Ballarat, irrespective of gender and educational level. A tendency was also noted for a greater proportion of insufficiently active females to consider social support to be a more important factor than was reported by insufficiently active males. Further, a higher level of social support was perceived to be available for those respondents who were sufficiently active as opposed to those classified as insufficiently active. Despite the strong indication of the importance of social support to the BPAS respondents, it is important to note that social support was not identified as a statistically significant predictor of participation in physical activity.

In general, these findings are consistent with data reported by Booth et al. (2000), who noted that support from friends and family is associated with increased participation in physical activity by Australian adults 60 years and older, and that those with a greater proportion of support showed higher levels of physical activity participation. Importantly, however, the data obtained in the BPAS indicated that social support was considered to be a strong facilitator for all insufficiently active adults, irrespective of age. Of interest was also the data which indicated that social support was particularly important to those insufficiently active respondents who were widowed, elderly, and less educated. Wilcox et al. (2000) supported this notion with the finding that both urban and rural women aged 40 years and over with lower education levels had less social support for participation in physical activity, and that this was independently associated with sedentary behaviour. It was also interesting to observe that there was a trend for individuals who reported that they were either married or in a de facto relationship to be insufficiently active. This trend may indicate that family pressures or a lack of family support negatively influenced the physical activity levels of individuals in this group. The importance of family factors as a critical determinant of physical activity participation rates has previously been reported by a range of authors including Sallis & Owen, (1999), Booth et al. (1997) and Eyler et al. (1999). In a practical sense, Will (1998) suggested that similar data from the North Carolina Wise Women intervention program indicated that the best approach would be increasing in social support by establishing community and neighbourhood walking groups.

ORGANISATIONAL (ENVIRONMENTAL)

The final factor to be explored under the socio-ecological model of McLeroy et al. (1988) are those areas broadly considered under the banner of social institutions and organisational determinants. The issues explored as barriers to participation in physical activity under this aspect of the socio-ecological model include access to facilities, adequacy of facilities, cost of exercising and access to transport. The facilitators included proximity of facilities, range of facilities, cost of facilities, quality of facilities, availability of leisure time and availability of organised sports.

Access to transport, lack of time due to leisure activities, concern about crime, no facilities nearby, and poor weather conditions were barriers to participation in physical activity by older adults in the 60–75 year age group. These barriers are defined in the socio-ecological model (McLeroy et al., 1988) as organisational barriers. Napolitano and Marcus (2000) also suggested that neighbourhood safety, convenience, proximity, and accessibility of facilitators are important determinants of physical activity participation.

As one might expect from the data presented above, the desire for less expensive facilities was seen as a facilitator of physical activity by all age groups, as was the need for more leisure time. However, type and proximity of recreational facilities was not seen as a facilitator of physical activity by most age categories. Interestingly, the availability of organised sports was not seen as a facilitator of physical activity participation. This has significance when considering the current government policy of encouraging membership of sporting groups as a means of encouraging physical activity (ASC, 2002). According to the requirements of the insufficiently active, provision of facilities for sport and physical activity will not necessarily increase this group's participation in physical activity as their requirements (more leisure time and better facilities) are completely different.

The strong indication that cost of participation was seen as a barrier to participation in physical activity by the inactive respondents is of concern. It is apparent from these data that there is a perception that physical activity involves significant cost. It can only be assumed that the respondents associated physical activity participation with membership of leisure centres or the purchase of specialist equipment such as specialist shoes. It is obvious that such a perception is incorrect but, nevertheless, one that must be addressed. The notion of environmental change to facilitate the uptake of physical activity was advocated by Robinson et al. (1993) when they suggested that physical activity–focused environmental changes should be carried out to support the public health guidelines as outlined in the Ottawa Charter (WHO, 1986) A specific potential solution was suggested by Brownson et al. (2000) and Will (1998) who advocated that the creation of low cost exercise facilities, such as walking trails, might increase physical activity participation among women and people in lower socioeconomic groups. There is also a need for local governments to explore the potential to offer discount facility access options to individuals within lower socio-economic groups. The breadth of any environmental changes has been highlighted by Sallis et al. (1998) who further noted that the physical activity environment must be created to cater for the psychological, logistical, and economic capacity of the participants.

The BPAS indicated that people needed more leisure time, people with whom to participate and common interest friends. 'Social support' was also a very important determinant, as discussed earlier. These findings are consistent with a Western Australian study by Bull (2000), where participants reported that they would be more active if they had better facilities and social support. The Chi square results significantly indicated in the 31% of insufficiently active people need 'more leisure time'. Chinn et al. (1999) found that UK women of a lower socioeconomic position lacked the leisure time necessary to increase their participation in physical activity. The BPAS data suggested that the tertiary-educated and VCE respondents required 'more leisure time'. This trend may be due to a higher involvement in 'work or study', or perhaps the priority is for more leisure activity rather than more exercise facilities.

Sallis et al. (1998) suggested the creation of a supportive environment for physical activity participation in the community, neighbourhood, and work site, can be implemented via structured programs (aerobic classes, supervised recreation, walking clubs and behaviour counselling) and unstructured programs (such as walking and jogging) are important aspects to consider for targeted group physical activity interventions. Models such as the Socioecological model (McLeroy et al., 1988), Social Cognitive Theory (SCT) (Bandura, 1986) and the Transtheoretical Model (TTM) (Prochaska & DiClemente, 1982, 1984), along with the findings of the present study, suggest that several constructs are important in physical activity behaviour. These include individual determinants (such as confidence, ill health, motivation, education, knowledge and barriers); interpersonal process primary groups (such as social support, which includes family and friends support and facilitators); and organisational determinants (such as facilitators and physical environment).

Discussion of the above theoretical models suggests that well-focused and targeted theory-based intervention programs could lead to increased physical activity participation in Ballarat. Such programs might include individual strategies aimed at targeting confidence or self-efficacy and increasing motivational readiness and minimising ill health; interpersonal strategies aimed at increasing social support; and environmental/organisational strategies aimed at targeting support for individuals with ill health and lower education levels, as well as creating low cost physical activity environments.

CONCLUSION

This study reported on the findings of the Ballarat Physical Activity Survey. It investigated Ballarat's current levels of physical activity and inactivity (making comparisons with relevant national data), identified the barriers and facilitators affecting increased participation in physical activity, examined the association between physical activity levels and particular health conditions, calculated the current health care cost to the community of physical inactivity, and discussed models for intervention. These findings are of major importance, providing a valuable basis for future comparative studies. The study revealed that although Ballarat people were more active, in general, than the overall Australian population, the barriers and facilitators affecting increased participation in physical activity were similar across both populations.

Physical Activity Levels in Ballarat

Although the majority of respondents to the Ballarat survey were sufficiently active, there were still 34.4% insufficiently active respondents. Of the insufficiently active population, six groups have been identified as targets for intervention:

- females
- the elderly
- married and de facto couples
- those with lower educational levels
- blue collar employees
- obese individuals

Comparison of BPAS and NPAS Results

In comparing the results of the NPAS and the BPAS, together with available statistics on the overall Australian population, the Ballarat survey revealed:

- a higher proportion of elderly people, blue collar employees, and obese individuals lived in Ballarat;
- more sufficiently active individuals (largely due to an increased participation in walking and vigorous exercise);
- fewer sedentary individuals;
- fewer individuals participating in moderate-intensity physical activity; and
- more individuals engaged in vigorous-intensity gardening.

Public Health Burden of Physical Inactivity in Ballarat

This study also investigated the association between physical inactivity levels and CHD, NIDDM, colon cancer, stroke, breast cancer, falls incidence, and all-cause mortality in the city of Ballarat, with the following findings:

- Insufficient physical activity was estimated to be responsible for 31 deaths from CHD and 20 deaths from strokes in Ballarat. A smaller proportion of deaths from colon cancer, breast cancer, and NIDDM were attributable to physical inactivity.
- The population attributable risk (PAR) was lower for CHD, stroke, NIDDM, colon cancer, breast cancer, and all-cause mortality than the Australian average
- The proportion of deaths in Ballarat from CHD, stroke, NIDDM, colon cancer, and breast cancer was higher than the Australian average
- The cost per capita for CHD and stroke was higher in Ballarat compared to the Australian average

Factors Affecting Physical Activity Among Insufficiently Active

The study investigated the features which determined, inhibited or promoted increased levels of physical activity among the insufficiently active. While this group displayed a good knowledge of physical activity recommendations, other factors were identified that contributed to their insufficient levels of physical activity.

- Predictors and correlates for insufficient activity were identified as lack of confidence, ill health, lower level of education, low level of intention to be physically active. These determinants reflect individual factors, whereas lack of support from family and friends relates to interpersonal factors.

- Major barriers to participation in sufficient activity were identified as lack of energy, and lack of time due to work or study. These barriers are individual determinants, and financial expenses are more of an organisational determinant.

- Required facilitators for participation in sufficient activity were identified as people with whom to participate, common interest friends, more leisure time, and less expensive facilities are organisational determinants.

- The barriers and facilitators identified were discussed in relation to the Socio-ecological model (McLeroy et al., 1988), Social Cognitive Theory (SCT) (Bandura, 1986), and Transtheoretical model (TTM) (Prochaska & DiClemente, 1982, 1984). These theoretical models provide framework for interpreting the individual, interpersonal, and organisational factors recognised in this study.

Future Research

Future research needs to explore in detail the following research questions:

- Future research needs to be carried out using well-focused and targeted theory-based pilot intervention programs. These programs should aim to increase confidence and self-efficacy, minimise ill health (and support those with ill health), help those with lower education levels, and increase motivational readiness. It is suggested that intervention programs based on the socio-ecological model (McLeroy et al., 1988) social cognitive theory (SCT) (Bandura, 1986), or transtheoretical model (TTM) (Prochaska & DiClemente, 1982, 1984) could be used to target these factors, and therefore could be successful in increasing the levels of physical activity among adult residents of Ballarat. These intervention programs should aim to target women, the elderly, the lower educated, and the obese.

- Future research needs to examine, in detail, the public health care cost attributable to physical inactivity of such conditions as colon cancer, breast cancer, NIDDM and falls incidences. This study was unable to examine this public health care cost in detail, due to the unavailability of relevant data in a regional setting.

- Finally, future research needs to monitor the levels of physical activity, the barriers and facilitators affecting increased participation, the population attributable risk factors, and the public health care cost of physical inactivity in Australian rural communities. These data will then be available for the planning, implementation and evaluation of physical activity programs in rural populations.

APPENDIX 1

2002 BALLARAT PHYSICAL ACTIVITY SURVEY

Physical Activity Survey

Associate Professor Warren Payne and Mr. Jayantha Dassanayake, on behalf of the University of Ballarat and the Central Highlands Primary Care Partnership **INVITE** you to participate in a survey of the physical activity levels of adults within Ballarat.

Participation in the survey is **VOLUNTARY**.

Your participation and the subsequent research results will be important for the planning of future health and exercise programs in Ballarat.

Your name and address have been selected randomly from the State Electoral Role.

Please read the following instructions and information before answering the questions:

- The questionnaire should only take about 15 minutes to complete.
- Please answer ALL questions.
- Please complete the questionnaire **YOURSELF** - don't give it to someone else to do unless a disability prevents you from actually writing the answers to the questions.
- **YOUR ANSWERS WILL BE STRICTLY CONFIDENTIAL**. Your name will not be able to be associated with your response.
- Please try to complete and return the questionnaire as soon as possible.
- Two reminder cards will be sent to you (irrespective of whether you have returned the questionnaire, as we will not be able to identify your individual response because of the confidentiality requirements).
- When you have completed the questionnaire, please return it in the envelope provided. No stamp is required.
- The bar code on the reply paid envelope is for Australia Post billing purposes only.
- The University of Ballarat Human Research Ethics Committee has reviewed and approved this study.
- In the unlikely event that some aspect of this questionnaire causes you personal distress, you may wish to contact the Principal Researcher, Assoc. Prof. Warren Payne, on 5327-9693 or the University Counseling Service on 5327-9474 (any consultations will be provided free of charge to you).

THANK YOU

WE HOPE THAT YOU ENJOY COMPLETING

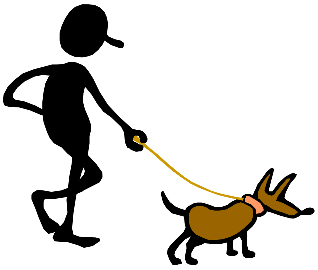
THIS QUESTIONNAIRE

Section 1: Participation in walking during the previous week

Please try to answer each question as accurately as you can.

1. ***IN THE LAST WEEK*** how many times have you **walked continuously**, for at least 10 minutes, for recreation/exercise or to get to or from places?

(Please tick **one** box)



Number of times per week

None	☐	5 Times	☐
Once	☐	6 Times	☐
2 Times	☐	7 Times	☐
3 Times	☐	7+ Times	☐
4 Times	☐	Don't know	☐

2. In total how much time do you estimate, you spent walking continuously ***IN THE LAST WEEK***? ***(Remember to total all periods of walking for each day and to start working backwards for seven days from yesterday)***

(Please tick **one** box per day)

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
None							
1 to 10 min							
11 to 20 min							
21 to 30 min							
31 to 40 min							
41 to 50 min							
51 to 60 min							
60+ min							

Section 2: Vigorous household chores in the previous week

3. **IN THE LAST WEEK** how many times did you do any vigorous household chores, (excluding gardening) which made you breathe harder or puff and pant?

Number of times per week

None	☐	5 Times	☐
Once	☐	6 Times	☐
2 Times	☐	7 Times	☐
3 Times	☐	7+ Times	☐
4 Times	☐	Don't know	☐

4. How long would you estimate that you spent doing these vigorous household chores ***IN THE LAST WEEK*? (*Remember to total all periods of vigorous household chores for each day and to start working backwards for seven days from yesterday.)***

(Please tick **one** box per day)

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
None							
1 to 10 min							
11 to 20 min							
21 to 30 min							
31 to 40 min							
41 to 50 min							
51 to 60 min							
60+ min							

Section 3: Vigorous gardening or hours worked around the yard

5. ***IN THE LAST WEEK*** how many times did you do any vigorous gardening or heavy work around the yard, which made you breathe harder or puff and pant?

Number of times per week

None	☐	5 Times	☐
Once	☐	6 Times	☐
2 Times	☐	7 Times	☐
3 Times	☐	7+ Times	☐
4 Times	☐	Don't know	☐

6. ***IN THE LAST WEEK***, how long would you estimate that you spent doing vigorous gardening or heavy work around the yard? **(*Remember to total all periods of vigorous gardening or work around the yard for each day and to start working backwards for seven days from yesterday.)***

(Please tick **one** box per day)

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
None							
1 to 10 min							
11 to 20 min							
21 to 30 min							
31 to 40 min							
41 to 50 min							
51 to 60 min							
60+ min							

Section 4: Vigorous physical activity that makes you breathe harder or puff and pant

This question excludes household chores, occupational activities or gardening, but includes the number of times doing vigorous physical activity.

7. ***IN THE LAST WEEK***, how many times did you do any vigorous physical activity, which made you breathe harder or puff and pant? (e.g., tennis, jogging, cycling, keep fit exercises)

Number of times per week

None	☐	5 Times	☐
Once	☐	6 Times	☐
2 Times	☐	7 Times	☐
3 Times	☐	7+ Times	☐
4 Times	☐	Don't know	☐

8. How long would you estimate that you spent doing this vigorous physical activity ***IN THE LAST WEEK***? (e.g., tennis, jogging, cycling, keep fit exercise). **(*Remember to total all periods of vigorous physical activity for each day and to start working backwards for seven days from yesterday.)***

(Please tick **one** box per day)

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
None							
1 to 10 min							
11 to 20 min							
21 to 30 min							
31 to 40 min							
41 to 50 min							
51 to 60 min							
60+ min							

Section 5: Moderate sports activities

This section *EXCLUDES* household chores, occupational activities or gardening. Please enter number of times doing moderate activities not already mentioned.

9. **IN THE LAST WEEK** how many times did you do any other more moderate physical activity that you haven't already mentioned? (e.g., lawn bowls, golf, gentle swimming etc.)

Number of times per week

None	☐	5 Times	☐
Once	☐	6 Times	☐
2 Times	☐	7 Times	☐
3 Times	☐	7+ Times	☐
4 Times	☐	Don't know	☐

10. What do you estimate was the total time that you spent doing these activities ***IN THE LAST WEEK****? (****Remember to total all periods of vigorous physical activity for each day and to start working backwards for seven days from yesterday.)***

(Please tick **one** box per day)

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
None							
1 to 10 min							
11 to 20 min							
21 to 30 min							
31 to 40 min							
41 to 50 min							
51 to 60 min							
60+ min							

Section 6: Average weekly level of activity
IN THE LAST SIX MONTHS

11. ***ON AVERAGE, IN THE LAST SIX MONTHS*** how much time did you spend each week walking for recreation/exercise or to get to or from places?

Average number of hours each week for the last six months

- None ☐
- 1 hour 10 min ☐
- 1 hour 45 min ☐
- 3 hours 30 min ☐
- 5 hours 15 min ☐
- 7 hours or more ☐

The next question *EXCLUDES* household chores, occupational activity or gardening.

12. ***ON AVERAGE, IN THE LAST SIX MONTHS*** how much time did you spend each week doing vigorous physical activity, which made you breath harder or puff and pant? (e.g., tennis, jogging, cycling, keep fit exercises, etc.).

Average number of hours each week for the last six months

- None ☐
- 1 hour 10 min ☐
- 1 hour 45 min ☐
- 3 hours 30 min ☐
- 5 hours 15 min ☐
- 7 hours or more ☐

13. ***ON AVERAGE, IN THE LAST SIX MONTHS*** how much time did you spend each week doing any other more moderate physical activity that you haven't already mentioned? (e.g., lawn bowls, golf, gentle swimming, etc.)

None	☐
1 hour 10 min	☐
1 hour 45 min	☐
3 hours 30 min	☐
5 hours 15 min	☐
7 hours or more	☐

Section 7: This section will ask about your physical activity in your occupation

This section is to be completed only if you are employed, otherwise please go to Section 8.

14. If you are employed, when you are at work, which of the following best describes what you do? Would you say you:

(Please tick **one** box)

Mostly sit or stand	☐
Mostly walk	☐
Mostly do heavy labor or physically demanding work	☐
Don't know/not sure	☐

15. If you are employed, on average when you are at work, how many hours per week do you participate in the type of activity you do most, as indicated above in question 14. (Please tick **one** box)

- 0-5 hours/week ☐
- 5-10 hours/week ☐
- 10-20 hours/week ☐
- 20-30 hours/week ☐
- 30-40 hours/week ☐
- 40+ hours/week ☐

Section 8: This section will ask about your TV/Video watching and recreational computer use

16. **ON AVERAGE** how many hours of ***TV/Video*** do you watch per day?

(Please tick **one** box)

- None ☐
- Less than 1 hour ☐
- 1-2 hours ☐
- 2-3 hours ☐
- 3-4 hours ☐
- 4-5 hours ☐
- 5+ hours ☐

17. **ON AVERAGE** how many hours of recreational computer use do you participate in per day (e.g., Internet, games)?

(Please tick **one** box)

- None ☐
- Less than 1 hour ☐
- 1-2 hours ☐
- 2-3 hours ☐
- 3-4 hours ☐
- 4-5 hours ☐
- 5+ hours ☐

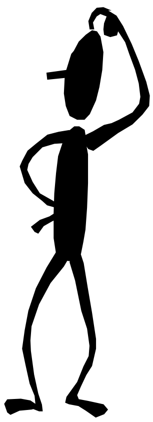
Section 9: Intentions to be physically active

The following statements are about the amount of exercise you *INTEND TO DO* in the near future.

18. Which one best describes how you feel at present?

(Please tick **one** box)

- You do ***NOT*** intend to be more active than you have been over the last week ☐
- You intend to be more active over the ***NEXT MONTH*** than you have been over the last week. ☐
- You intend to become more active sometime over the ***NEXT 6 MONTHS*** than you have been over the last week. ☐
- Don't know ☐



Section 10:
Opinion on physical activity recommendations

19. To what extent do ***YOU*** agree or disagree with each of the following statements about physical activity and health. (Please tick **one box for each row**)

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Taking the stairs at work or generally being more active for at least 30 minutes each day is enough to improve your health					
Half an hour of brisk walking on most days is enough to improve your health					
To improve your health it is essential for you to do vigorous exercise for at least 20 minutes each time, 3 times a week					
Exercise doesn’t have to be done all at one time - blocks of 10 minutes are okay					
Moderate exercise that increases your heart rate slightly can improve your health					

Section 11: Confidence in being physically active

20. What confidence rating best describes how ***YOU*** feel in the following situations?

(Please tick **one box for each row**)

	Not at all confident	Slightly confident	Moderately confident	Very confident	Extremely confident
You could exercise when you are tired					
You could exercise when you are in a bad mood					
You could exercise when you feel you don't have time					

Section 12: Barriers and facilitators to participation in physical activity

21. If you want to participate more in physical activity than you do now, why aren't you able to?

(Please tick the box(es) that you feel are relevant to you)

I don't want to participate more	☐	No facilities near by	☐
Ill health	☐	Available facilities are inadequate	☐
Lack of energy	☐	Requires too much self discipline	☐
Lack of time because of work or study	☐	Lack of necessary skills	☐
Lack of time because of other leisure activity	☐	Poor access to transport	☐
Costs too much	☐	Poor weather conditions	☐
Concern about crime	☐	No time	☐
Other ………………………..	☐		

22. If you wanted to participate more in physical activity which three (3) of the following would be most likely to increase the amount of physical activity you do?

(Please tick the box(es) that you feel are relevant to you)

Nothing	☐	Better facilities	☐
Closer facilities	☐	People with whom to participate	☐
Different facilities	☐	Common interests of friends	☐
Less expensive facilities	☐	Fitness test with personal activity program available	☐
More information on benefits of doing physical activity	☐	More leisure time	☐
Employer sponsored activities available	☐	Organised sports available	☐
Organised fitness classes available	☐		

Others……………………

Section 13: Social support for physical activity

23. How supportive is ***YOUR FAMILY*** towards your participating in exercise/physical activity?

(Please tick **one** box)

- Very much against ☐
- Against ☐
- Neither against nor supportive ☐
- Supportive ☐
- Very supportive ☐
- Not applicable ☐

24. How supportive are ***YOUR FRIENDS*** towards your participating in exercise/physical activity?

(Please tick **one** box)

- Very much against ☐
- Against ☐
- Neither against nor supportive ☐
- Supportive ☐
- Very supportive ☐
- Not applicable ☐

Section 14: About you

(Please tick **one** box)

25. Are you a male or female?

Male ☐
Female ☐

26. What is your age?

……………Yrs

27. What is your marital status?

Married or Defacto ☐
Single ☐
Widowed ☐

28. What is your approximate weight in pounds, stones, or kilograms?

Pounds……………………………..
Stones……………………………….
Kilograms…………………………..

29. What is your approximate height in feet and inches or cms?

Feet…………………………inches……………
Centimeters………………………..

30. How ***MANY*** people ***UNDER 18*** reside at your home?

……………………………………………..

31. How ***MANY*** children ***AGED 5 AND UNDER*** reside at your home?

……………………………………………….

32. How ***MANY*** adults between ***18 and 75***, including yourself live in your household?

……………………………………………….

33. What is the highest level of education you have ***COMPLETED***?

(Please tick **one** box)

Never attended school, some primary school ☐
Completed primary school ☐
Some high school ☐
School certificate/intermediate/year 10/4th form ☐
HSC/leaving/year 12/6th form ☐
TAFE certificate/diploma ☐
University, CAE or other Tertiary institution degree ☐
Other, please specify……………………………………..

34. What is your current occupation?

(Please tick **one** box)

Manager/Administrator ☐
Professional/Para-professional ☐
Tradesperson ☐
Clerk ☐
Sales person and personal service worker ☐
Plant machine operator/driver ☐
Laborer ☐
Unemployed ☐
Home duties ☐
Retired ☐
Student ☐
Other, please specify……………………………

35. Which language do you usually speak at home?

English	☐	Macedonian	☐
Arabic	☐	Maltese	☐
Cantonese	☐	Mandarin	☐
Croatian	☐	Polish	☐
Dutch	☐	Russian	☐
Filipino	☐	Serbian	☐
French	☐	Slovene	☐
German	☐	Spanish	☐
Hindi	☐	Vietnamese	☐
Hungarian	☐	Lebanese	☐
Italian	☐		

Others…………….

36. What suburb or town do you live in? (e.g., Alfredton, Wendouree, Buninyong)

………………………………………………………………………………………

37. Are there any other comments you wish to make regarding participation of physical activity?

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

THANK YOU FOR YOUR TIME

PLEASE CHECK THAT YOU HAVE COMPLETED ALL RESPONSES ON EVERY PAGE

PLEASE RETURN THE QUESTIONNAIRE IN THE ENVELOPE PROVIDED

(NO POSTAGE STAMP REQUIRED)

APPENDIX 2

REMINDER POSTCARD

UNIVERSITY of BALLARAT

RE: PHYSICAL ACTIVITY SURVEY

Recently, you were mailed a copy of the Physical Activity Survey from the University of Ballarat. The results of this survey will be important for the planning of future health and exercise programs in Ballarat.

The response rate for the survey has been very encouraging. We realise that you may have already completed and returned the survey but because of the confidentiality requirement of the study we are not been able to identify your actual return. If you **have not** already completed the survey, it would be greatly appreciated if you could do so. Please return the survey in the 'Reply Paid' envelope provided.

Thank you for your participation in the survey.

Associate Professor Warren Payne (Principal Researcher)
Telephone: 5327-9693

APPENDIX 3

CALCULATION OF PAR

Table A1

Proportion of Diseases Attributable to Physical Inactivity

DISEASE	RR*	N = P(RR-1)*	D = 1+P(RR-1)*	PAR = N/D (%)
All-cause mortality	1.4 (moderate) 1.7 (vigorous)	0.146 0.2555	1.146 1.2555	12.7 20.4
CHD-mortality and incidence	1.5 (moderate) 1.9 (vigorous)	0.1825 0.3285	1.1825 1.3285	15.4 24.7
Stroke mortality and incidence	2.0 (moderate) 3.3 (vigorous)	0.365 0.8395	1.365 1.8395	26.7 45.6
NIDDM incidence	1.3	0.1095	1.1095	9.9
Colon cancer incidence	1.5	0.1825	1.1825	15.4
Breast cancer incidence	1.1 (moderate) 1.4 (vigorous)	0.0365 0.146	1.0365 1.146	3.5 12.7
Falls incidence	1.4 (moderate) 2.5 (vigorous)	0.146 0.5475	1.146 1.5475	12.7 35.4
Depression symptoms	1.3	0.1095	1.1095	9.9

RR: Relative risk;

P: Prevalence of inactivity in Ballarat (0.365)

D: Denominator

N: Numerator

PAR: P*(RR-1)/(1+P*(RR-1)) = kP/(1+kP) where k = RR-1 & P is prevalence

* Source: *Burden of Disease 1996: Local government areas and regions of Victoria,* DHS, Victoria, 2000; *The cost of illness attributable to physical inactivity in Australia*, J. Stephenson, A. Bauman, B. Smith, & B. Bellew, 2000, Canberra, DHAC, ASC.

APPENDIX 4

CASEMIX METHODOLOGY

The following is an extract taken from Casemix Funding in Victoria, Victorian Department of Human Services (DHS, Victoria, 2002).

Casemix funding in Victoria

Definitions

COST WEIGHTS

Cost weights are developed each year based upon the costs of treating individual patients in Victorian public hospitals. Hospitals report the costs of over half a million patients annually. In addition to new cost weights, DHS often makes changes to the WIES in response to industry concerns. Consequently, casemix funding in Victoria has evolved considerably from the relatively simple model introduced in 1993-1994.

STANDARD RATES

Hospitals/Health Services are funded at standard rates per WIES. Metropolitan hospitals receive $2240 per WIES while country hospitals receive slightly more in recognition of the higher fixed costs of running small hospitals.

PAYMENT METHOD

Hospitals/Health Services receive a target WIES allocation at the beginning of each year. They are funded for WIES up to, but not in excess of, that target (ie the system is capped).

Since 1993 casemix has expanded to include ambulatory patients in metropolitan hospitals and some large country hospitals (VACS). Next year a casemix based funding system (CRAFT) will be fully introduced for rehabilitation patients in designated rehabilitation units.

Casemix is augmented by a series of WIES copayments and specified grants that are not tied to WIES eg Teaching and Research Grants

Casemix Funding for Acute Hospital Care in Victoria, Australia

by Dr Chris Brook, Director, Acute Health, Department of Human Services, Victoria, Australia and Immediate Past President, International Society for Quality in Health Care (lSQUA).

Introduction

Victoria was the first State in Australia to introduce casemix funding for all public hospitals. It has continued to be recognised as the leading Australian practitioner of casemix management of health care. The Victorian Department of Human Services introduced the casemix funding system on 1 July 1993 while managing significant funding cuts to the health budget.

Prior to this, public hospitals in Victoria were funded on a historical basis and subject to detailed input controls. Moving from historical to casemix funding has enabled hospitals to make more informed decisions on the best and most appropriate use of their resources. Casemix funding encourages more efficient patient treatment, and recognises the costs associated with different procedures.

The casemix funding system for acute health services continues to be refined and monitored. This ensures that acute health remains a vital and dynamic sector providing carefully targeted services. Recently, new casemix applications have been introduced to support rehabilitation patients and ambulatory services for all major hospitals and will soon cover the whole episode of care and incentives for better care after hospital.

This article sets out the background to casemix and related output based hospital funding and describes how current service purchasing for acute care works in the State of Victoria, Australia.

The Department of Human Services' Acute Health program managed outlays of around AUD $4 billion in 2000/01 which 70% was expended in casemix payments for hospital inpatient services. These services involved in excess of 1.2 million patient separations in 2000/2001 There are around 90 acute health casemix funded hospitals in Victoria.

The Concept of Diagnosis Related Groups (DRGs)

When a patient is discharged from hospital, their diagnosis, and the care they have received, is recorded as in the form of a principal diagnosis (which may include a specific procedure) and, as well, any secondary diagnosis(es) or complications.

This diagnostic recording is governed by the International Classification of Diseases (ICD). The ICD system is universal, but not static. It is constantly modified, with the most significant recent change being the introduction of its 10th iteration ICD-10. There are currently around 15,000 possible ICD-l0 principal diagnoses, so, with secondary diagnoses and complications, the number of patient-specific diagnostic permutations is enormous.

Diagnostic recording was established as an epidemiological tool, to allow health systems to understand the nature of acute hospital care. Its complexity, however, limited its usefulness.

In the late 1970s, Professor Robert Fetter, of Yale University, developed the concept of Diagnosis Related Groups (DRGs) to simplify the complexity of patient specific diagnoses, by grouping similar diagnostic categories into clinically meaningful diagnostic clusters, where resource use was also similar.

US authorities quickly perceived the potential value of DRG as a payment tool. Thus, in 1980, the New Jersey State introduced the first casemix funding system. Other systems moved, at first slowly, but subsequently much more rapidly, so that, today, casemix is becoming the standard inpatient funding mechanism across the globe.

There are three rules for a competent DRG system. These are that:

- each DRG must be clinically meaningful - that is that the diagnostic clusters must be accepted by clinicians;
- each DRG must be resource homogeneous - that is that the type of resources used, and their amount, should on average be the same for each episode of care within the DRG; and
- within each DRG, the specific diagnostic episodes should “map” to that DRG alone, and not to multiple possible DRGs.

There are complex coding rules and audit procedures, which ensure that these fundamental rules are followed. They rest, however, on the underlying ICD system and the DRG profile in use in each system.

The DRG profile varies from health system to health system. For example there are many hospitals treatments categorised as inpatient events in Australia, which in other countries would be "office-based procedures". There are currently around 760 DRGs (VIC-DRG5) in use in Victoria, which, while consistent with Australian National DRGs (AN DRG5) vary according to local practice. VIC-DRGs are constantly reviewed as are AN-DRGs, which have strong Victorian input. Most importantly, both AN-DRG5 and VIC-DRG5 are reviewed each year by clinician panels

The Victorian Casemix Funding System

The overall aim of casemix funding was to enhance and expand the hospital system in Victoria through a process that was free from centralised bureaucratic control, engendered competition and economic incentives for hospitals, and rewarded efficiency and growth in services while at the same time guarded quality. Turning DRGs into casemix funding works as follows:

• as soon as possible after discharge, the diagnosis(es) for each patient is recorded according to ICD-10. The patient-specific information is then coded to a DRG;

• each DRG has a particular "weighting" set around a notional value of 1. The weighting is derived through annual costing studies which compare, in participating hospitals, the relative resource consumption of each DRG against all others. Intra-hospital costing systems are fundamental to casemix. While they vary between hospitals, the relativity in resource consumption for each DRG within each hospital produces a reliable weighting, or index series;

• the aggregate number of DRGs in any time period, multiplied by the weighting of each, results in a number called a weighted separation (a separation is a discharged patient event);

• because DRG5 are resource homogeneous on average, the system recognises outliers, when the length of stay is abnormally long, or abnormally short - according to agreed statistical parameters. Short stay outliers receive a reduced payment and long stay outliers an increased payment. These payments can be converted into the equivalent of DRG weights. This conversion, initially unique to Victoria, collapses all DRG payments into a single number - the Weighted Inlier Equivalent Separation, or WIES;

• WIES are then multiplied by the price (set annually for each grouping of similar hospitals) per unit of WIES (the price paid for a notional DRG with a weighting of 1) to determine the funding available within any time period.

So, for example, a simple endoscopy with weight 0.3, multiplied by current unit WIES price of around $2,400 results in funding of $720. A liver transplant with weight 40, results in funding of $96,000.

The Victorian casemix funding system is deliberately clinically neutral. That is, the price paid for each inpatient episode is determined solely by the relative weight of the relevant DRG, and the unit WIES price. Clinical neutrality was a touchstone for clinical acceptance of casemix, and remains paramount for clinicians.

The system for inpatient payments, therefore, is highly complex - or sophisticated - but has the net effect of reducing an incomprehensibly complex set of patient-specific episodes of care into a relatively reliable and predictable payment and communication structure.

Current Purchasing Arrangements for Acute Care in Victoria, Australia

The term “purchasing” is something of a misnomer as it implies specified price and volume arrangements for particular service types. In fact, casemix and related output funding approaches are designed only to achieve uniformity of price and improvement in technical efficiency (as desired from time to time). They are, in reality, a mechanism to relate funds to the outputs of care and to improve accountability, rather than to purchase services on behalf of particular clients of the health care system.

A fundamental feature of current arrangements is subsidarity. The principle of subsidarity means that the services provided to any given individual should be decided as close as possible to the interface between that individual and their carer. In other words, the choice of clinical care is dictated by local consideration, with casemix entirely neutral about the relative price advantage or disadvantage of particular forms of care.

Hospitals, in the context of a capped annual acute health budget, are provided with capped annual budgets. These capped annual budgets are broken down into streams of care funding for the different components of casemix, other acute outward funding systems, subacute, mental health, etc. Thus in the case of inpatient casemix a hospital knows in advance the total number of WIES it will have available in a year and must undertake planning, to the best of its ability, but with no capacity for additional funding in the event of budget overrun.

The amount of money provided, and the price paid for any given component, will depend on a complex set of considerations which ultimately boil down to the level of total resource available, required savings, additional funding in the form of wage growth, funding for specific initiatives and/or general growth, etc.

Variation of individual hospital or network total funding is based on the historical allocation of resource; any planned growth or reduction due to initiatives; the level of available resources; and whether the hospital is in an area with lower or higher than average age, sex and socio-economic adjusted population utilisation of hospital services.

The system does not provide resources such that a given hospital has a defined population and provides all services to that population. In broad, community hospitals are expected to obtain levels of 65% and 75% self sufficiency, but can not be expected to be fully self sufficient in all services - for example there are obvious needs for referral to specialists and other treatment services, Patient choice is also a fundamental feature of the public hospital system and that choice is exercised, particularly in relation to specialist care. Therefore while hospitals and networks continually argue for increased resource on the basis of the population that they serve, a more appropriate and robust comparator is whether the people in a defined population are receiving an equivalent range and level of services as those in any other defined area. It should be noted, that, while the principle of subsidarity operates at the individual patient/carer level the system is not laissez-faire. Budget caps and the need to ensure that emergency and urgent care is always provided dictates a series of planning measures at hospital, network and whole of system level. In addition the system utilises capital and recurrent resource restrictions to ensure that duplication, particularly of highly expensive high technology care, is minimised. Finally there are specific price signals, such as through bonus and penalty arrangements, which encourage desired policy outcomes - such as meeting emergency and elective surgical waiting time targets.

Conclusion

Casemix is not a health policy in its own right. It is a benchmark pricing system designed to ensure that the same price is paid for the same work by like hospitals - no matter where it is undertaken (within planning parameters). It emphasises technical (cost) efficiency and, to this end, has been instrumental in transforming Victoria's hospital system from arguably Australia's least efficient, to a highest level of efficiency.

Casemix has in the eyes of some, particularly treasury officials, encouraged the view that health care financing, and management of the hospital system, is simple, if not easy. The sophistication of the concept of WIES (as previously described, an abstract derivative number) has led some elements of central government to the view that, not just casemix, but WIES alone, can be used to determine health policy. While cognisant of other parameters, there is a danger that WIES can be disproportionately focussed upon as the only measure of hospital performance.

In fact WIES, indeed casemix applies to only two-thirds of acute funding in Victoria. The remaining third (in context, almost $1 billion p.a.) goes to a variety of non-inpatient, or grant-based funding - where casemix is not appropriate, or adequate. Finally, it needs to be observed that acute hospital care in Victoria, as indeed in the rest of Australia, is becoming more acute, and with less and less discretionary capacity, in a continuous manner. At the present moment, in adult general metropolitan public hospitals, approximately fifty percent of all admissions are emergency admissions. Of the remaining fifty percent, thirty percent are described as non discretionary, that is their diagnoses are such that the patients predictively would have to become emergency admissions within days or weeks if not admitted. This leaves approximately twenty percent of all admissions which can be said to have a discretionary element. The great majority of these patients are urgent and semi urgent elective surgical and medical patients. Thus genuine discretion in the current acute public hospital system is tiny. This is reflected in the nature of surgical waiting lists, as well as pressures on emergency and other admissions.

2000/2001 marks the eighth year of casemix funding in Victoria. The success of casemix funding since its introduction has been impressive and there have been ongoing improvements to established policies for inpatient and outpatient funding and refinements to major access and performance programs. Victoria is now recognised nationally and internationally as being at the forefront of output based hospital funding.

APPENDIX 5

1997 ACTIVE AUSTRALIA SURVEY

PHYSICAL ACTIVITY SURVEY

Hello, is this (phone number)

Good afternoon/evening, my name is .... I am calling on behalf of the {client's name}

We are conducting a "regional/national" survey on physical activity. The research results will be important for the planning of future health and exercise programs in your local area. Your telephone number has been selected randomly from the White Pages. A member of your household will be asked to answer a few questions over the phone.

Could I ask how many people in your household are aged between 18 and 75 years of age

Field name:	QHSIZE		
Field type:	Numeric		
Content:	Household size - number of people aged 18 to 75 years of age (national sample (18 and 75)		
	9	=	9 or more
	99	=	Refused

Could I speak to the person AGED BETWEEN 18 AND 75 who had the last birthday?

Would that be yourself?

[If it is clear that the speaker is not aged between 18 and 75, omit this question, say `who would that be?' or similar]

[If necessary, explain why we must speak to the person who had the last birthday. We must use a random factor (like next birthday) to avoid skewing the survey results. In many households one person usually answers the phone - we need to sample everyone's opinion.]

[IF NOT - when required person is on phone]

Good afternoon/evening, my name is .... I am calling on behalf of the "sponsor's name".

We are conducting a "regional/national" survey on physical activity, to find out about the health of the Australian population. The research results will be important for the planning of future health and exercise programs in
your local area. Your telephone number has been selected randomly from the White Pages. All that is involved is answering a few questions over the phone.

The survey should take NO MORE THAN 15 minutes. If there are any questions you prefer not to answer just say so. Would you help us with this survey?

[IF NO] Thank you very much for your time.

Question: **Q2 Have you heard or seen any messages about exercise or physical activity IN THE PAST MONTH?**
Field name: Q2
Field type: Numeric
Content:

1	=	Yes
2	=	No
3	=	Don't know
9	=	Refused

Skip: if Q2 not equal to 1, go to Q5

Question: **Q3A What is one message that you remember?**
Field name: Q3A
Field type: Character
Content: Message remembered
99 = Don't know / can't recall

Skip: if Q3A = 99, go to Q5

Question: **Q4A Where did you see or hear this message?** Unprompted
Field name: Q4A1 Q4A2 Q4A3 Q4A4 Q4A5
Field type: Character
Content: **Unprompted** answer. The following codes were used when applicable. If the answer given was 20, 30, 40 or 50, the interviewer would prompt with program or advertisement / story or advertisement, as detailed in the codes below.

20	=	Television	21 = program	22 = advert/message
30	=	Radio	31 = program	32 = advert/message
40	=	Newspaper	41 = story	42 = advert/message
50	=	Magazine	51 = story	52 = advert/message
60	=	Billboard or poster		
71	=	At a GP's surgery		
72	=	At a sports or social club		
73	=	From family or friends		
99	=	Don't remember		

Question: **Q4AOTH Where did you see or hear this message?** Unprompted
Field name: Q4AOTH
Field type: Character

Content: **Unprompted** `other' answer to: Where the message was seen or heard. This field contains response which were additional to the coded responses in Q4A.

Skip: if Q4A not equal to 99 AND Q4AOTH not equal to 99, go to Q3B
i.e. if respondent provided an answer to the unprompted message question, go to Q3B.

Question: **Q4A1 Could you have seen or heard this message ...? OR [`Would it have been?']** [READ CODE HEADINGS: TV,RADIO ETC. - ENTER CODE/CODES]
Field names: Q4AP1 Q4AP2
Field type: Character
Content: **Prompted** answer to the message question.

20 = Television [prompt] 21 = program 22 = advert/message
30 = Radio [prompt] 31 = program 32 = advert/message
40 = Newspaper [prompt] 41 = story 42 = advert/message
50 = Magazine [prompt] 51 = story 52 = advert/message
60 = Billboard or poster
71 = At a GP's surgery
72 = At a sports or social club
73 = From family or friends
99 = Don't remember
OTHER - Specific - entered in Q4AOTH

Question: **Q3b. Do you remember any other messages about exercise or physical activity that you saw or heard in the last month?**
Field name: Q3B
Field type: Character
Content: Other messages which were heard or seen.
99 = Don't remember any other messages

Skip: If Q3B = 99, go to Q5

Question: **Q4b Where did you see or hear this message?**
Field names: Q4B1 Q4B2 Q4B3 Q4B4 Q4B5
Field type: Character
Content: **Unprompted** response indicating where the message was seen or heard. The following codes were used when applicable.

20 = Television [prompt] 21 = program 22 = advert/message
30 = Radio [prompt] 31 = program 32 = advert/message
40 = Newspaper [prompt] 41 = story 42 = advert/message
50 = Magazine [prompt] 51 = story 52 = advert/message
60 = Billboard or poster
71 = At a GP's surgery
72 = At a sports or social club
73 = From family or friends
99 = Don't remember

Skip: if Q4B not equal and Q4BOTH not equal to 99, go to Q5
if Q4B=0 and Q4OTH < 2, go to Q4B

Question: **Q4b1. Could you have seen or heard this message ...? OR [`Would it have been?']**
Field name: Q4BP1 Q4BP2
Field type: Character
Content: **Prompted** response indicating where the message was seen or heard. The following codes were used when applicable.

20 = Television [prompt] 21 = program 22 = advert/message
30 = Radio [prompt] 31 = program 32 = advert/message
40 = Newspaper [prompt] 41 = story 42 = advert/message
50 = Magazine [prompt] 51 = story 52 = advert/message
60 = Billboard or poster
71 = At a GP's surgery
72 = At a sports or social club
73 = From family or friends
99 = Don't remember

Question: **Q5. Have you heard of the exercise and physical activity campaign `Exercise - you only have to take it regularly not seriously'?**
Field name: Q5
Field type: Numeric
Content: 1 = Yes
2 = No
3 = Don’t know
9 = Refused

Skip: If Q5 not equal to 1, go to Q1M

Question: **Q5a. What messages do you remember?**
Field name: Q5A
Field type: Character
Content: Messages seen or heard
99 Don't remember

[INTERVIEWER: ONLY NSW INTERVIEWS WILL GO TO `Where did you see or hear...?']

Skip: If Q5A = 99, go to Q1M
If region not equal to 2 go to Q1M (i.e. if region is not NSW, go to Q1M)

Question: **Q1. ON AVERAGE, how many hours of TV/video do you watch per day?**
Field name: Q1M **Field name:** Q1H
Field type: Numeric **Field type:** Numeric
Content: Minutes **Content:** Hours

77 = Don't know 77 = Don't know

[INTERVIEWER: THIS IS TOTAL HOURS - IF NECESSARY DIVIDE TOTAL WEEKLY HOURS BY 7]

We would like to ask you about the physical activity you did in the last week:

Question: ***Q8. IN THE LAST WEEK how many times have you walked continuously, for at least 10 minutes, for recreation/exercise or to get to or from places?***

Field name: *Q8*

Field type: *Numeric*

Content: *Number of times*

99 = Don't know - use as an absolute last resort

Skip: If Q8 = 0, go to Q7D

Question: ***Q9. In total, how much time do you estimate you spent walking in this way IN THE LAST WEEK?*** *[INTERVIEWER: THIS IS `CONTINUOUS' WALKING]*

Field name: *Q9M* ***Field name:*** *Q9H*

Field type: *Numeric* ***Field type:*** *Numeric*

Content: *Minutes* ***Content:*** *Hours*

77 = Don't know *777 = Don't know*

The next question does not include gardening.

Question: ***Q10. IN THE LAST WEEK how many times did you do any vigorous household chores which made you breathe harder or puff and pant?***

Field name: *Q10*

Field type: *Numeric*

Content: *Number of times, in the last week, in which vigorous household chores were done.*

99 = Don't know - use as an absolute last resort.

Skip: If Q10=0, go to Q12

Question: ***Q11. How long would you estimate that you spent doing these vigorous household chores IN THE LAST WEEK?***

Field name: *Q11M* ***Field name:*** *Q11H*

Field type: *Numeric* ***Field type:*** *Numeric*

Content: *Minutes* ***Content:*** *Hours*

77 = Don't know *777 = Don't know*

Question: ***Q12. IN THE LAST WEEK how many times did you do any vigorous gardening or heavy work around the yard which made you breathe harder or puff and pant?***

Field name: *Q12*

Field type: *Numeric*

Content: *Number of times, in the last week, spent doing vigorous activity in the yard*

99 = Don't know - use as an absolute last report

Skip: If Q12=0, go to Q14

Question: ***Q13. IN THE LAST WEEK how long would you estimate that you spent doing vigorous gardening or heavy work around the yard?***

Field name: *Q13M* ***Field name:*** *Q13H*

Field type: *Numeric* ***Field type:*** *Numeric*

Content: *Minutes* ***Content:*** *Hours*

77 = Don't know *777 = Don' know*

The next question excludes household chores or gardening:

Question: ***Q14. IN THE LAST WEEK, how many times did you do any vigorous physical activity which made you breathe harder or puff and pant?*** *(eg. tennis, jogging, cycling, keep fit exercises)*

Field name: *Q14*

Field type: *Numeric*

Content: *Number of times doing vigorous physical activity*

99 = Don't know - use only as an absolute last resort

Skip: If Q14=0, go to Q16

Question: ***Q15. How long would you estimate that you spent doing this vigorous physical activity IN THE LAST WEEK?***

Field name: *Q15M* ***Field name:*** *Q15H*

Field type: *Numeric* ***Field type:*** *Numeric*

Content: *Minutes* ***Content:*** *Hours*

77 = Don't know *777 = Don't know*

This question excludes household chores or gardening:

Question: ***Q16. IN THE LAST WEEK how many times did you do any other more moderate physical activity that you haven't already mentioned?*** *(eg. lawn bowls, golf, gentle swimming, etc)*

Field name: *Q16*

Field type: *Numeric*

Content: *Number of times doing moderate activities not already mentioned*

99 = Don't know - use only as an absolute last resort

Skip: If Q16=0, go to QN9M

Question: ***Q17. What do you estimate was the total time that you spent doing these activities IN THE LAST WEEK?***

Field name: *Q17M* ***Field name:*** *Q17H*

Field type: *Numeric* ***Field type:*** *Numeric*

Content: *Minutes* ***Content:*** *Hours*

77 = Don't know 777 = Don't know

The next three questions are about your average WEEKLY level of activity IN THE LAST SIX MONTHS:
[INTERVIEWER - MAKE SURE THIS IS CLEAR TO THE RESPONDENT]

[PREVIOUS WEEK: HOURS & MINUTES appear in case respondent says last week was an average week]

Question: **QN9. On average, IN THE LAST SIX MONTHS how much time did you spend each week walking for recreation/exercise or to get to or from places?**
Field name: QN9M **Field name:** QN9H
Field type: Numeric **Field type:** Numeric
Content: Minutes **Content:** Hours
77 = Don't know 777 = Don't know

The next question excludes household chores or gardening:

[PREVIOUS WEEK: HOURS & MINUTES appear in case respondent says last week was an average week]

Question: **QN15. On average, IN THE LAST SIX MONTHS how much time did you spend each week doing vigorous physical activity which made you breathe harder or puff and pant?** (eg tennis, jogging, cycling, keep fit exercises, etc)
Field name: QN15M **Field name:** QN15H
Field type: Numeric **Field type:** Numeric
Content: Minutes **Content:** Hours
77 = Don't know 777 = Don't know

The next question excludes household chores or gardening:

Question: **QN17. On average, IN THE LAST SIX MONTHS how much time did you spend each week doing any other more moderate physical activity that you haven't already mentioned?** (eg lawn bowls, golf, gentle swimming, etc)
[PREVIOUS WEEK: HOURS & MINUTES appear in case respondent says last week was an average week]
Field name: QN17M **Field name:** QN17H
Field type: Numeric **Field type:** Numeric
Content: Minutes **Content:** Hours
77 = Don't know 777 = Don't know

[RANDOM ordering of the following statements]
The following statements are about the amount of exercise you intend to do in the near future.

Question: Q18 Which one best describes how you feel at present? [Read statements]
Enter 1 only for the statement chosen by respondent
You do NOT intend to be more active than you have been over the last week.
You intend to be more active over the NEXT MONTH than you have been over the last week.
You intend to become more active sometime over the NEXT SIX MONTHS than you have been over the last week.

Field name: Q18
Field type: Numeric
Content:
1 = You do NOT intend to be more active than you have been over the last week.
2 = You intend to be more active over the NEXT MONTH than you have been over the last week.
3 = You intend to become more active sometime over the NEXT SIX MONTHS than you have been over the last week.
9 = Don’t know

[RANDOM ordering of the following statements]

Question: Q19. To what extent do you agree or disagree with the following statements about physical activity and health? [Read out scale]
Q19P1 Taking the stairs at work or generally being more active for at least 30 minutes each day is enough to improve your health
Q19P2 Half an hour of brisk walking on most days is enough to improve your health
Q19P3 To improve your health it is essential for you to do vigorous exercise for at least 20 minutes each time, 3 times a week
Q19P4 Exercise doesn't have to be done all at one time - blocks of 10 minutes are okay
Q19P5 Moderate exercise that increases your heart rate slightly can improve your health

Field names: Q19P1 Q19P2 Q19P3 Q19P4 Q19P5
Field type: Numeric
Content:
1 = Strongly agree
2 = Agree
3 = Neither agree nor disagree
4 = Disagree
5 = Strongly disagree
6 = Don't know - do not read out
9 = Refused - do not read out

[RANDOM ordering of the following statements]

We would like to find out how confident you are to exercise in certain situations.

Question: QN20. What confidence rating best describes how you feel in the following situations? [Read out scale]
QN20P1You could exercise when you are tired
QN20P2You could exercise when you are in a bad mood
QN20P3You could exercise when you feel you don't have time

Field names: QN20P1 QN20P2 QN20P3
Field type: Numeric
Content:
1 = Not at all confident
2 = Slightly confident
3 = Moderately confident
4 = Very confident
5 = Extremely confident
[9 = Refused]

Question: **QN21. How supportive is YOUR FAMILY towards you participating in exercise/physical activity?** [Read out scale]
Field name: QN21
Field type: Numeric
Content:
1 = Very much against
2 = Against
3 = Neither against nor supportive
4 = Supportive
5 = Very supportive
[8 = Not applicable]
[9 = Refused]

Question: **QN22. How supportive are YOUR FRIENDS towards you participating in exercise/physical activity?** [Read scale]
Field name: QN22
Field type: Numeric
Content:
1 = Very much against
2 = Against
3 = Neither against nor supportive
4 = Supportive
5 = Very supportive
8 = Not applicable
9 = Refused

Finally a few questions to help classify your answers

Question: **Q25. What is your sex?** [OBSERVE OR ASK]
Field name: Q25
Field type: Numeric
Content:
1 = Male
2 = Female
9 = Refused

Question: **Q26. Could I ask your age please?**
Field name: Q26
Field type: Numeric
Content: Age in years
99 = Refused

Question: **Q27. What is your MARITAL STATUS?**
Field name: Q27
Field type: Numeric
Content:
1 = Married/ Defacto
2 = Single
3 = Widowed
9 = Refused

Question: **Q28. What is your approximate weight in pounds, stones, or kilograms?**

Field name: Q28S
Field type: Numeric
Content: Stone
Min = 4 stone
77 = Don't know
777 = Don't know

Field name: Q28P
Field type: Numeric
Content: Pounds
Min = 45 pounds
77 = Don't know
777 = Don't know

Field name: Q28K
Field type: Numeric
Content: Kilograms
Min = 20 Kilograms
Max = 200 kilograms
777 = Don't know

Question: **Q29. What is your approximate height in feet & inches or cms?**

Field name: Q29F
Field type: Numeric
Content: Feet
Min = 3 feet
Max = 7 feet
77 = Don't know
777 = Don't know

Field name: Q29I
Field type: Numeric
Content: Inches
Min = 0 inches
Max = 11 inches
77 = Don't know
777 = Don't know

Field name: Q29C
Field type: Numeric
Content: Centimetres
Min = 90 cm
777 = Don't know

Question: **Q30. How MANY people UNDER 18 reside at your home?**
Field name: Q30
Field type: Numeric
Content: Number of people under 18 living in household
99 = Refused

Question: **Q30a. How many children AGED 5 AND UNDER reside at your home?**
Field name: Q30A
Field type: Numeric
Content: Number of children aged 5 and under living in household
99 = Refused

Question: **Q31. How many adults aged between 18 and 75, including yourself, live in your household?**
Field name: Q31
Field type: Numeric
Content: Number of people aged between 18 and 75 living in household
99 = Refused

Question: **Q32. What is the highest level of education you have COMPLETED?**
Field name: Q32
Field type: Character
Content:
1 = Never attended school, some primary school
2 = Completed Primary school
3 = Some High school
4 = School certificate/Intermediate/Year 10/4th form
5 = HSC/Leaving/Year 12/6th form
6 = TAFE certificate/diploma
7 = University, CAE or other tertiary institution degree
Other [type in answer]

Question: **Q33. What is your current occupation?**
Field name: Q33
Field type: Character
Content:
1 = Manager/Administrator
2 = Professional/Para-professional
3 = Tradesperson
4 = Clerk
5 = Salesperson and Personal Service Worker
6 = Plant and Machine Operator/Driver
7 = Labourer
8 = Unemployed
9 = Home duties
10 = Retired
11 = Student
Other [type in if unable to classify]

Question:	**Q34. What language do you usually speak at home?**		
Field name:	Q34		
Field type:	Character		
Content:	1 = English	13 = Lebanese	
	2 = Arabic	14 = Macedonian	
	3 = Cantonese	15 = Maltese	
	4 = Croatian	16 = Mandarin	
	5 = Dutch	17 = Polish	
	6 = Filipino	18 = Russian	
	7 = French	19 = Serbian	
	8 = German	20 = Slovene	
	9 = Greek	21 = Spanish	
	10 = Hindi	22 = Vietnamese	
	11 = Hungarian	23 = Other	
	12 = Italian	99 = Refused	

Question: **Q35. What is your postcode?**
[If postcode unknown enter suburb name]
Field name: Q35
Field type: Numeric
Content: Postcode

Question: **Q36. Would you be willing to participate in a similar survey in the future?**
Field name: Q36
Field type: Numeric
Content: 1 = Yes
2 = No

Could I have your full name & address so we can let you know when we want to talk with you again. These details will NOT be kept with your answers.

Field name: QSNAME
Field type: Character
Content: Surname
99 = Refused

Field name: QFNAME
Field type: Character
Content: First name or initials
99 = Refused

How do you prefer letters to you to be addressed?'

Field name: QTITLE
Field type: Character
Content: Title
99 = Only contact by phone

Field name: QADD

Field type: Character
Content: Street address
99 = Only contact by phone

Field name: QSUB
Field type: Character
Content: Suburb
99 = Only contact by phone

Field name: QPCODE
Field type: Character
Content: Postcode

Field name: QAREA
Field type: Character
Content: STD code

Field name: QTEL
Field type: Character
Content: Phone number for re-contact

GLOSSARY

body mass index (BMI)

The measure of a person's weight in relation to their height, calculated as weight in kilograms divided by height in metres squared. A BMI of 20–25 kg/m^2 is considered ideal.

BPAS

Ballarat Physical Activity Survey, conducted in 2002.

burden of disease

The total significance of disease for society beyond the immediate cost of treatment. Measured in years of life lost to ill health as the difference between total life expectancy and disability-adjusted life expectancy.

CHD

coronary heart disease

cost of illness (COI)

The total costs incurred by a society due to a specific disease. Includes medical costs, and sometimes indirect costs of production loss, reduced quality of life and premature mortality. A variant on burden of disease.

CVD

cardiovascular disease

DALY (Disability-Adjusted Life Year)

The aggregation of YLL and YLD at the population level. Reflective of the burden of disease in a population.

diabetes mellitus

A metabolic condition characterised by hyperglycaemia resulting from the body's inability to use blood glucose for energy. *See also* type 1 diabetes and type 2 diabetes.

dose-response relationship

The connection between a change in amount, intensity or duration of exposure and the change (increase or decrease) in the risk of the outcome.

duration

The length of time a respondent reports participation in physical activity within reporting period.

frequency

The number of times a respondent reports participation in physical activity within a reporting period.

GBD

Global burden of disease. See burden of disease.

HDL

high-density lipoprotein

health benefit

Participation in leisure-time physical activity of sufficient intensity and duration. Moderate-intensity leisure-time physical activity over a period of one week for a total of 150 minutes or vigorous-intensity leisure-time physical activity for 60–90 minutes is thought to confer a health benefit.

insufficient activity

Physical activity of an amount or type insufficient to confer a health benefit; i.e., either completely inactive (sedentary), or not sufficiently active for good health.

intensity

Self-perceived and self-reported intensity (e.g., moderate, vigorous) at which respondent participates in physical activity.

intervention

Specific program designed to increase the physical activity levels of individuals, specific groups, communities or entire populations.

kilocalorie (kcal)

Unit of energy used to calculate the metabolic 'cost' of physical activity. 1 kilocalorie = 1,000 calories = 4,184 joules = 4.184 kilojoules.

leisure-time physical activity

Sport and recreational physical activity.

LGA(s)

Local Government Area(s)

MET (metabolic equivalent)

Unit used to estimate the metabolic cost (oxygen consumption) of physical activity. One MET is defined as the energy expenditure for sitting quietly, which for the average adult is 1 kilocalorie body weight in kg^{-1} hr^{-1} or 3.5 ml of oxygen body weight in kg^{-1} min^{-1}. METs are used as an index of the intensity of physical activity.

moderate-intensity physical activity

Leisure-time physical activity requiring 3–6 times as much energy as rest or intensity of 3–6 METs; for example, brisk walking, slow swimming, heavy gardening, heavy housework, windows, tennis, badminton, line dancing and light aerobics.

NIDDM (non-insulin dependent diabetes mellitus)

See type 2 diabetes.

NPAS

National Physical Activity Survey, conducted in 1999.

obesity

Overweight by 30% of the ideal body weight.

physical activity

Body movement produced by contraction of skeletal muscle that substantially increases energy expenditure above the basal level. Physical activity can be categorised by type, intensity, purpose and context.

physical inactivity

No reported physical activity.

population attributable risk (PAR%)

Proportion of disease incidence that would be prevented by eliminating a risk factor. It depends on the prevalence of the risk factor and its strength (relative risk).

relative risk (RR)

Excess incidence or prevalence of a disease in people with a given risk factor compared to those without the risk factor.

risk factor

Exposure or characteristic that increases the rate of disease relative to those unexposed or without the characteristic.

sedentary

Physically inactive with no participation in walking, moderate or vigorous activity during the previous week, resulting in an estimated energy expenditure of <50 kilocalories a week.

sufficient activity

Leisure-time physical activity of sufficient intensity and duration to confer a health benefit; i.e., duration of greater than or equal to 150 minutes of walking and/or moderate-intensity physical activity, and/or vigorous-intensity physical activity per week (where vigorous-intensity activity is weighted by a factor of two to reflect its greater intensity).

type 1 diabetes

A form of diabetes mellitus most often occurring in children and young adults, where the pancreas no longer makes insulin, and therefore blood glucose cannot enter the cells to be used for energy. Also known as insulin-dependent diabetes.

type 2 diabetes

The more common form of diabetes mellitus, where the body is unable to use insulin correctly, either by not producing enough or becoming resistant to its effects. Also known as non-insulin dependent diabetes (NIDDM), or late-onset diabetes.

vigorous-intensity physical activity

Physical activity of an intensity to cause the heart to beat rapidly and the breathing to be fairly hard (but not breathless), and which may cause mild perspiration. It is associated more with structured exercise or competitive sports such as running, jogging, squash, swimming hard, cycling, basketball, football, or heavy aerobics.

WHO

World Health Organization

YLL (Years of Life Lost)

Sum of years of life lost due to premature death.

YLD (Years Lived with Disability)

Years lived with disability, adjusted for severity.

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