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An assessment of the level of physical activity in adolescents of the Illawarra and evaluation of the validity of the physical activity questionnaire

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AN ASSESSMENT OF THE LEVEL OF PHYSICAL ACTIVITY IN ADOLESCENTS OF THE ILLAWARRA
and
EVALUATION OF THE VALIDITY OF THE PHYSICAL ACTIVITY QUESTIONNAIRE

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IN THE NAME OF

ALLAH

THE COMPASSIONATE AND THE MERCIFUL

DECLARATION

I declare that the work described in 'assessment of the level of physical activity in adolescents of the illawarra and evaluation of the validity of the physical activity questionnaire' is entirely my own work. References to the work of others are indicated in the text. This work has not been submitted for a degree to any other university or institution.

Fatemeh H Oskouie

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ABSTRACT

Physical activity in adolescence has become a major field of interest in the prevention of hypokinetic diseases. This study highlights the level of physical activity of adolescents in grades 8 and 10 in the Illawarra using a questionnaire. It also highlights the relationship between physical activity amongst adolescents, with (regard to) their demographic characteristics, perceptional factors, social factors and environmental variables. This study also estimates the validity of the physical activity questions of the 'Youth Health Survey', which is carried out in the Illawarra area by the Illawarra Area Public Health Unit using heart rate monitoring and a diary.

It is concluded that a substantial percentage of adolescents (62.6 percent) do not meet the International Physical Activity Guideline I, which calls for participation in physical activity every day as part of their lifestyle. It is also concluded that 84 percent of adolescents do meet International Physical Activity Guideline II, which calls for participation in moderate to vigorous activity for 20 minutes, 3 or more days per week.

The main determinants of physical activity are age, gender, and ethnicity. Other factors affecting physical activity are the activity habits of significant others, particularly mothers and friends. The main reasons for participating in physical activity are making friends, to lose weight and to look good. The present findings imply that health promotion programs would be more effective if they were designed with the emphasis on making friends, looking good and losing weight.

It is also concluded that the validity of the physical activity questions, as used in WHO related surveys, is moderate for adolescents aged 13-16. It is concluded that the questionnaire is a valid indicator of physical activity among

adolescents. It is also concluded that physical activity in adolescents needed to be promoted especially in females.

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It has been said that it is the responsibility of a person to keep his/her body healthy. A healthy body makes a person powerful enough to be able to carry out his/her spiritual responsibility. Physical activity is thought to be one of the important ways to achieve and maintain a healthy body. Therefore, physical activity is like praying (Esfahani, 1996).

CHAPTER ONE

INTRODUCTION

1.1 Introduction

The World Health Organization (WHO) (1995) stated that approximately half of the world's population is insufficiently active. The increased use of motor transport and also more time being spent on sedentary leisure activities such as television viewing have, to a large extent, promoted non-active lifestyles. Life style consists of ways of living, and the patterns of behaviour in the circumstances of one's own life (Breslow, 1996). Up to one third of developed countries have a sedentary lifestyle (Owen et al., 1995). The ever increasing likelihood that people are inclined towards a sedentary lifestyle is not restricted to developed countries, but is increasingly becoming an aspect of developing countries, particularly in urban areas (Hart, 1984). Children and adolescents are also becoming less active. Houses are furnished in ways that promote activities in seated or resting positions. Children are kept seated indoors, at school, for most of the day and at home they do homework and watch television for many hours (Riddoch & Boreham, 1995).

In the past, a certain amount of energy was regularly expended as a necessary part of daily activities such as walking, farming, chopping wood, or cycling. That level of physical activity has declined due to modern technology, particularly through the use of energy-saving devices like the motor car (Egger and Champion, 1992).

Based on the new recommendation of United States Surgeon General, the minimum level of exercise required to maintain or enhance cardio-respiratory fitness for all ages is 30 minutes or more of moderate intensity physical activity on most days over the course of the week (Manley, 1996).

It is reported that less than 10% of adult Americans are sufficiently active (Wilmore & Costill, 1994). In other words most of the Americans have a low level of physical activity or are inactive (Caspersen & Merritt, 1995). A recent study also shows that two-thirds of Canadian women and half of Canadian men are inactive or rarely active. This study also reports that only one in ten men and one in twenty women are physically active at least three times a week at the level sufficient for cardio-respiratory fitness. These proportions are also documented in Australian studies (Hetzel, 1987).

The survey on the fitness level of Australians shows that 23% of adults have a sedentary lifestyle. Only 16% of men and 14% of women are exercising at a level rated as highly physically active. In addition, a previous analysis of five Department of Sport, Recreation and Tourism surveys indicates that 15% of all adult Australians could be classified as active at this level (Commonwealth Department of Sport, Recreation and Tourism, 1992). Furthermore, the 1989 Risk Factor Prevalence Study finds that 27% of men and women do not undertake any exercise during their leisure time (AIHW, 1994). It is also reported that 30% of Australian adults do not participate in recreational physical activity (Booth et al., 1992).

The low levels of physical activity and a reduction in cardio-respiratory fitness (or aerobic capacity), associated with the modern lifestyle, are generally recognized as important contributing factors in the aetiology of chronic disease and cardio-vascular disease (Hatziandreu, 1988; Leon and Norstrom, 1995; Page, 1995; Simons-Mortons et al., 1991; Davison & Grant, 1993). Recent evidence

also indicates that inactivity is one of the known independent risks associated with coronary disease (Nichols et al., 1992). Individuals who fail to exercise sufficiently are about twice as likely to develop coronary heart disease as the physically active people (WHO, 1995). Coronary heart disease continues to be one of the main causes of premature death in Australia - that is, death before the age of 70 years (Bennett & Magnus, 1994).

Inactivity increases the risk for obesity (Sallis, 1993). Studies suggest that about 50 percent of middle-aged and 25 percent of young Australians are overweight and that the level of obesity is rising among the inactive Australian population (Risk Factor Prevalence Study Management Committee, 1990; Egger and Champion, 1992; Wise & Graham-Clarke, 1994). Obesity is one of the major risk factors of coronary heart disease (CHD) (Deveaux et al., 1986).

The ways in which people habitually behave, may cause them to suffer from a variety of diseases (Coonan, 1991). In modern societies, sedentary living leads to more deaths being attributed to lifestyle-related diseases such as heart disease, strokes, diabetes, obesity and bowel and breast cancer (Coonan, 1991). Such diseases are occurring in both developing and developed countries. It is estimated that by early next century there will be twice as many such deaths. In most countries of the Western Pacific Region, lifestyle-related diseases constitute at least three of the five main causes of death (Han & Erben 1993). Lifestyle-related diseases are also the greatest causes of death in Australia (Smith et al., 1993; Commonwealth of Australia (1993); Nutbeam et al., 1993, Camerom, 1995). Cardiovascular disease and cancers now account for almost three quarters of Australian deaths (Coonan et al., 1991).

Health promotion is increasingly being placed at the forefront of the health agenda for member states of WHO in the Western Pacific Region. Australia, in its revised national health goals and targets makes specific reference for the first time to health outcomes (Han & Erben, 1993). There are four groups of goals and targets

to improve the Australian health and quality of life in the year 2000 and beyond including healthy lifestyle and health risk factors, preventable mortality and morbidity, health literacy and health skills and healthy environments. An example of a healthy lifestyle is participation in regular physical activity (Nutbeam & Wise, 1993; NSW Health Department, 1994). The new program concerns itself with the improvement of health at five stages of human life, and the planning of activities in relation to each of these stages. Adolescence is one of these stages, and physical activity is one of the activities which relates to the program specific for this age period (Han & Erben, 1993).

Proper physical activity may be especially important during adolescence, the stage in which rapid growth occurs and when excessive accumulation of fat may contribute to health problems and psychological difficulties in later life. Physical activity promotes health during adolescence and assists in the prevention of specific diseases in adulthood. There is a necessity for a positive approach towards the development of health-promoting physical activities, if adolescents are going to be encouraged to refuse many health-damaging behaviours (Sallis, 1993).

It is well known that many of the behaviours associated with adult morbidity and mortality begin during the adolescent years (Sallis, 1993). It is also estimated that half of the mortality among adults is a direct result of modifiable behaviour factors (Hamburg et al., 1993). Intervening during adolescence provides the opportunity not only to prevent the onset of health-damaging behaviours, but also to intervene with health-related behaviours such as a physically active life style (Sallis, 1993).

The rationale for promoting physical activity in children and youth is well established. Firstly, a substantial amount of evidence shows the potential for preventing cardiovascular diseases and major causes of mortality in populations by increasing the level of physical activity and physical fitness in the less active groups (Blair et al., 1989: Eaton, et al., 1995; Leon, et al., 1987: Slattery &

Jacobs, 1988: Hirayama, 1990). Secondly, adolescence is believed to be an ideal stage in mental and physical development for learning health-related behaviour patterns, including physical activity. These physical activity patterns would be carried on into adulthood (Telama et al. 1994; Perry et al., 1990; Engerstrom, 1986; Hurrelmann et al., 1995; Dept of Health Victoria, 1986; Stone et al., 1995; Shilton et al., 1995).

The level of physical activity in adolescence can be a predictor of activity levels in later life (WHO Expert Committee, 1986; Freedson, 1992; Wold & Kannas, 1993). Prevention of cardiovascular disease can be started in adolescence while lifestyle habits are being formed. One of the health-related lifestyle habits known to affect cardiovascular risk is the frequency of exercise engaged in per week and the duration and intensity of regular physical activity among adolescents (Kelder et al., 1993; Nader, 1995).

Bone development in adolescence is related to the risk of osteoporosis in later life, especially among women. Regular physical activity during the growth years facilitates the development of bones and may prevent them from becoming osteoporotic. Adolescence, therefore, is a critical stage for the prevention of osteoporosis (Sallis, 1993). It is important to encourage children to take up activities which will continue throughout their lives and do not depend on group participation. These activities can be selected by gathering information about their regular physical activity.

It is also reported that atherosclerosis begins in childhood and adolescence and eventually causes more than half of all deaths. There is growing consensus that promoting heart-healthy physical activity patterns in adolescents is essential for reducing premature deaths due to heart disease (Sallis, 1993).

Furthermore, recent research suggests that fat cell numbers may be significantly changed through exercise habits at three particular stages in life. One of these stages is early adolescence (12-15 years). Once cell numbers are

increased they cannot be reduced in number at a later time, except in size (atrophy). Therefore, life style factors such as exercise are seen as vital at this stage for developing a body structure which will aid in weight control (Egger and Champion, 1992).

Schools are an important part of the public health system from the perspective of information exchange, and they are an appropriate place to reach young people while their lifestyle habits of exercise are still forming (Cameron, 1995). The secondary school years form the most important life stage for the shaping of health in adulthood (Hurrelmann et al., 1995). The main target of intervention strategies for adolescents is a healthy lifestyle behaviour. When setting targets and goals, it is important to have information about personal, social, and environmental determinants of health behaviour (Nutbeam & Wise, 1995). Information about patterns and determinants of adolescent physical activity assists in promoting healthy behaviour.

A variety of approaches have been used to assess physical activity. Currently, the most practical method of quantifying physical activity levels is by questionnaire. Self-completing questionnaires typically record information on the types, frequency and duration of activities performed over a set period of time. LTPA (Leisure Time Physical Activity) questionnaires first appeared in the literature in the mid-1960s. They were designed for use among specific, mainly middle-aged male population groups. Even though they varied in their modes of scoring, periods of activity recall, and overall complexity, associations were observed between physical levels and chronic health conditions. In 1978, a questionnaire to assess only LTPA (the Minnesota LTPA questionnaire) was published as the most popular option available. The validation of Leisure Time Physical Activity questionnaires has relied upon indirect methods, such as the assessment of cardio-respiratory fitness, body composition and activity diary reporting (Lamb & Brodie, 1990).

A study has been carried out by Aaron et al. (1993) on physical activity in a cohort of 1245 adolescents aged 12-16 years. This study provided a descriptive epidemiology of leisure physical activity in adolescents. The questionnaire was 'recall self-administered'.

To measure adolescent physical activity some researchers have used self-report physical activity measures. These include interviewer-administered and self-administered instruments. Interviewer-administered measures are used by Linder et al., 1983; Verschuur et al., 1985; Walac et al., 1985; Sallis et al., 1988; and Sallis et al., 1990. With the exception of the study by Linder et al., (1983) which was conducted on usual activity, other studies were conducted on activity recall in a given specified time period. A review of the literature revealed that there are investigations using self-report physical activity measures such as those conducted by Telama et al., 1985; Sallis et al., 1988; Tell et al., 1988; Sallis et al., 1991, Murphy et al., 1990, Aeron et al., 1993, and Eaton et al., 1995. Others have focused on energy expenditure by comparing body acceleration and heart rate (Meijer et al., 1989). Diary measures to measure physical activity in adolescents have been used in some studies (Seliger et al., 1974 and Bouchard et al., 1983, cited in Sallis, 1991).

Although some studies were conducted on the assessment of physical activity by recording the heart rate, little attention was paid to measuring the usual activity of the adolescents.

Despite advances in the understanding of physical activity in Australia, several issues remain that require further research. For example, in order to plan services and facilities and to evaluate programs, the levels of adolescent participation in physical activity by age, gender, ethnicity, and parents' occupation should be monitored. Social and environmental factors that influence participation in physical activity should also be identified (Booth et al., 1995).

1.2 The Aim of This Study

Given that there are multiple influences acting on the physical activity behaviour of adolescents, the aim of this study is to investigate the patterns of physical activity of adolescent students in years 8 and 10 in the Illawarra area. This study focuses on the type, duration and frequency of participation in moderate to vigorous physical activity by adolescents. It also highlights relationships between the physical activity amongst adolescents and the factors including personal characteristics such as age, gender, country of birth, body mass index (BMI), fatness and the individual perception of health and body size and the way they look. The relationship between the physical activity and social factors including family, peer group, teachers and physical environmental variables such as television/video viewing and computer game playing also is highlighted. An understanding of these relationships can guide health professionals in planning physical activity programs for adolescents.

In addition, this study attempts to establish whether the Illawarra area's adolescents are following international guidelines, and offer recommendations based on research findings. There are two main International Physical Activity Guidelines for Adolescents. These guidelines have been published in a recent statement of the International Consensus Conference on Physical Activity Guidelines for adolescents. According to these guidelines, all adolescents should be physically active daily or nearly every day as part of their lifestyle and adolescents should engage in three or more activity sessions per week that last 20 minutes or more and that require moderate to vigorous levels of exertion (Sallis & Patric, 1994; Ewart et al., 1994; DuRant & Hergenroeder, 1994).

Furthermore, in spite of some studies being carried out on adolescent physical activity, there is no standardised questionnaire for measuring adolescent physical activity. This study attempts to validate a physical activity questionnaire using a one-week activity diary and one-week heart rate monitoring. It will

examine the validity of physical activity questions of the "Youth Health Survey" which is based on the World Health Organization's Cross-National Survey on "Health Behaviour in School-Aged Children" (Wold et al., 1994) to be carried out in the Illawarra area by the Illawarra Area Public Health Unit during 1996.

Given these issues, the following specific objectives were chosen for the research presented in this dissertation:

1. To determine the level and duration of physical activity of adolescents in the Illawarra area.
2. To determine the relationship between physical activity and personal characteristics of age, gender, grade, country of birth and language amongst subjects.
3. To determine the relationship between the anthropometric measurements such as Body Mass Index and fatness of the adolescents and the level of physical activity.
4. To determine the relationship between physical activity and adolescents' perception of their own body including health, size and the way they look.
5. To find out the relationship between physical activity and social variables including peers, family, the teacher they like, competition and taking part in a sports club.
6. To find out the relationship between adolescents' physical activity and environmental variables such as watching television, playing video-games and opportunities for physical activity in terms of time, cost, access to facilities, access to transport and a separate swimming pool.
7. To find out the relationship between the adolescents' physical activity and reasons for participation in physical activity.
8. To determine the type of activity that adolescents usually participate in.
9. To validate the physical activity questions which are being used in the

current study and the "Youth Health Survey", which is being carried out by the Illawarra Area Public Health Unit.

1.3 The Significance of This Study

The need for such a comprehensive study as this is made clear from a search of the literature. The literature demonstrates that knowledge of the extent of adolescent physical activity and inactivity is basic to their service planning and other initiatives promoting participation in healthy physical activity. There have been some epidemiological studies describing the physical activity of adolescents (Pate et al., 1994; Wold et al., 1994). A few studies have been conducted on the relationship between self recorded physical activity levels and objective measurements such as heart rate monitoring (Sallis et al., 1993), and the activity diary record in adolescents (Bouchard et al., 1983). There are also a few studies researching the patterns of physical activity in young adolescents (Raitakari et al., 1996). However, different dimensions of activity such as kilocalory expenditure, aerobic capacity, weight bearing, strength, flexibility and their relationships to certain performance measures have led to inaccurate validation and incomparable findings (Dipietro et al., 1993). Moreover, a number of physical activity studies have been carried out, but none of them have been found to be comprehensive. This present study utilizes a multi-instrument design including the questionnaire, diary, heart rate monitor and skinfold test.

While some research has been carried out into the physical activity of adolescents, little information is available on the duration, intensity and hours engaged in physical activity per week (Freedson, 1991). The level of activity and many of the factors that determine their physical activity are not clearly known (Freedson, 1992). In addition, the validity of the existing physical activity questionnaires is also under debate (Dipietro et al., 1993; Freedson, 1992). Many activity questionnaires in present use have been shown to be reliable for adults but

may not be appropriate for adolescents (Aaron et al., 1993).

In order to identify physically inactive and active adolescents and to evaluate the effects of prevention policy measures, it is necessary to develop a scale for monitoring the intensity and duration of physical activity and its related characteristics. The author believes that if data about the type intensity, duration and frequency of physical activity amongst adolescents can be collected, it can form the basis for physical activity training programs, which should result in positive health outcomes and improve the quality of life of Illawarra youth.

The report of this study will have significance for a wider audience. Policy makers and administrators will find it relevant when developing strategies and programs. The findings can be used in developing public policies to promote higher levels of involvement in regular physical activity.

A WHO Scientific Group (1994) recommends research into the area of physical activity, particularly the examination of psychological factors underlying a preference for physical inactivity. Therefore, the findings of this study will help to develop strategies for a physical activity program for school-aged children. Researchers and program planners will find information on methods of assessing physical activity levels in adolescents, their exercise habits, and material relating to the validation of measurements. Exercise instructors in high schools and health professionals will be able to influence the student physical activity program at school. Students from health-related courses will find useful information related to methods of assessing physical activity levels in adolescents.

The information in this study can provide a basic knowledge of the health implications related to the physical activity levels in adolescents, and thus assist service providers in developing physical activity programs suitable for adolescents. Data on the differences in physical activity levels according to gender may lead to more effective intervention for both sexes.

Primary health care providers can effectively use the recommended

guidelines in the promotion of healthy physical activities for their adolescent clients.

1.4 The organization of the thesis

The following chapters are included in this thesis: Chapter One deals with the introduction, the purpose of the study, its significance and the arrangement of the thesis. Chapter Two describes the theoretical concepts of physical activity and its health effects. Chapter Three describes the measuring of physical activity and validating of the physical activity questions. The design and methodology, hypotheses and the statistical techniques for analysing the data of the research are described in Chapter Four. Results are presented in Chapter Five using descriptive and inferential statistics in order to describe the demographic characteristics of the samples and to determine the relationship of physical activity with personal, social, perceptional and environmental variables. The type of usual activity is presented, and the relationship between the reasons for participation in physical activity is also determined and presented. Chapter Six covers the discussion and limitations of this study and it follows with the conclusion which involves the development and justification of the set of recommendations.

CHAPTER TWO

PHYSICAL ACTIVITY AND ADOLESCENCE

2.1 Introduction

This chapter reviews literature concerning the concepts of physical activity and adolescence. The concept of physical activity will be developed by looking at the definitions and intensity of physical activity, as well as aerobic and anaerobic physical activity. The relation between the energy system and physical activity is also discussed. Major health influences and outcomes associated with regular physical activity will be examined. The author has also focused on the health benefits of appropriate physical activity according to its intensity, duration, and frequency. In addition, the physical activity guidelines for adolescents are explored and the period of adolescence will be defined. Since this study aims to validate the physical activity questionnaire of the Youth Health Survey, conducted by the Illawarra Public Health Unit, the concept of validation is further developed in the following chapter.

2.2 Physical Activity: Definitions

Caspersen et al. (1989) provide definitions for the terms 'physical activity', 'exercise', and 'Physical fitness'. Physical activity is defined as a 'behaviour', considered to be "any bodily movement produced by skeletal muscles that results in caloric expenditure" (p.424). Exercise, which is considered to be a subcategory of physical activity, is defined as physical activity that is "planned, structured, repetitive. It results in the improvement or maintenance of one or more facets of physical fitness" (p.425). Physical fitness is not a behaviour but a "set of outcomes or traits that relates to the ability to perform physical activity" (P. 425). It is referred to as a set of attributes that people have to achieve that relates to the ability

to perform physical activity (Caspersen et al., 1985).

Physical activity includes exercise, sport and equivalent energy expenditures in other types of active leisure, occupational work, and domestic tasks (Shephard, 1995). Thus physical activity can be any movement of the body (or substantial parts of body) produced by skeletal muscles (Edward and Franks, 1992; Bouchard et al., 1993).

Physical activity has also been referred to as "habitual physical activity" (Mercer, 1989). Subsets of activities within habitual physical activity include exercise. Exercise is defined by Bouchard et al. (1990) as leisure time physical activity. The role of habitual physical activity in leisure-time activities is an area of interest for researchers in the field of physical and health education. It is important that factors relating to the choice of habitual physical activities in leisure time are identified. Although these definitions will be used in a broad sense in this thesis, the distinction between habitual physical activity and exercise is not always so clear-cut.

Given these definitions, one can view physical activity as behaviours that include exercise, defined as planned, structured activities such as jogging, rowing, swimming, and/or resistive weight training and flexibility activities. This behaviour also includes leisure/occupational activity which is less structured and generally less continuous such as yard work, stair climbing, housework, and physically demanding occupations. Conditioning activities and sports are likely to be exercise, while household tasks and work activities are unlikely to be called exercise because they are not done to improve fitness (Kaplan et al., 1993). The outcome of physical activity, whether it is participation in exercise or leisure, can be measured in terms of physical fitness (Adams and Edginton, 1989).

2.2.1 Anaerobic and Aerobic Physical Activity

The method by which the body produces energy is determined by the intensity and duration of an activity. Activities that require sudden bursts of effort such as jumping and sprinting need a large production of energy over a short period of time. These types of movement are powered by energy systems that do not require oxygen and are termed *anaerobic,* which literally means without air. In these types of movements, energy comes from high energy phosphate substances in the muscles or from the use of sugar materials in the muscle, resulting in the production of lactic acid (Egger and Champion, 1992).

Aerobic means 'with oxygen'. Aerobic exercise is any repetitive, rhythmical exercise involving the large muscle groups of the body that raises the heart rate and can be maintained for a continuous twenty to thirty minutes. When exercising aerobically the amount of oxygen taken in by the body is the same as the amount being used. Because the oxygen requirement of the working muscles is being met in this way, the activity can be maintained for some time. Brisk walking, jogging, running, cycling, swimming and dancing are examples of aerobic physical activity which are mostly low power output activities that call for continued energy production over a prolonged period. Aerobic exercise is not a stop/start activity, but one which can be maintained for some time at a steady pace (McCarthy, 1989).

Aerobic energy requires the use of carbohydrates and fats. These are broken down, through a process of 20-25 chemical steps to form adenosine triphosphate (ATP), with water and carbon dioxide as by products. Unlike the anaerobic system, the aerobic system is capable of producing large amounts of ATP without simultaneously generating by-products producing fatigue. Basically activities that utilise aerobic metabolism are those which increase the heart rate to >120 beats per minute; use the large muscles of the body (the thighs, trunk, arms and shoulders) and are carried out over an extended period of at least 15-20 minutes. These activities include walking, swimming, jogging, running, skiing,

dancing, cycling, rowing and skipping (Egger and Champion, 1992).

ATP is made from food carbohydrates, proteins and fats. Fat has a basic useable form in the body as free fatty acids (FFA). Triglycerides are the FFA_S stored in the adipose or fat tissue and in the skeletal muscles. The metabolisation of FFA from the fat stores to the muscles is important in the control of body weight, because during prolonged exercise of moderate intensity, FFA represent the major source of fuel for ATP production. Furthermore, FFA can only be activated as an energy fuel via the aerobic system. Stored fats are most readily used as fuel at low levels of exercise intensity such as walking and jogging. Therefore, for the purpose of decreasing fat on an overweight individual, gentle, rhythmic exercise is preferred to high intensity activity (Egger and Champion, 1992).

As the efficiency of the cardiovascular system in carrying oxygen to the muscles improves, the total amount of oxygen consumed by working muscles per minute increases. The maximal value of oxygen used is called an individual's aerobic capacity or maximal oxygen uptake (VO2 max). A higher VO2 max indicates an increased ability of the heart to pump blood to the lungs to ventilate oxygen, and of the muscles to take up oxygen (Egger and Champion, 1992).

2.2.2 Physical Activity and Energy System

Human energy is a result of the conversion of chemical energy (ATP or adenosine triphosphate) to mechanical energy (muscular contraction). ATP is stored in a small amount in the muscle and is the energy currency of the body. ATP is produced in three ways, which are called energy systems, including: i) ATP-CP (creatine phosphate) system; ii) Lactate acid system; iii) Oxygen system. The major factor determining which energy system is used, is the type of activity and its duration (Robertson & Glover, 1989).

At the very beginning of the activity the main source of energy is released

through breaking chemical bonds (phosphate bonds) of adenosine triphosphate which is stored in muscle. ATP is recreated in the body by using creatine phosphate which is another phosphate fuel and is also stored in the muscle. Since the amount of creatine phosphate in muscle is limited, this system provides energy for muscular action for about ten seconds of muscle action. This system of energy is called the ATP system, and is independent of oxygen supply or an anaerobic source of energy (Robertson & Glover, 1989).

When the activity is continued for more than ten seconds the body turns to the use of carbohydrates as a main fuel for reproducing ATP. This is called the 'lactic acid system' or 'anaerobic glycolysis' which means dissolving glucose in the absence of oxygen. During anaerobic glycolysis the glucose is incompletely broken down to provide the necessary ATP for about two minutes of physical activity. As a result of inadequate oxygen the pyruvic acid that was formed from the glucose is converted into a toxic by-product called 'lactic acid' (Robertson & Glover, 1989).

After about two to three minutes of exercise the body can increase its intake of oxygen and produce ATP aerobically. This is called the 'oxygen system' of ATP production. Aerobic production of energy occurs in the mitochondria of the cells and involves the break down of carbohydrate, fat or protein, resulting in the release of large amounts of ATP. The aerobic breakdown of carbohydrate reproduces ATP and the by-products of carbon dioxide and water, which are easily eliminated from the body. There is no accumulation of lactic acid during aerobic glycolysis. This system may provide enough fuel for two to three hours of physical activity. Fat is also a reserve source of aerobic ATP production. The production of energy from the breakdown of fat needs more oxygen than to produce the same amount of energy from carbohydrates. Therefore, the person becomes breathless and tired and will have to decrease the rate of exercise. This will happen in running, swimming, and cycling. The body will only use protein

as ATP production in extreme situations such as starvation and continuous physical activity (Robertson & Glover, 1989).

2.2.3 Intensity of Physical Activity

Edward and Franks (1992), state that physical activity has three levels. Low intensity exercise is activity occurring at less than 50% of functional capacity, with little increase in respiration and no discomfort. These authors report that this exercise can be recommended, except for individuals with extreme disease or physical impairment, to expend calories and lower the risk of health problems. Moderate intensity exercise involves activity at 60% to 85% of functional capacity, which causes mild breathlessness and some perspiration. High intensity exercise, which is called 'vigorous exercise', involves activity at 80% to 120% of functional capacity and is recommended only for those interested in high level performance after medical screening. Therefore, one should exercise at low intensity for health maintenance, at moderate intensity for physical fitness, and at high intensity for performance. The intensity of physical activity has been defined in several ways. Londeree and Moeschberger (1982) determined the intensity of physical activity by a specific percent of maximal oxygen uptake or specific percent of maximal heart rate (HR max). For example the researcher suggested that 75% of heart rate max is equivalent to 60% of maximal oxygen uptake regardless of the state of fitness.

The intensity of physical activity has also been classified based on the type of activity. In a study conducted by Faucette et al. (1995) activities such as walking, gymnastics, volleyball, and horseback riding are classified as low-intensity. Activities including dancing, hiking/climbing, tennis, baseball/softball, basketball, football, and kickball are classified as medium-intensity, and activities including jumping rope, running, jogging, soccer, swimming, skateboarding, skating, bicycling, surfing, and aerobic dancing are classified as high intensity. Eaton et al. (1995) measured physical activity in adults with the question "In the

past month, how often, on average did you do continuous vigorous exercise (such as brisk walking, jogging, swimming, bicycling, or aerobic exercise) for 20 minutes or more? It was: < once a week, 1 or 2 times a week, 3 or more times a week, or not at all. In this study those who reported no activity or activity less than once a week were classified as sedentary. Those who exercised 1-2 times a week were considered moderately active. High levels of activity included those who exercised 3 or more times per week.

Physical activity is categorised by Bennett and Magnus (1994) into vigorous and less vigorous activities. The vigorous level of activity is defined as physical activity causing breathlessness, puffing and panting. The less vigorous level includes walking. Aerobic exercise is defined by these researchers as vigorous exercise which occurs three or more times a week for an average of 20 minutes or more per session.

In other studies the assumed level of physical activity level is based on the subjects' heart rates. Children were assumed to be more active than others when they spent longer periods of time in higher heart rate ranges. For example, the percentage of times during a specific time period where the heart rate was > 120 beats per minute (bpm) has been used as a measure of higher activity in children aged 5-7 years old (DuRant et al., 1993).

Faucette et al. (1995) classify activity levels based on MET values (metabolic equivalent or ratio of metabolic rate for specific activity divided by the resting metabolism). Low intensity activities scored three METs and included five activities of walking, gymnastics, volleyball and horseback riding. Moderate-intensity activities scored five METs and included dancing, hiking/climbing, tennis, squash, baseball, football, and kickball. Eight activities including running/jogging, soccer, skateboarding/skating, swimming, bicycling surfing and aerobic dancing are classified as high-intensity level activities and scored nine METs. In a study carried out by Raitakari (1996), physical activity was assessed

by MET values. Subjects in this study are defined as having a moderate level of physical activity if they participated in intense leisure-time physical activities, that is, a minimum of 6 MET hours/week which corresponds to a moderate physical activity of 20 min/session, 3 times a week. Furthermore, research was conducted by VandenBergh et al. (1995) in which activities are classified according to the subjects' energy expenditure, by using the ratio between the working metabolic rate and basal metabolic rate (metabolic equivalent, MET). In this study, the low intensity level of activity was four times the basal metabolic rate (4 METs). Light intensity is 4-7 METs moderate intensity was equal to 7-10 METs, and heavy activities were estimated at 10 METs or more.

The American College of Sports Medicine and the American Center for Disease Control and Prevention also defined moderate activity as exercise involving 2-6 METs (the metabolic equivalent or ratio of metabolic rate for specific activity divided by the resting metabolism). Walking briskly, cycling for pleasure, moderate swimming, golf by pulling a cart, home care, general cleaning and canoeing leisurely are included in this category (Friedlander, 1995). Walking briskly at 6 Km/h gave steady state heart rate averaging 146 beats in British children aged 11 to 16 years (Armstrong et al., 1990)

2.3 Physical Activity and Health Benefits

It is stated that physical activity can be part of an overall health maintenance program (Alpert & Wilmore, 1994), and regular participation in moderate and/or vigorous physical activity is an acknowledged component of a healthy life style (Pate et al., 1994). This can be supported with the studies that have been reasonably consistent in showing the benefits of a physically active lifestyle. Difficulties in accurately measuring physical activity do not make it easier to answer the question about dimensions such as frequency, intensity and duration of physical

activity necessary for health benefit (Eaton, 1994). But evidence shows that the dimensions of physical activity are important and necessary for the protection of health. These dimensions should be sufficient to improve physical and mental health. A frequency of less than three sessions of activity per week is not sufficient to increase fitness. However, more than five session per week does not provide extra fitness. The time spent on physical activity is also important. Short duration exercises with high intensity are not as effective as those of a moderate intensity with a longer duration. Sufficient duration of physical activity for cardio-respiratory health benefit is 20 minutes or more of moderate to vigorous activity (Sallis & Patrick1994).

In order to improve cardiovascular fitness, it is necessary to engage in repetitive physical activity involving large muscle groups at 60% to 80% of maximum heart rate (moderate to vigorous activity level) for at least 20 minutes three times per week (Millstein et al., 1993). Raitakari et al. (1996) reports that 60% of the maximum heart rate or 50% of the maximum oxygen uptake and even higher intensity levels (70% of the maximum heart rate) have been recommended for children in order to increase fitness.

Until recently, it was believed that regular intensive or vigorous physical activity was necessary to produce cardiovascular health benefits, but research has suggested that more moderate levels, and intermittent bouts of activity, can also have cardio-protective and other positive health effects (Blair et al., 1989; WHO Scientific Group, 1994; Leon & Norstrom, 1995).

There is good evidence that regularly taking part in moderate-level physical activity can have significant health benefits. It has been suggested that moderate physical activity enhances physical, mental and social well being (Wold & Kannas, 1993). Moderate intensity activity has been shown to have a positive effect in the development of skeletal mass in children (Meerkin, 1994). Modest

amounts of exercise or leisure-time activity can help reduce the risk of cardiovascular disease (Nichols et, al., 1992). Engaging in a moderate physical activity, such as recreational walking or cycling, can protect against certain types of neoplasm; particularly tumor of the descending colon and the female reproductive tract (Shephard and Shek, 1995).

The type or mode of regular physical activity is also important. Many health benefits can be achieved by engaging in one or more cardiovascular endurance activities such as walking, jogging, running, hiking, cycling, rowing, and swimming (Wilmore and Costill, 1994). Walking has gained recognition as a health beneficial activity and these benefits can be achieved even by engaging in regular, less vigorous walking. Walking is possible in many places and at any age in almost any kind of environment. Walking can take many forms such as race walking, power walking, aerobic walking, hill walking and strolling. Any walking is better than none at all, but longer and faster walks can lead to greater health-related improvements, such as a reduction in body mass. A moderate amount of regular walking decreases blood pressure, lowers body fat and reduces the risk of coronary heart disease (Sallis, 1993; Blake et al., 1987).

It is also reported that low intensity, long duration walking plays an important role in increasing high-density lipoprotein (HDL) cholesterol in relation to LDL (low-density lipoprotein) which is a favorable effect on atherosclerosis (Wilmore & Costil, 1994, Stefanick & Wood, 1994). Walking will also decrease anxiety and increase general well-being (Sallis, 1993). Regular walking may increase bone density and decrease the incidence of osteoporosis which often results in fractures of the vertebra or femur in older women (Davison & Grant, 1993). It has been found that after 11 weeks of walking 3 days per week at 80% of maximum heart rate, a 10% increase in aerobic power occurs in obese teenagers (Rowland et al., 1991). Walking is associated with cardiovascular and psychological benefits, weight loss, improving lipid profiles, controlling of

hypertension and delaying the loss of bone mineral content in later life (Sommers et al., 1995).

It has been also reported that health-related benefits might be achieved from regular physical activity involving low intensity activities. In other words these benefits can be achieved even below the levels which are recommended for health benefits. The cardiac improvement may also be achieved with either short-duration and high intensity physical activity or long-duration and low intensity physical activity, and even with multiple shorter-duration physical activity (Wilmore & Costill, 1994). Recently United States Surgeon General recommended 30 minutes or more of moderate intensity physical activity per day to maintain or enhance cardio-respiratory fitness (Manley, 1996).

Physical activity usually has a positive impact on health, in different ways. Booth et al. (1995) pointed out that the most direct effect of physical activity is the physiological adaptation of the body. The other, less direct, effect of physical activity involves different systems of the body which influence health. Although the health benefits of physical activity can not be described separately due to its direct and indirect effects on body, some health benefits of physical activity are described below.

2.3.1 Physical Activity and Blood Pressure

The early prevention of hypertension by physical activity reduces the prevalence and severity of adult hypertension and the costs of medical care. It is reported that children who have elevated blood pressure during adolescence are at significantly higher risk of having hypertension in adulthood (Ewart et al., 1995). Physical activity usually leads to reduction of blood pressure, which is one of the risk factors of cardiovascular disease (Eaton et al., 1995). Physical activity can be

an effective way to reduce both systolic and diastolic pressure in hypertensive adolescents. Studies have also reported a small decrease in either or both systolic and diastolic pressure in normotensive adolescents (Schneiderman et al., 1989; Alpert & Wilmore, 1994).

It has also been indicated that resting blood pressure is on average 2-5 mm Hg lower in physically active persons than in inactive persons, and the incidence of high blood pressure, that is, elevated blood pressure of at least 140 mm Hg or greater and/or diastolic blood pressure of at least 90 mm Hg or greater (Nieman, 1990), is lower in persons who are habitually active than in inactive persons (Ewart et al., 1995). The mechanism of reduction of blood pressure by physical activity is not completely known (Wilmore & Costill, 1994).

2.3.2 Physical Activity and the Heart

A physical activity, especially aerobic exercise, induces significant changes in myocardial function. The most commonly reported myocardial effect of aerobic exercise is a slower resting heart rate. The resting heart rate is the radial pulse determined during rest. The resting heart rate can be best determined by the average of heart rates taken on at least three mornings upon awakening (Nieman, 1990). It can also be determined by the mean of five minimum heart rates in a day measured by a heart rate monitor (Morrow & Freedson, 1994). Other effects reported following exercise training are increased stroke volume, that is the volume of blood ejected from a ventricle at each heart beat, equal to the difference between the end-diastolic volume and the end-systolic volume. The mechanism of these myocardial adaptations may be a reduction in resting sympathetic activity and an increase in parasympathetic activity (Schneiderman et al., 1989).

It is also stated that aerobic exercise reduces susceptibility to heart disease through controlling hypertension, reduction of body fat levels and the reduction of

depression and anxiety (McCarthy, 1989). Aerobic activity of a relatively vigorous nature such as walking and running will reduce the risk of coronary heart disease (Maleki, 1996). This result can be promoted through engaging in physical activities requiring energy expenditure of 7.5 kcal/min such as cycling and brisk walking sustained for three periods of 20 minutes per week (Biddle & Mutrie, 1991).

The mechanism by which this protection occurs seems to be related to the decreased lower body mass (Eaton et al. 1995). Data from the 1989-1990 National Health Survey indicates an association between participation in exercise, the level of exercise, and relative body mass index (BMI) for males and females (Australian Bureau of Statistics, 1993). This mechanism is also related to the decreased blood pressure, higher high-density lipoprotein (HDL) cholesterol, lower total cholesterol/HDL ratio as a consequence of exercise (Eaton et al., 1995). It can also be related to the positive preventive effect of physical activity on serum lipoprotein profiles and insulin resistance (WHO scientific Group, 1994).

From a health promotion context, physical activity may be considered as a key factor in changing a lifestyle destructive to cardiovascular health, such as smoking and dietary habits. It is reported that physical activity decreases the prevalence of smoking (Wold & Kannas 1993) and is related to food habits (Eaton et al., 1995).

In 1981 the WHO Expert Committee on Prevention of Coronary Heart Disease (CHD), stressed the importance of weight reduction in many populations because of evidence that it helps to lower elevated levels of blood cholesterol (WHO Expert Committee, 1986; Gotto et al., 1995). Experimental evidence indicates that regular physical activity usually leads to a fall in body weight and blood pressure (Pescatello & DiPietro, 1993). This evidence also suggests that regular physical activity should be encouraged as an important preventive strategy for cardiovascular disease (that is, coronary heart disease, stroke, and peripheral vascular disease) risk

factor control (WHO Expert Committee, 1986; Hatziandreu, 1988). Several large studies have demonstrated the protective effect of physical exercise against subsequent development of ischaemic heart disease (Gotto et al., 1995, Unger, 1996, Bijnen et al. 1994).

In addition, recent studies tend to show that regular exercise protects women, in particular, from cardiovascular disease and especially coronary artery disease. After menopause, the risk of coronary artery disease appears to increase in women. This increase may result from changes in lipid metabolism as a result of hormonal changes. However, women who exercise are protected from the effects of these changes (Johnson & Lombardo, 1994; Linder et al., 1983, Lupton & Najman, 1989).

2.3.3 Physical Activity and Diabetes

Regular physical activity has an effect on the delay and primary prevention of NIDDM (non-insulin-dependent diabetes, Type II diabetes) as discussed by Biddle & Mutrie, (1991); Shephard, (1995); and Wilmore and Costill, (1994). This might be a consequence of the body's increasing response to insulin, known as 'insulin sensitivity'. Insulin sensitivity of the cell will increase as a result of the utilisation of glucose by muscles being used in aerobic activity such as jogging, tennis and swimming (NHMRC, 1994).

Glucose is one of the main sources of energy during physical activity. It results from the conversion of glycogen stored in the liver and is transferred by the blood to the active tissues for metabolisation. As the duration of exercise increases, the liver converts more glycogen to glucose. Increasing amounts of glucose in the blood do not ensure that the muscle will use the glucose. Insulin facilitates the transportation of the glucose into the muscle fibers.

However, during prolonged physical activity plasma insulin levels decrease

while the need for glucose utilisation is increased. So exercise may increase the muscles' 'insulin like effect' by enhancing insulin binding to receptors on muscle fibers. This is termed the 'insulin sensitivity' of the cell. Therefore, physical activity reduces the need for a high level of plasma insulin to transport glucose across the muscle cell membranes into the cell (Wilmore & Costill, 1994).

Without a family history of being overweight, it is possible to be overweight as a consequence of lifestyle habits such as inactivity. Physical activity will lead to the prevention of diabetes through weight reduction. Excessive weight and obesity play a major role in the development of Type II diabetes. Obesity reduces the responsiveness of the pancreatic beta cells to the stimulation of increased blood glucose concentrations. Obesity will lead to the reduction of cell numbers and/or inactivation of their insulin receptors. As a consequence insulin becomes less effective in the blood stream as glucose is transported into the cells (Wilmore and Costill, 1994).

Physical activity may also increase the lifespan of people with diabetes, particularly for those with Type II diabetes (Biddle & Mutrie, 1991; Moy et al., 1993). In Type II diabetes, the cells become resistant to insulin. The muscle contraction has an insulin-like effect. In other words, membrane permeability to glucose increases with muscular contraction due to physical activity. This will lead to the translocation of glucose from the plasma into the cell, which decreases insulin resistance and improves insulin sensitivity (Wilmore and Costill, 1994).

2.3.4 Physical Activity and Osteoporosis

Osteoporosis is widely accepted as a health problem. It is referred to as a condition entailing a severe reduction in bone density and as a consequence increases fracture risk in later life (Armstrong & Welsman, 1996). Osteoporosis is common in older women and following menopause women have a fracture prevalence six times greater than men (Armstrong and Welsman, 1996). It has

been suggested that physical activity offers protection against osteoporosis. This will be possible through maximising bone mass early in life. A major factor in increasing bone mass and strength is mechanical force through gravity or muscle pull (Rutherford, 1990, Snow-Harter and Marcus, 1991; Bailey and Martin, 1994). Peak bone mineral content results from the accumulation of bone during growth and maturation. One of the factors that has an influence on determining peak bone mineral content is physical activity (VandenBergh et al., 1995).

There are several important environmental factors that may affect bone density but physical activity is probably the single most important lifestyle influence for an individual's continued bone health (McCarthy, 1989). This is because activity builds muscles and muscles put stress on the bones of the body. Gravity and movement also exert force on the skeleton. However, the type, amount and consistency of exercise are important. Both high levels and low levels of physical activity increase the risk of osteoporosis (Bacon et al. 1996). Weight-bearing physical activity such as brisk walking, running, and stair climbing is most effective on bone density and the recommended amount is an hour, three to four times weekly (Coney, 1991). This is supported by Armstrong and Welsman (1996), who suggest bone health and prevention of osteoporosis can be achieved by putting emphasis upon body mass-supporting physical activity such as running, aerobics, skipping rather than physical activity such as cycling and swimming activities.

2.3.5 Physical Activity and Psychological Benefit

Physical activity can be psychologically beneficial (Ugner, 1995). Calfas and Taylor (1994) conducted a study into the effect of physical activity on psychological variables in adolescence. This study was a review of 20 articles, which suggested that physical activity was consistently related to improvements in self-esteem, self-concept and the reduction of depressive symptoms and

anxiety/stress. In addition, a meta-analytic study suggested that children who experience physical activity interventions have higher self-esteem scores than the control groups (Gruber, 1989). This is also supported by Delaney and Lee (1995). Moreover, a prospective UK study has confirmed that there are benefits to the mental health of teenagers associated with regular physical activity (Steptoe and Bulter, 1996).

Regular exercise has an effect on the central nervous system. It improves cognitive function as a result of increasing oxygen and glucose transport to the brain. Physical activity also increases the ability to cope with stressors (Edward and Franks, 1992). Physical activity, such as running, may help people to cope with the stresses of daily life. This might be as a result of fitness, which is associated with the reduction of sympathetic responses from any given stressors, and its association with a quicker return to normal levels for systems which are affected by stress (Biddle & Mutrie, 1991).

There are several mechanisms that operate together to provide a positive psychological effect from exercise. These include changes in the central nervous and sympathetic nervous systems, improvement in self-esteem, feelings of mastery and an increasing work capacity. Exercise is also beneficial because it may distract people from many negative aspects of life (Wilmore & Costill, 1994).

Biochemical changes as a consequence of physical activity are also responsible for variation in one's psychological function. Some determinants of a person's psychological state are central neurotransmitters, the cortisol level, body temperature, cerebral blood flow and endogenous opiates, which can all vary during physical activity. Neurotransmitters such as norepinephrine, dopamine, serotonin and other amines within the brain carry electrical signals between neurons. Their reduction in the central nervous system has been associated with depression and other mood disorders. Physical activity can increase amines levels in the peripheral circulation. Consequently, it has a positive effect on the

psychological state (Rowland, 1990).

Regular physical activity may provide psychological strength and a natural high through the release of endorphins (Biddle & Mutrie, 1991). Endorphins are endogenous brain opiates and are also known as mood elevators. These substances also have a pain reduction effect similar to morphine. Studies in human physiology indicate an increase in plasma endorphin levels with physical activity (Rowland, 1990).

2.3.6 Physical Activity and Lipid Metabolism

Physical activity and aerobic fitness have an effect on lipid metabolism. Studies in this area suggest that levels of physical activity resulting in increased aerobic capacity are associated with more normal blood levels of total cholesterol, lower levels of LDL (low-density lipoprotein) cholesterol and increased levels of high-density lipoprotein cholesterol (HDL). These changes occur in association with decreased body fat and increased lipoprotein lipase activity, which is probably responsible for the increased availability of free fatty acids (FFA) for aerobic metabolism (Lupton & Najman, 1989).

2.3.7 Physical Activity in Prevention of Cancer

It is believed that physical activity may have a direct effect in reducing the incidence or delaying the onset of cancer (Shephard & Shek, 1995). Various types and amounts of exercise influence physiological (Biddle & Mutrie, 1991) and biochemical events (Rowland, 1990), auto immune mechanisms (Lee & Wing, 1992) and body-fat depositions (Royall, 1988; Biddle & Mutrie, 1991). These are all thought to be related to cancer occurrence (Lee & Wing, 1992).

There is also evidence that physical activity is protective against breast

tumors and cancer of the female reproductive tract (Shephard and Shek, 1995). Early menarche, later menopause, and fatness are risk factors of breast and reproductive system cancer among women. Physical activity during childhood will lead to lower breast and reproductive system cancer. This is as a consequence of the later onset of menarche, earlier menopause and leanness among those who are physically active during childhood (Neiman, 1990).

Those who have a sedentary life style have a 30 - 100 percent greater risk of colon cancer (Nieman, 1990). Physical activity has an effect against colon cancer and recent studies are suggesting the following possible reasons for this preventative effect of physical activity on colon cancer. Firstly, physical activity stimulates muscle movement of the large intestine. Consequently the time that the intestinal wall is in contact with any cancer-producing chemical is reduced. Secondly, physically active people usually are less obese than sedentary people, and obesity is a colon cancer-related risk factor (Neiman, 1990; Biddle & Mutrie, 1991). Physical activity also reduces the incidence of cancer through its influence on the immune system which is examined in section 2.3.8.

2.3.8 Physical Activity and the Immune System

Although little is known about the impact of physical activity on the incidence of infectious disease and the immune response to infection, evidence indicates that moderate exercise seems to have beneficial effects on immune function (Shephard & Shek, 1995). Moderate physical activity may improve one's resistance to infectious disease (Pedersen, 1996 & Hoffman, 1996). Moderate physical activity may also decrease the incidence of cancer (Conn, 1996). Reduction in the incidence of cancer may be as a result of increasing energy output through physical activity and therefore decreasing the energy available to the tumor. This effect can be supported by a study result showing that patients with auto-

immune disease such as rheumatic arthritis were treated by decreasing their energy sources through fasting which caused suppression of arthritic inflammation (Conn, 1996).

It is also believed that physical activity affects both the pro-inflammatory and anti-inflammatory elements of the immune system. These effects can be demonstrated by stimulating the production of 'cytokines' within active skeletal muscle and possibly within the splanchnic bed and kidney (Bagby et al., 1996). Cytokines are small molecular weight proteins that serve as intracellular signals (Cannon, 1996) which can be produced by a wide variety of cells. Cytokines have a specific role in the function of the immune system to maintain the homeostasis (physiological balance) through the recognition and elimination of pathogens, or the repair and elimination of damaged cells. These tasks can be accomplished by the two kinds of cytokines, including the pro-inflammatory and the anti-inflammatory cytokines (Bagby et al., 1996).

2.4 Adolescence

Adolescence spans the decade from 10 years of age to 19 years of age (World Health Organisation, 1995). The starting point of adolescence has also been equated with the 'teenage' years (ie. 13 years) (Taylor and Muller 1995). It begins with puberty, the earliest signs of the development of secondary sexual characteristics, and concludes with the actual or anticipated attainment of adult responsibility. The concept of adolescence is based on the recognition that adolescence is a developmental period between childhood and adulthood. During adolescence, development proceeds along four major areas of growth: physical, psychological, cognitive and social. Adolescence is a period of rapid growth of new tissue. For example more than 20% of one's total growth in size, height, and up to 50% of adult bone mass is achieved during adolescence (WHO, 1995).

Adolescence is also a very important period for the development of bone mass. During adolescence bone mineral density (BMD) increases between 15% and 75% of the adult value (Armstrong, and Welsman, 1996).

There are three sub stages for adolescence; early adolescence mid-adolescence and late adolescence. The characteristic of early adolescence includes the beginning of separation-individuation from parental figures, moving towards increasing self-reliance, together with a need for peer group attachment (Taylor and Muller 1995). It is in this stage that adolescents establish healthy lifestyles such as an active lifestyle that is likely to carry into adulthood and have lifelong significance for health (Humburg et al., 1993). In mid-adolescence, significant characteristics revolve around the greater awareness of changes through physical maturation and, in particular, an awareness and acceptance of one's body and sexuality; peer group relationships and acceptability become more important, as does the need to consider and plan for future employment (Taylor and Muller 1995).

During the period of late adolescence the young person is strengthened by greater cognitive skills and is expected to integrate harmoniously into all of the components of his or her society. In addition, with a sense of emancipation from parents and increasing autonomy, the late adolescent attempts greater depths in relationships beyond the family network and begins to plan for economic independence. Such features of late adolescence often contribute to making these young people potentially vulnerable to accepting new philosophies (Taylor and Muller 1995).

The behavioural beginnings of adolescence start at about 11 years (Taylor and Muller 1995). Adolescents' health behaviour is increasingly seen to be contributing to the risk factors of chronic diseases (Bauman, 1992). The lack of appropriate physical activity is an important risk factor of chronic disease (Page, 1995). Thus, it is important to know the risk-taking behaviours of adolescents when planning programs for health promotion (Bauman, 1992).

2.5 Physical Activity Guidelines for Adolescents

Since regular physical activity in adolescence has been shown to be associated with adult health, it seems reasonable to propose that children should practice regular physical activity habits so that they can carry this health habit into adulthood. Suitable physical activity also has the following highly desirable and immediate health benefits for adolescents: the normalising of body weight and body composition and promoting positive mental health. These immediate health outcomes are highly desirable. Schools are an important forum for adolescent health promotion because of the amount of time adolescents spend there, and because of the natural opportunities schools provide for health promotion efforts (Shilton et al., 1995).

Adolescents can lay a foundation for their health over a lifetime by the choices of physical activity behaviour (Humburg et al., 1993; Telama et al. 1994). Regular physical activity in childhood, and particularly during adolescence, will lead one to carry this health-related behaviour into adulthood. Guidelines for increasing physical activity in adolescents have been published in a recent statement by the International Consensus Conference on Physical Activity Guidelines for Adolescents (Sallis and Patrick, 1994).

The International Consensus Conference on Physical Activity Guidelines for Adolescents convened to review the effects of physical activity on the health of adolescents, in order to establish age-appropriate physical activity guidelines, and to consider how those guidelines might be implemented in primary health care settings. The invited experts and representatives of scientific, medical and governmental organisations established two main guidelines. Firstly, all adolescents should be physically active (participation in physical activity for 30 min or more) daily or nearly every day as part of their lifestyle. Daily physical activity can be as a part of play, games, sports, work, transportation, recreation, physical education, planned exercise and in the context of family, school, and community activities. Secondly,

adolescents should participate in moderate to vigorous activity for 20 minutes, 3 or more days per week (Pate et al., 1994; Calfas & Taylor, 1994; Commonwealth Department of Sport, Recreation and Tourism, 1992). Moderate to vigorous activities are those that require at least as much effort as brisk or fast walking, jogging, stair climbing, basketball, skating, swimming laps, soccer, dance, strength (resistance) training, lawn mowing, strenuous housework, running, skiing and cycling (Sallis and Patrick, 1994).

Morrow and Freedson (1994) suggested that adolescents should be involved in regular physical activity. Adolescents' physical activity should involve the large muscles and provide an aerobic stimulus such as walking running, cycling, rope jumping and swimming. However, additional aerobic benefits may be achieved with moderate to vigorous physical activity, for example, a minimum of three days per week for a minimum of 30 min at intensity of 75% of heart rate reserve. These writers also have estimated 75% of heart rate reserve/maximum heart rate by using the following equation: RHR + 0.75 (MHR - RHR), where, RHR = resting heart rate and MHR = maximum heart rate.

A person's maximum heart rate can be determined by subtracting their age from 220 (McCarthy, 1989). Given this, the maximum heart rate for adolescents aged 13 and 15 are 207 and 205 beats per minute respectively. In the study by Ewart et al. (1995) 70% of maximum heart rate was a target zone. This target zone was derived by subtracting the subject's resting heart rate from her estimated maximum heart rate (220 - age), multiplying the reminder by 0.70 and adding the resting heart rate to this product. In this study the average 14 years old girl's assumed resting heart rate is 82 beats per minute (bpm), which yields a target heart rate of 169 beats per minute.

Physical activity has an effect on growth hormone and testosterone levels in adolescents. This is supported by a study carried out by Zakas et al. (1994) on prepubertal and pubertal adolescent boys in Greece. The study indicates that high

intensity training can be a stimulus for increasing the growth hormone and testosterone levels in 13-years-old boys and 16-years old boys.

Adequate physical activity has an important effect on the health of adolescents. Consequently, the promotion of regular physical activity should be a priority for physicians and other health professionals. Individual activities such as walking, running, jogging, and jumping rope that generate moderate-to-vigorous levels of movement intensity are chosen by educators because they can be transferred outside schools to personal play opportunities. These activities are also more likely to be carried over into adulthood (Faucette et al., 1995). Stoto et al. (1990) suggested that physical activity programs should emphasize aerobic and lifetime activities such as cycling, swimming, tennis, and running, and decrease time spent on football, basketball and other team sports. Neiman (1990) also supports this suggestion.

2.6 Determinants of Physical Activity in Adolescents

Participation in physical activity as a health-related behaviour is influenced by a number of determining factors (Bouchard et al., 1993). Determinants of physical activity include demographic variables such as age, gender, ethnicity and the parents' social class. Other factors are social variables such as peer influences and family influences; perceptional variables such as perception of one's own health and body; and environmental variables such as watching television and playing video games (Sallis, 1993).

Although, sufficient data on adolescents' physical activity is lacking, a few studies were conducted relating to the determinant of physical activity in adolescents. The result of a study carried out by Kemper et al. (1986), with the longitudinal sample from secondary schools in Amsterdam, indicates that the amount of physical activity diminishes from age 12 to 17 years. Another study on the determinants of sporting behaviour among 456 young people aged 12 to 18

years conducted by Kroesbergen & Haanen (1995) indicates that for girls, social factors play a main role in physical activity. This study, which was a cross-sectional study, indicates that activity levels decline with increasing age across adolescence and this decrease is more marked in females than in males. Bauman (1992) carried out a population-based survey on adolescents' health and lifestyle in South Western Sydney among children who were 13 to 15 years old. Results from the physical activity section of this study indicated a decline in physical activity participation between ages 11 and 15. In addition, a review of large population-based studies by Pate et al. (1994) also showed that, adolescents engage in physical activity for a mean of one hour per day and that activity levels decline with the increasing age of adolescents. The reduction is also more evident in females than in males (Aaron et al., 1993; Pate et al., 1994; Sallis et al., 1992). The study of Pate et al. (1994) indicates that about two thirds of males and one quarter of females participate in moderate to vigorous activity for 20 minutes three or more times a week.

Insufficient data also exists on the activity level of adolescents and on the effect of economic and racial differences upon the physical activity patterns of adolescents. Therefore, a clear statement cannot be made on the effect, if any, that ethnicity, culture and gender have on the level and duration of physical activity. However, in 1989-1990 a National Health Survey was conducted on people aged 15 years and over, with the purpose of collecting information about health status of Australians. The finding derived from self-reported intensity, frequency and duration of exercise undertaken for recreation, sport or fitness in the past two weeks. The study results showed that 41 percent of those born overseas do not participate in a significant level of exercise, compared to 33 percent of the Australian born. Females born overseas are less likely to undertake exercise than those who are born in Australia, with females from non-English speaking countries being the least likely to exercise. It also indicates that those born

overseas (aged 15-24 years old) are less likely to undertake exercise than those born in Australia with the corresponding percentages being 19.7 and 24.5 (Australian Bureau of Statistics, 1993). On the other hand, a few studies suggested that physical activity is more strongly related to socioeconomic status than to race/ethnicity (Sallis, 1993; Sallis et al., 1992; Shephard, 1986).

Social factors such as peer group pressure and family physical activity habits also have an effect on adolescent physical activity. Adolescents perform much of their physical activity within group settings. It is believed that most of the influences on the physical activity habits of adolescents are from the family, parents and peers. Parents have the strongest influence on their children's level of physical activity (Hamburg et al., 1993; Sallis et al., 1992; Telama et al., 1994). Shephard (1986) reported that there is a positive relationship between the student's physical activity and the mother's exercise habit and the father's current physical activity. In addition, a study conducted by Anderson & Wold (1992), on parental and peer influence on leisure-time physical activity in young adolescents in Norway, indicates that significant others have an important effect on promoting physical activity in young adolescents. The authors also stated that several European and North American studies report the influence of parents and peers on physical activity.

Adolescent physical activity behaviour can also be influenced by self-identified barriers such as perceptions of personal health and body image (Hamburg et al., 1993). Particularly after the age of 13, children undergo dramatic changes in their bodies, which result in the accumulation of fat in girls, and of muscle in boys. For girls, particularly, these changes are accompanied by body image disturbances associated with menarche. There is great pressure on both girls and boys to take personal responsibility for their bodies and their appearance (McDonald, 1991). It is also believed that the implementation of physical activity programs in the population was not very successful because of

the uncertain psychological barriers that prevent individuals from participating in regular physical activity and from being motivated to continue exercising (WHO Scientific Group, 1994).

The concept of normality, and ideal weight, is an important consideration, which changes from culture to culture. A study was carried out by Felts et al. (1992) on the relationship of adolescents' perceptions of relative weight to physical activity levels and the time spent viewing television. The results showed that adolescents who perceived themselves as too fat reported fewer days of vigorous activity, fewer hours of exercise and more hours spent viewing television on school days. Females made up 75% of those reporting they were "too fat" and trying to lose weight. Sallis et al. (1992) stated that obese adolescents are less active than lean ones.

A study on the activity of children (Shephard, 1986) of both sexes, ages 12 to 14 years at two junior high schools in the Toronto area showed that there are gender difference with respect to motivation for physical activity like 'looking better' (females much more than males), 'being healthy' and having fun (males more than females).

In addition, the degree to which adolescents participate in different types of physical activity depends on a number of environmental factors. Sallis et al. (1992) claims that it is important to identify those characteristics of the physical environment that influence the levels of adolescent physical activity to help in promoting positive health changes. There is little information available regarding the conceptualisation of physical environment variables, and few measurements of these variables exist. Time and place factors, television viewing, and access to physical activity facilities and programs can be thought of as physical environment characteristics.

Adolescents spend the largest part of their leisure time in watching television and playing video games (Janz, 1990). The report of the World Health

Organisation cross-national survey in 1993-94 on health behaviour in school-aged children indicates that the majority of the adolescents did not watch TV more than four hours a day. The pattern of TV watching was different in each age group, and the proportion of watching TV declined by age. At each age, more boys than girls watched TV four or more hours a day (King et al., 1996). Television viewing by children may increase energy intake through consumption of foods advertised on television, and decrease energy expenditure because of the reduction in their activity rate. It is reported that adolescents who watched more television daily are more obese than those who watched less television (Figueroa-Colon et al., 1992; Janz, 1990). A review of a few studies on TV viewing and physical activity by Pate et al. (1994) showed that the average 10 to 17 year old spends 3 hours per day watching television. It also showed that the US adolescents spend 2-3 hours per day watching TV.

Turker (1986) examined the relationship between the amount of television viewing and physical activity in adolescents and classified television viewers into three categories: light viewers (< 2 hours per day), moderate viewers (2-4 hours per day) and heavy viewers (> 4 hours per day). The finding of this study showed light television viewer males were more physically fit and active than those of either the moderate or heavy TV viewing groups. A study of Canadian adolescents reported no significant relationship between television viewing and physical activity (Shephard, 1986).

Despite the popular opinion that children are becoming less active due to television and video related activities, data on time trends in adolescents physical activity are lacking (Sallis et al., 1992). It is reasonable to assume, however, that time spent watching television is a barrier to physical activity. If an adolescent spends 6 hours at school, 2 hours on home work, 2 hours on personal care and eating, 3 hours or more watching television, and 8 hours sleeping every 24 hours, there is little time left for physical exercise (Sallis, 1993).

Furthermore, the availability of relevant facilities and supplies also has an influence on adolescent physical activity. Many out of school activities require facilities, such as fields and basketball courts. However many healthy physical activities, such as walking and running can be performed with limited facilities and supplies (Sallis, 1993).

In addition, the perceived reason for participation in physical activity is one of the most important factors in the participation of physical activity (Wold & Kannas 1993). Although the reasons people become physically active are complex and dynamic (Caspersen et al., 1985), the findings of a study in Finland indicate that the four main reasons for Finnish pupils of adolescent age (11-19) participating in physical activity are recreation, sociability, competition and health (Wold & Kannas, 1993). Findings of another study on health behaviour and lifestyle of adolescent age (11-15) in Finnish pupils showed that fun is a main reason for adolescent's participation in sport. Competition or desire to be a sport star were not important reasons for participating in sport for older adolescents, and winning decreases its importance as students grow older. However, health-related reasons to take part in sport differ with gender (Wold & Kannas 1993).

2.7 Conclusion Based on the Literature

In conclusion, physical activity has many health benefits such as positive health effects on blood pressure, prevention of heart disease and diabetes, psychological health, promotion of lipid metabolism and prevention of cancer and the support of the immune system. These health benefits can be obtained through improvement of physical activity habits during adolescence. Adopting an appropriate lifestyle in the adolescence stage of life is considered important to the attainment of optimal peak bone mass and prevention of osteoporosis. The health benefits of physical activity are related to the frequency, duration and intensity of

physical activity. The intensity of physical activity is measured in different methods such as the type of activity, using subject's heart rate and MET values.

Physical activity must be regarded as a lifetime responsibility, because the benefits may be lost if the participation stops. Since adolescents' physical activity habits, particularly in the early adolescent period, can be carried into adulthood, they need intervention in this period. Adolescents should be encouraged to make it a lifetime task to take part in appropriate physical activity. To achieve the lifestyle target for Australia's health in the year 2000, intervention during adolescence is needed. To promote regular physical activity in adolescents, the determinants for being physically active such as personal characteristics, social and environmental factors affecting physical activity, the reasons for participation in the physical activity and the type of physical activities must be investigated from the health promotion point of view.

CHAPTER THREE

MEASURING OF PHYSICAL ACTIVITY LEVELS

3.1 Introduction

In this chapter measurement of physical activity levels and assessment of the validity of the physical activity questionnaire is examined. The measurement of physical activity is an important component of health research. The difficulties in determining the activity levels of the population should not be underestimated. Physical activity levels can not be directly quantified by laboratory testing. Therefore, there is a marked variability between and within studies concerning the measurement of physical activity (LaPorte et al., 1982). In a review of physical activity assessment LaPorte et al. (1985) identified over 30 different techniques. However, it was recently stated that about 50 different individual assessment methods are available for use in the assessment of physical activity levels (Bouchard et al., 1993).

Since there is insufficient evidence on the measurement of physical activity among adolescents, the assessment of physical activity is widely examined in this chapter. This is followed by the measurement of physical activity among adolescents.

3.2 Assessment of Physical Activity

Physical activity measurement can be based upon energy consumption, energy expenditure or energy balance. Self-administered and observational diary records of meals that subjects have eaten, are examples of energy consumption (dietary records). From the point of energy expenditure, job classification, survey methods, behavioural observation, calorimetry, mechanical or electronic monitoring and the use of physiological markers can be mentioned. The third

approach, which is energy balance, compares calories consumed with energy expended (Shephard, 1986).

Physical activity can be measured through a direct or indirect approach. Direct methods of physical activity assessment are those which are designed to measure physical activity, or constructs related to physical activity. Examples of these methods include questionnaires, activity diaries, electronic monitors, direct observation and calorimetry which is the measurement of metabolic rate. Indirect methods are those methods which are believed to have a high correlation with physical activity, but which do not directly measure physical activity. These include job classifications, dietary assessments, and body composition assessments (Shelton & Klesges, 1995).

Both direct and indirect measures have been developed to assess physical activity levels (Montoye & Tylor, 1984; Blair, 1984; LaPorte et al., 1985; Baranoweski, 1988; Wold et al., 1994; Booth et al., 1995). Despite numerous attempts having been made to develop and test methods of physical activity assessment, no single instrument fulfils the multiple criteria of being valid, reliable, and practical. Thus the validity of existing physical activity questionnaires is questionable (Freedson, 1991; Aaron et al., 1993; LaPorte et al., 1985; Caspersen, 1989).

The major direct and indirect procedures used for the assessment of physical activity are explored in this part and include: physiological measurement, mechanical and electronical monitoring, heart rate monitoring, dietary intake records, anthropometry, calorimetry, behavioural observation, questionnaires, and activity diaries.

3.2.1 Physiological Measurement

Physical activity can be assessed by physiological measurements such as VO_2 max. VO_2 max is a laboratory direct method for measurement of oxygen

uptake. V is the volume of oxygen used per minute, O_2 is oxygen, and max represents maximal physical activity conditions. The maximal rate of oxygen is the maximal rate at which oxygen can be taken up, distributed and used by the body during physical activity (Nieman, 1990). VO_2 max, which is also called cardiorespiratory endurance (maximal oxygen uptake or aerobic capacity) can increase as a consequence of regular participation in vigorous activities (Booth et al., 1995). Maximal oxygen uptake or VO_2 max also refers to a peak oxygen consumption which the body eventually reaches when faced with increasing physical activity. This peak value, which is a predictor of good health and is associated with being physically active, is a measurement of cardiorespiratory endurance and aerobic fitness (Wilmore & Costill, 1994).

VO_2 max is measured by collecting and analysing expired air samples in a laboratory. It also requires skilled staff and special equipment and study subjects should attend a special facility. The advantages of this method include sufficient knowledge about its physiological basis, acceptability of its procedures, and its reliability, together with its construct validity such as its correlation with the ability to perform moderate intensity physical activity for extended periods of time. The disadvantage of the method is that the accuracy is dependent upon the cooperation of the subject. Placing such a burden on subjects may create a bias in the study sample and makes for an inaccurate estimation of activity levels in the population. This method is less suited for use in adolescents because it is too intrusive. In addition, the costs of measuring aerobic capacity are considerable (Booth et al., 1995). Furthermore, it is believed that Vo2 max has a major hereditary component and is affected by factors such as gender, age, relative weight. As a consequence it can not be used as a valid measure of physical activity (Montoye et al. 1996).

3.2.2 Behavioural Observation

The behavioural observation technique can also be used for estimation of physical activity levels. This technique, which is a direct measure of behaviour, provides information about specific activity patterns (Shephard 1986). Subjects should be viewed or videotaped during school, in physical education classes and recess time, or at home by trained observers using a standard observation form. Behavioural observation requires a well-trained observer who notes the activities of the subject on a minute by minute basis through direct observation or using a videotape (Shephard, 1986). The outcome measure of behavioural observation can be in kilocalories or nominal scores that are directly related to caloric expenditure (Freedson, 1992). Although direct observation is not practical for use on large population studies, it is useful for small samples. The behavioural observation method is generally used as the criterion measure of physical activity (Freedson 1992) or as a method for the validation of physical activity survey questionnaires and mechanical and electronic monitoring (Baranowski et al., 1984; Shephard, 1986; McKenzie, 1991). Problems with direct observation include the likelihood of a selection bias and it also requires direct observation of subjects which has an influence on subjects' typical behaviour (Booth et al., 1995; Bouchard et al., 1993). The observer must be properly trained to prevent observer bias. Observers or videorecorders need to be in the environment where behaviours of interest occur, thereby limiting situations where data can be collected. It is time consuming, and direct observation is costly in comparison to other methods (Mckenzie, 1991; Freedson, 1992). In addition, adult energy expenditure values may be used to convert the activities into energy expenditure, which may underestimate children's level of energy expenditure (Freedson, 1992). Moreover, based on the author's knowledge, direct observations have not been tested for measurement of physical activity in adolescents. However, there are a few large behavioural intervention studies such as project CATCH conducted on

children and adolescents to promote physical activity (Perry et al., 1990). Behavioural observation has not been used in this study to measure the level of activity in adolescents.

3.2.3 Monitoring Mechanical and Electronic Motion Sensors

Monitoring devices are used to assess and record body movement (Freedson, 1991). Motion sensors seem to be more practical than direct observation. Their use is not as costly as direct observation (Freedson, 1992). A mechanical or electronic accelerometer can be used to ascertain normal human movement in field settings. There are only a few kinds of mechanical motion sensors such as the early example of the pedometer, the actometer, the Large Scale Integrated Sensor (LSI) and the caltrac accelerometer (Freedson, 1992). The pedometer consists of a lever arm, spring and gear. This device is worn on the hip, waist or ankle to assess the distance covered by measuring acceleration and deceleration. Verschuur (1987) has used a pedometer to measure physical activity in children aged 12-13 and 16-17. The actometer is also another motion sensor which measures acceleration and deceleration. This motion sensor is like a wristwatch where movement causes a rotor to turn. It is worn on the wrist or ankle (Freedson, 1991). The LSI is a motion sensor consisting of a cylinder with a ball of mercury and a switch. Closing of the switch as a consequence of the rolling down of the ball of mercury into a mercury contact switch registers as a movement. This motion sensor is placed on the hip to measure physical activity (LaPorte et al., 1982). The caltrac accelerometer, which measures exercise intensity, has replaced the pedometer, actometer and LSI in physical activity research. The size of the caltrac accelerometer is $14 \times 8 \times 4$ centimetres and weighs 400 grams. It is worn on the non-dominant hip and assesses vertical acceleration that is converted to kilocalories. Through this movement sensor caloric expenditure can be measured with a liquid crystal display (Freedson,

1991). This can be carried out by programming the device with the individual's age, gender, body mass, and stature. According to the evidence, these motion sensors are usually used in early childhood or prepubescence (Freedson, 1991) and with adults (Gretebeck and Montoye, 1992). An accelerometer called Computer Science Application (CSA) was also used by Janz (1994) to evaluate its validity and stability for measuring children's (7-15 years) physical activity, using heart rate telemetry as the criterion measure. This electronic device is small, lightweight, and powered by a 1/2 V battery. It can be worn at the waist, on the wrist, or around the ankle. Movement counts can be stored in the memory over a period of several weeks, producing a minute-by-minute chronological record of movements. In Janz's study the physical activity was assessed in two ways: 1) mean movement counts per day, and 2) number of minutes spent at movement counts equal to or more than 256 counts per minute (the 80th percentile of movement counts per minute that is reflecting vigorous activity) per day.

Mechanical and electronic motion sensors are expensive and inaccurate for some activities such as swimming and cycling (Booth et al., 1995).

3.2.4 Heart Rate Monitors

Heart rate monitoring is an objective measurement of physical activity. Shelton and Klesges (1995) consider that heart rate monitors provide greater objectivity and are generally more practical and less time consuming than direct observation. Heart rate monitors have been found to be useful measures of physical activity because they directly measure physiological parameters relating to physical activity and provide continuous records that may reflect the intensity and duration of daily activity. To measure habitual physical activity a minimum of 5 days of recordings is needed (Gretebeck and Montoye, 1992). It is believed that direct heart rate monitors are strong indicators of the quality of physical activity and energy expenditure in the natural environment, and heart rate monitors are

recommended as a valid and practical objective measure of physical activity (Freedson, 1989; Freedson, 1991; Saris, 1986). The heart rate is linearly related to energy expenditure, and it is assumed that higher heart rates are related to higher rates of energy expenditure and oxygen consumption (Freedson, 1991; Janz, 1994; Freedson, 1992).

Using of the heart rate as a measure of physical activity is based primarily on the strong positive association between the increase of heart rate and energy expenditure. However, there are some limitations in the use of heart rate measurement such as: the specific activities and the time engaged in the activities are not known (Freedson, 1991); the slope of the relationship between heart rate in individuals due to their different endurance capacity (Haskell et al., 1993); active subjects have a lower heart rate than sedentary people (Londeree & Moeschberger, 1982); the heart rate can be influenced by other factors, such as emotional stress (Haskell et al., 1993), surrounding temperature and fatigue (Booth et al., 1995); the heart rate can also be influenced by noise, humidity and the time and size of food intake. Moreover heart rate, both at rest and during physical activity, also varies throughout the day. This is called 'diurnal variation', which refers to alternative variations that occur during 24 hours of the day (Wilmore & Costill, 1994). Activation of different muscle groups can also cause heart rate to respond differently. For example the heart rate response to arm exercise is greater than leg exercise whilst the energy expenditure of leg exercise is greater than that of arm movements (Freedson, 1991). It is also inaccurate for some activities such as swimming and cycling (Booth et al., 1995).

All of the above effects are seen in lower zones, that is, when the heart rate is below 120 beats/min. Thus, heart rate monitoring should be considered a tool for assessing moderate to vigorous activity (Riddoch & Boreham, 1995). In addition, it should be borne in mind that the major advantage of heart rate monitoring is that it eliminates difficulties associated with recall of activity

(Freedson, 1991). The heart rate technique is considered one of the best alternative methods for measuring physical activity (Saris, 1986).

3.2.5 Dietary Record

Food consumption record is an indirect method for physical activity measurement which is based upon energy expenditure. This can be done through direct observation or self-administered dietary record. Disadvantages of these methods include: impossibility of determining frequency, duration, and intensity of activity; a heavy person consumes more energy than a lighter person; inter- and intra-subject variability; underestimation of energy expenditure due to neglect of snacks (Shephard, 1986).

3.2.6 Anthropometry

Physiologically, diet and physical activity determine energy balance in the body and thus influence body composition (Sallis, 1993). Body composition is also one of the physical fitness components, which are associated with physical activity (Pate, 1991). Body composition can be assessed by anthropometric measurements. This assessment reflects inadequate or excessive food intake, insufficient physical activity and disease. Anthropometry is the most universally applicable in assessing the size, proportions and composition of the human body. Anthropometry is especially important during adolescence. Adolescent anthropometry allows the monitoring of obesity as a health risk (WHO, 1995).

The measurement of skinfold (SKF) thickness as an indicator can be used to identify obesity. Skinfold thickness is an objective measurement of subcutaneous fat which provides an estimate of body fat in adolescents (Greipp, 1988; Heyward, 1991; Himes & Dietz, 1994). It is stated that the site of measurement, either a single site or a combination of sites, can be representative of the average thickness of subcutaneous fat (Nichols and Sheng, 1992). Kemper et

al. (1986) determined the body fat (fat mass) of adolescents by measuring four skinfold thicknesses including biceps, triceps, the subscapular region and the suprailliac region. Ross and Gilbert (1985) have used skinfold thickness (sum of triceps and subscapular skinfolds (mm) to measure the degree of body fatness in American school-aged children. These authors state that skinfold thickness helps to predict vulnerability to a wide range of degenerative diseases such as hypertension, heart disease, diabetes, psychological disorders, and impaired tolerance of heat. Armstrong et al. (1990) also assessed the skinfold thickness of triceps and the subscapular region to find out the relationship between physical activity and skinfold thickness. No significant relation was found between the amount of physical activity (heart rate) and the skinfold thickness.

Recent studies have shown significant variations in body fatness among children and adolescents. National studies in the United States between 1985 and 1990 showed an increase in adolescent obesity of 39%, and an increase in super obesity of 64%. Adolescents are defined as obese by a percentile rank for skinfold thickness. Obesity, in these studies, was defined as a triceps skinfold thickness in excess of the 95th percentile. Data from these studies showed that increased obesity was greater among adolescent girls (Taylor and Muller, 1995).

Boileau et al. (1985) developed skinfold equations to predict body fat (%BF) of children. These equations use the sum of two skinfolds, triceps and subscapula or triceps and medial calf. This method is a fairly reliable estimate of body fat and is based on assumptions including: the relationship between total subcutaneous fat and total body fat, the sum of skinfolds (SKFs) can be used to estimate total body fat, the distribution of fat subcutaneously and internally is similar for all individuals within each gender, the sum of skinfolds is a good measure of subcutaneous fat, there is a relationship between the sum of skinfolds, and that age is an independent predictor of body fat for both males and females (Heyward, 1991).

In 1988 Slaughter et al., also developed age specific skinfold equations for estimating % BF (body fat percentage) of boys and girls from 8 to 17 years of age (see Table 3.1). These equations use the sum of two skinfolds including the sum (Σ) of triceps and subscapula or sum of triceps and medial calf. In 1993 Janz et al., validated both equations for girls (Σtriceps + Subscapular skinfold equation and Σtriceps + medial calf equation), and the sum of triceps plus medial calf equation for boys (Heyward & Stolarczyk, 1996). Heyward and Stolarczyk (1996) have suggested the use of triceps plus subscapular SKF equations to estimate the %BF of adolescent girls and boys.

TABLE 3.1

Prediction skinfold equations for children

Method	Gender	Equation
SKFs		
Σ triceps + calf	Boys (all ages)	% BF = 0.735 (ΣSKF) + 1.0
	Girls (all ages)	% BF = 0.610 (ΣSKF) + 5.1
Σ triceps + subscapular		
(ΣSKF>35 mm)	Boys (all ages)	% BF = 0.783 (ΣSKF) + 1.6
	Girls (all ages)	% BF = 0.546 (ΣSKF) + 9.7
(ΣSKF<35 mm)	Boys (all ages)	% BF = 1.21 (ΣSKF) - 0.008 (ΣSKF)^2 + *I
	Girls (all ages)	% BF = 1.33 (ΣSKF) - 0.013 (ΣSKF)^2 -2.5

Source: Slaughter et al. (1988) and Heyward & Stolarczyk (1996).
SKF = sum of skinfolds (mm), *I = intercept substitutions based on malnutrition and ethnicity for adolescent boys (the corresponding substitution for pubescent is -5.2 and -3.4 for black and white respectively. The corresponding substitution for postpubscent is also -6.8 and -5.5 for black and white respectively).

Lohman (1987) has developed charts for the estimation of the percentage of body fat for children between 6 and 17 years of age. By locating the sum of 2 skinfolds (triceps plus subscapular or triceps plus calf) on the chart and looking for the approximate percent fat value one can estimate fat percentage. According to Lohman (1987) 10-20 percent body fat is the optimal range for boys, 20-25 percent body fat is moderately high and 25-31 percent fat is high and > 31 percent fat is very high. The corresponding percentages for girls are 15-25, 25-30, 30-35 and > 35. Therefore the cut off value for high for boys is >25% and for girls >30% body fat. (See Figure 3.1). The use of these charts is also suggested by

Heyward & Stolarczyk (1996). Lohman (1987) suggests that there can be a risk of heart disease, diabetes or hypertension for those adolescent boys who increase their level of fatness above 20 percent and carry this into young and middle age adulthood. This is also the case for girls who increase their level of fatness above 25 percent.

FIGURE 3.1

The level of adolescents' fatness based on the estimated percentage of fatness

		MALE	
Low	Optimal	Mod high	High
< 10%	10-20%	20-25%	> 25%
		FEMALE	
Low	Optimal	Mod high	High
< 15%	15-25%	25-30%	> 30%

Sources: Lohman (1987) and Lohman (1992)

Another way of measuring obesity is by body mass index as determined by dividing body weight in kilograms by the square of body height in meters (Kg/m^2) (Bacon, 1996; Eaton et al., 1995; and Egger and Champion, 1992). Obesity is referred to as carrying more than 25% body mass as fat (Egger & Champion, 1992). Body mass index (BMI) was recommended by the WHO as the basis for the indicator of thinness and being overweight during adolescence. It is also recommended that the BMI-for-age data for US children can be used on a temporary basis for children in other developed countries such as Australia (WHO Expert Committee, 1995). It is suggested that the combination of elevated BMI (same or more than the 85^{th} percentile) and high subcutaneous fat (same or more than the 90^{th} percentile for both subscapular and triceps skinfolds) is needed to identify overweight and over-fat adolescents (WHO Expert Committee, 1995). Adolescents with a BMI more than the 95^{th} percentile for age and sex or more than 30 (in Kg/m^2) should be considered overweight. Adolescents with a BMI between the 85^{th} percentile and the 95^{th} percentile for age and sex should be considered at risk of overweight. (Himes & Dietz, 1994; WHO Expert Committee, 1995).

Accordingly the BMI for adolescents 13-16 years in a developed country can be based on Table 3.2.

TABLE 3.2
Percentiles of BMI-for-age, male and female adolescents, 13-16 years

Age	Male $85^{th} - 95^{th}$	Female $85^{th} - 95^{th}$
13	21.9 – 25.9	23.0 – 27.0
14	22.7 –26.9	23.8 – 27.9
15	23.6 – 27.7	24.2 – 28.5
16	24.4 –28.5	24.7 – 29.1

Source: Himes & Dietz, 1994

3.2.7 Calorimetry

Measurement of physical activity can be based on energy expenditure. About 40 percent of the energy produced during the metabolism of glucose and fat is used to produce ATP (adenosine triphosphate). The remaining 60 percent is converted to heat. Measurement of body heat production (energy expenditure) is called calorimetry (Wilmore & Costill, 1994). Calorimetry can provide an accurate measurement of average daily energy expenditure under controlled laboratory conditions. Calorimetry procedures can be carried out through direct or indirect methods (Bouchard et al., 1993). The direct calorimetry method (direct heat exchange) requires restricting the subject to a special chamber where the amount of heat their body produces is measured. The walls of the chamber contain copper tubing through which water is passed. The heat produced by the body radiates to the walls and warms the water. Consequently the temperature of the chamber will increase through the generation of heat by the body (Wilmore & Costill, 1994). The problem with this procedure is that it is very expensive, intrusive and is limited in the types of activities that can be examined.

Indirect calorimetry, which is also called respirometry is based on the assumption that the respiratory exchange of oxygen and carbon dioxide equals that used and released by the body tissues. Therefore, caloric expenditure can be estimated by assessing respiratory gases or indirect calorimetry. Indirect

calorimetry measures the amount of CO_2 released and oxygen consumed (Wilmore & Costill, 1994). The more active the subject is, the more oxygen they consume. Indirect calorimetry requires the subject to wear a face mask and mouthpiece and, some times, to carry a calorimeter on their back which measures the amount of oxygen consumed. This method has not been used in the present study as it is too intrusive for adolescents. It is also expensive and influences normal activity patterns (Booth et al., 1995).

3.2.8 Survey Method

A survey is the most common method of estimating a population's physical activity. It may be used for estimating the duration and frequency of each activity on a recall period. The modes of data collection by this method include self-administered questionnaires, mail questionnaire, personal interviews and telephone interviews. Survey methods include job classification, self-assessment recall questionnaires and quantitative histories (Bouchard et al., 1994). Assessment of physical activity according to job classification is based on energy expenditure regarding job description. Since all persons performing given tasks do not expend similar amounts of energy the accuracy of this method is under debate (Booth et al., 1995). Recall questionnaires including self- or interviewer-administered questionnaires, assess usual or actual physical activity participation during the past 1 to 4 weeks. Recall questionnaires are non-reactive, acceptable to respondents and acceptable to administrators because the volume and detail of information that they give relative to cost and time is profitable. Recall questionnaires are commonly used for larger studies. The reliability and validity of recall measures has not been fully determined (Ainsworth et al., 1994). Retrospective histories are much longer and more detailed than other questionnaires, and are designed to get quantitative and qualitative information about specified times longpast such as one month or one year. The Minnesota Leisure-Time Physical Activity Questionnaire

(LTPA) is the most common quantitative history instrument. This method is time consuming to complete for the participant, and to enter and analyze data for researchers. It is also expensive (Ainsworth et al. 1994).

Caspersen and Merritt (1995) have conducted a large survey on 'physical activity trends among 26 states, 1989-1990', among United States adults. In this study a telephone-administered questionnaire named BRFSS (Behavioural Risk Factor Surveillance System), developed by state health departments and the Centers for Disease Control and Prevention, was employed. The level of physical activity was estimated using the velocity of activities such running, jogging, walking and swimming. The activity patterns are classified into four categories based on leisure time physical activity level. The categories are: 1) physically inactive (no leisure time physical activity); 2) irregularly active (activity performed less than 3 times per week, less than 20 minutes per session or both); 3) regularly active, moderate (activity performed 3 or more times per week, at least 20 minutes per session and less than 60% of maximal cardiorespiratory capacity); and 4) regularly active, vigorous (3 or more times per week, at least 20 minutes per session, at least 60% of maximal cardiorespiratory capacity, and rhythmically contracting large muscle groups).

3.2.9 Activity Diary

Activity diaries or records provide information about specific activity patterns. Diary annotation is a direct method of assessment in which one notes the physical activity performed on a given time. Notes should be made on weekdays as well as weekends to improve accuracy in determining physical activity patterns. There is evidence that diaries, if they are to be useful, must be maintained at least for several days (Montoye & Taylor, 1984; Godin & Shephard, 1984). Diaries are not practical for use in large studies, but are useful with small samples. Diaries are used in energy balance studies and are also useful for validation of physical

activity survey questionnaires. Diaries are time consuming for participants and their co-operation is needed. They require a lot of effort and are time-consuming for researchers (Ainsworth et al., 1994).

A combination of methods seems reasonable because the error provided in one method may not be duplicated in the second method (Montoye & Taylor, 1984). A self-report activity diary provides information about specific activity as it will eliminate the limitation in use of the heart rate monitor relating to specific activity (Freedson, 1991). The quality of data can be improved by listing specified types of activities in the activity diary (Ainsworth et al., 1994).

3.3 Assessment of Physical Activity in Adolescents

There are a few published studies with methodological differences on physical activity in adolescents. The techniques used to assess physical activity in children include questionnaires, direct mechanical motion sensors and heart rate monitors (Freedson, 1992). Some methods, which are used in this area will be discussed in this part.

The World Health Organisation has conducted a cross-national survey on physical activity behaviour. This survey which is part of a study on health behaviour in school-aged children (HBSC) in 24 European countries, is focused on physical activity as a behaviour. The estimation of weekly cardiovascular activity by the HBSC study was measured with two questions. To measure the level of physical activity, the students were asked how often per week they exercise outside school hours until they are out of breath or they sweat. In this study the duration of exercise for each session is not being asked. Respondents were also asked how many hours a week they exercise (Wold et al., 1994). Results of this survey are reported by King et al. in 1996. In this study students who exercised vigorously (they get out of breath or they sweat) two or more times a week were named highly active. The results indicate that the level of physical

activity was quite high among boys, but less so among girls. Between 62 and 92 percent of boys across the age groups and 41 to 84 percent of the girls reported they exercised vigorously 2 to 3 times a week.

Aaron et al. (1993) conducted a study on the past years physical activity among 1245 adolescents aged 12-16 years in Pennsylvania, in a metropolitan school district near Pittsburgh. They were annually surveyed to assess past year leisure physical activity. The purpose of this study was to develop a physical activity questionnaire to measure the past year leisure activity and evaluate its appropriateness for adolescents. It is also intended to describe the epidemiology of leisure activity in adolescents. To estimate the level of activity students were asked to indicate all leisure activities that they had participated in at least 10 times during the past year. An estimate of the average number of hours per week spent in each activity was calculated and then hours from all activities were totaled to derive an overall leisure physical activity estimate, averaged over the past year. The validity of the questionnaire was indirectly tested by correlating the estimates of hours/week and MET-hours/week of physical activity to subjects' fitness as determined by the time taken to complete the one mile walk/run test. There was a significant inverse association between the estimates of hours/week of physical activity and time taken to complete the one mile walk/run test.

Since heart rate increases linearly with exercise effort, this is often used as a measure of intensity of physical activity (Egger and Champion, 1992). Heart rate monitoring is a useful technique for the objective assessment of children's physical activity. However, a few factors must be taken to account. They include: preventing inter-unit variability by testing the devices before experimental use; detection of malfunctions of the device as soon as possible with periodic monitoring of the device; and children may also have a tendency to play with the device. Thus tampering should be minimized by careful attachment of the devices (Freedson, 1991).

The number of days required to determine habitual physical activity by heart rate measurement is important. For example, the results of a study (Gretebeck and Montoye, 1992) showed that the number of days required to measure physical activity by heart rate monitor with less than a 5% error is a 7-day period. The average is 4.9 days. Weekdays as well as weekends need to be included.

Armstrong (1990) utilised the heart rate monitor to examine the patterns of physical activity on a British sample of 266 children (163 girls, 103 boys) aged 11 to 16 years. In this study an appropriate physical activity was defined as dynamic movement of large muscles for 20 minutes or longer, three or more times a week at an intensity producing heart rates 140 or more beats/min (70 % of maximal heart rate). In this study the amount of physical activity, considering its frequency, intensity and duration, was assessed with continuous monitoring of the heart rate over three weekdays and one Saturday. Armstrong also measured subjects' physical characteristics such as height, weight, and skinfold thickness (triceps and subscapular region). The conclusion was that British children have a low level of habitual physical activity, and children occasionally participate in the appropriate volume of physical activity believed to benefit the cardiopulmonary system.

Janz (1994) has used the number of minutes equal to or more than 60% of heart rate reserve (HRR) as an index of vigorous activity in children (7-15 years). Janz has used heart rate monitors to evaluate the validity of an accelerometer for measuring children's activity (No = 31 volunteers, 16 boys and 15 girls). In this study physical activity measured through the heart rate telemetry data based on: 1) average net heart rate per day, 2) number of minutes equal to or more than 60% heart rate reserve (HRR) per day as an index of vigorous activity and 3) number of minutes spent at equal to or more than 150 heart rate per minutes was also used as an index of vigorous activity. HRR was estimated using the equation of (maximal heart rate – resting heart rate × 60) + resting heart rate. The maximal heart rate was

predicted (220 – subject age) and the baseline heart rate was considered as the subject's resting heart rate.

Some researchers such as Gretebeck and Montoye (1992) monitored the heart rate in adults in order to determine the level of activity through the mean heart rate. The authors conducted a study on the variability of some objective measures of physical activity. The heart rate monitor has been used to determine how many days subjects should be monitored to provide an estimate of habitual physical activity in employed men 24 - 67 years old. The watch was set to record the heart rate each minute that the subject was being monitored (about 13 hours/day). A heart rate index was calculated by dividing the mean heart rate by the mean baseline heart rate, to reflect physical activity. The instruments were attached in the early morning before the subject engaged in any physical activity and were removed and read late in the evening before the subject retired for the night. An estimate was made of the number of days required to measure with less than a 5% error. It was concluded that a 7 day period was necessary. There is no reasonable to assume a similar research protocol conducted within adolescents.

Verschuur and Kemper (1985)b, carried out a longitudinal study of physical activity patterns on a sample of 232 adolescents aged 12-18 from the Netherlands. The heart rate monitor was utilised to measure the hours spent daily on moderate and vigorous activity. Assuming there is a linear relationship between the heart rate and oxygen uptake, moderate intensity in this study referred to energy expenditure above 50% VO_2 max (50% of maximal oxygen uptake) and vigorous intensity is referred to as HR above 75% VO_2max (75% of maximal oxygen uptake).

Sallis et al. (1993) conducted a study on children's physical activity on a sample of 102 subjects grade 5,8 and 11 in California. The purpose of this study was to assess the reliability and validity of self reports of physical activity. The subjects were recruited from physical education classes (one grade 5, one grade 8

and one grade 11 including 36, 36 and 30 volunteers respectively). In this study the heart rate monitoring was utilised as the criterion for assessing the validity of self-report. Moderate intensity is defined as heart rate 120 beats or more per minute, and vigorous activity is referred to as heart rate 140 beats or more per minute.

Pate et al. (1994), carried out a study on physical activity in adolescents. This study was a review of a few studies including population surveys and small groups studies with objective measurement methods (heart rate monitors or motion sensors) carried out in different countries such as the USA, Canada, Germany, England and Netherlands. In this review studies are categorised into two groups based on the types of instruments that were utilised to measure the adolescents' physical activity, including large population surveys and small group studies. The small group studies refer to objective monitoring such as heart rate monitoring and short-term physical activity reports. The findings indicate that adolescents engaged in physical activity of any intensity for a mean of one hour per day. Males are more active than females. Approximately two thirds of boys and one quarter of girls participated in moderate to vigorous activity for 20 minutes 3 or more days per week. Activity levels declined with increasing age. This study also suggests that the majority of adolescents are meeting Guideline I, that is, participation in physical activity for 30 minutes daily or nearly every day. A small percentage of adolescents meet Guideline II, which is participation in three or more 20 minute sessions per week of moderate to vigorous physical activity. It also concluded that although adolescents are quite physically active, many of them report little participation in planned and structured exercise, and the decline in physical activity with increasing age indicates that many adolescents are at risk of becoming sedentary adults.

Sallis (1991) reviewed studies on the reliability of children's self-reported usual physical activity. These studies include three self-administered recalls, one

interview-administered recall, one diary, and one proxy report (teachers or parents reporting the child's physical activity). Different dimensions of physical activity such as type, frequency, intensity, duration, and also weekdays and weekend physical activity were measured in the studies. This review indicated that the reliability of self-administered measures for adolescents was high and, generally, the validity data was limited but supportive. It is also reported that studies strongly support the use of physical activity diaries by adolescents. The only self-report activity diary which is reported in this review was the one in which indirect validity has been obtained by measuring the Kcals working capacity. A significant association ($r = 0.80$) was reported between the activity diary and working capacity.

Little is known about the physical activity of adolescents in Australia and it is not clear whether adolescents in the Illawarra area are meeting the international guideline I, which calls for participation in physical activity for 30 minutes or more on most days. Also it is not clear whether the adolescents in the Illawarra area meet guideline II, which recommends participation in three or more 20 minutes sessions per week. of moderate to vigorous physical activity sessions

3.4 Validity of the Physical Activity Questionnaire

A measuring device is valid if it measures what we think it is supposed to be measuring. Validity itself is a simple concept, but the determination of the validity of an instrument is not easy. Validity is concerned with the relationship between concept and indicator. The objective of attaining a valid indicator that perfectly represents the intended determinants is unachievable. Instead, validity is a matter of degree, not an all-or-none property. The three most basic types of validation include criterion-related validity, construct validity, and content validity (Carmines & Zeller, 1983).

Criterion validity is used when the purpose is to use an instrument to estimate a criterion which is external to the measuring instrument (Carmines & Zeller, 1983). There are two kinds of criterion validity including concurrent validity and predictive validity. If the criterion exists in the present, then concurrent validity is assessed by correlating a measure and criterion at the same time. Using skinfolds to estimate body fat is an illustration of concurrent validity (Morrow et al., 1995). On the other hand, if the validity concerns a future criterion which is correlated with the relevant measure, it is called predictive validity (Carmines & Zeller, 1983). For example, prediction of heart disease in later life due to lack of physical activity is a type of predictive validity (Morrow et al., 1995). However, the same variable can be used to predict even if one currently has heart disease. Therefore, identifying criterion validity from predictive validity is based on the point of time at which the criterion is measured.

Criterion-oriented validation (concurrent validation) for physical activity is difficult because there are no valid reference methods that independently measure habitual physical activity. Therefore, some researchers have studied the relationship between the assessed habitual physical activity and another parameter that is thought to be related to habitual physical activity such as physical work capacity in a Dutch population (Baecke et al., 1982).

The construct validity method can be used to determine the ability of an instrument to measure the research concepts (Roberts & Burke, 1989). Construct validity of the questionnaire is of interest for a study when a completely valid criterion is not available (Baecke et al., 1982), and when no criterion or universe of validity is accepted as entirely adequate to define the quality to be measured (Carmines & Zeller, 1983). Construct validation involves three steps including specification of the theoretical relationship between the concepts themselves; examination of the empirical relationship between the measures of the concept; and finally, interpretation of the empirical evidence as to how it clarifies the construct

validity of a particular measure. In other words construct validity focuses on the extent to which an instrument performs in accordance with theoretical expectation (Carmines & Zeller, 1983).

The construct validity of a self-reported physical activity is difficult, however, without a gold standard. Different dimensions of activity such as kilocalorie expenditure, aerobic capacity, weight bearing, strength, flexibility and their relationships to certain performance measures has lead to inaccurate validation and subsequently low correlation coefficients (DiPietro et al., 1992).

Baecke et al. (1982), investigated the construct validity of a self-administered questionnaire about habitual physical activity in a group of young men and women in a Dutch population. In this study lean body mass (LBM) which is calculated from total body weight (W), and percentage of body fat (BF%) [LBM = W(100-BF%)/100] was chosen as a parameter of body composition. It is assumed that there is a positive relationship between lean body mass (LMB) and physical activity.

Content validity " refers to the degree to which a measure covers the range of meanings included within the concept" (Friis & Sellers, 1996 p: 291). Content validity is based on the experts judgement and validation from the literature. This validation provides some evidence for validity of a data collection method. Content validity is usually used in the development of a questionnaire. The completed instrument as based on concepts from the literature is judged by those who have some degree of expertise concerning the research topic. Experts evaluate each item of the instrument as to how well it represents the variable to be tested. The instrument is also evaluated for its suitability in examining variables in the study population (Roberts & Bruke, 1989).

Physical activity can also be validated through direct or indirect validity. Direct validation refers to a criterion variable that is an objective measure of physical activity, such as observation or activity monitoring (Sallis, 1991, Aaron

et al., 1995). Self reported activities can be validated by the direct method (Wallace et al., 1985), such as using the caltrac monitor in combination with a heart rate monitor (Sallis et al., 1988), or heart rate monitor alone (Sallis et al., 1991). In other words, the use of a heart rate monitor is not only a means of measuring heart rate intensity during physical activity (Quinn & Stand, 1995), but also can be used for validation of physical activity questions. Heart rate data is used to validate the self-reports of physical activity on the questionnaire. Heart rate is strongly related to physical activity and is recommended as an accurate index of physical activity. At lower heart rate values, the heart rate is affected by physical activity and psychological variables, however, psychological states are unlikely to cause the extreme and prolonged heart rate elevation occurring as a consequence of moderate to vigorous physical activity. Therefore, heart rate can be judged as an appropriate criterion for validating reports of a high level of physical activity.

The indirect validity of the physical activity questionnaire refers to the criterion variable which is believed to be related to physical activity but is not in itself a measure of physical activity. An example is VO_2 max (maximal oxygen uptake) which can be used as the criterion against which field measures were validated, and high density lipoprotein (HDL) cholesterol. Nevertheless data on their associations with physical activity in adolescents is inconsistent (Sallis, 1991). Indirect validation has also been carried out by some researchers using the body mass index, HDL and low density lipoprotein LDL (Sallis et al., 1988) and VO_2 max (Tell and Vellar 1988; Murphy et al., 1988).

Indirect validity of the physical activity questionnaire is also referred to as construct validity as there is no universally accepted criterion or a valid questionnaire as a gold standard. The indirect or construct validation of self-reports of physical activity such as diary and questionnaire (Freedson, 1991), direct observation and accelerometer (Janz, 1994) can rely upon heart rate

monitors. Indirect validity can also be sought with measures considered to be associated with physical activity such as body composition, physical fitness, physical activity diaries and energy (dietary) intake (Lamb & Bride, 1990).

The relationship between the self reported intensity of physical activity and the measured intensity of physical activity by the diary and the heart rate monitor will serve to validate the physical activity questions. To find out how the results from the diary and the heart rate monitor agree with the questionnaire K (Kappa) coefficient of agreement can be used with the following equation:(Morton and Dobson, 1989):

$$K = (O-E)/(1-E)$$

Where 'O' is referred to as the observed proportion of agreement, 'E' is the expected proportion of agreements.

Kappa can be calculated by first estimating the results which could be expected as a result of chance, in view of marginal totals. The expected result can be calculated in the same way as for the $\chi 2$ test. K measures the amount of agreement beyond that which would be expected by chance (O-E) as a proportion of maximal agreement beyond chance (1-E). The value of K ranges between zero to one. Kappa equals 1.0 when there is a perfect agreement, and equals 0 when the agreement equals that expected by chance. The Kappa co-efficient of agreement only confined to categorical data. The K levels of less than 0.4 indicate poor agreement and levels of greater than 0.75 indicate, in general relatively-good agreement. For measures of agreement between two continuous data, the intra-class correlation co-efficient should be used Negative values of K are also possible as its value may range from –1 to +1. In order to provide an idea of the precision of K value the confidence interval should be also reported. Agresti (1990) has also suggested Kappa for measurement of agreement between two measurements.

There is insufficient data on assessing the validity of the most commonly used physical activity questionnaires. Washburn and Montoye (1986) reviewed

the validity of the physical activity questionnaires most commonly used for adults. This review indicates that only the validity of one of the eight previously used physical activity questionnaires (Taylor leisure time activity questionnaire) is assessed for adolescents boys aged 12-14 years. This questionnaire was designed to test the hypothesis that physical activity of sufficient intensity and duration to produce a cardiovascular training effect is necessary for protection from coronary heart disease. This instrument consists of two portions. The respondents complete a portion of the questionnaire indicating their past 12 months leisure time activities. A trained interviewer completes detailed information concerning the number of occasions in each month and the average duration of the activity on each occasion. Results are expressed as a total activity metabolic index (work metabolic rate/basal metabolic rate). Activities are classified as light moderate and high metabolic index with the intensity codes of 2-4, 4.5-5.5 and 6.0 kcal per minute, respectively. This questionnaire is compared with objective measures of physical activity by LaPorte et al., in 1982 using three-day dietary records, and two-day readings from an actometer, Large Scale Integrated Sensor (LSI), that is, a small device designed to measure activity as body movement. The results showed non-significant correlations between the Taylor questionnaire and all measures. LaPorte et al. (1982) reports that perhaps longer sampling is needed to measure individual activity levels.

From an epidemiological point of view, validity of a test can be tested using the methods developed for the evaluation of a screening test. Assuming the questionnaire is a screening test the validity of the questionnaire referred to its ability to determine which individuals are actually active (sensitivity of the questionnaire), and which are actually inactive. Sensitivity and specificity are two components of validity and are determined by comparing the results obtained by the questionnaire (screening test) with those determined from a definitive test (heart rate monitor) (Mausner & Kramer 1985). Assuming that there is no error in

the measurements by the heart rate monitor, the extent to which the questionnaire agrees with the results derived by the heart rate monitor provides a measure of sensitivity and specificity. Depending on whether a participant is active or inactive he/she can be labeled a, b, c and d (Figure 3.2). A sensitive test identifies a high proportion of those who really are active and creates few who are falsely inactive. A specific test also determine a high proportion of those who really are inactive and creates few false active (Mausner,1985).

Friis and Sellers (1996) state that to measure the validity of a test, sensitivity and specificity and two other measurers must be considered including positive predictive value (PPV) and negative predictive value. The positive predictive value is referred to as the proportion of individuals screened positive by the test who actually have the disease a/(a + c) (Figure 3.2). The negative predictive value is the proportion of individuals screened negative by the test who actually do not have the disease d/(b + d) (Figure 3.2). Accordingly, assuming the heart rate monitor is a valid measurement, the positive predictive value (actives) for the questionnaire is the proportion of actives indicated by the questionnaire who actually are active by the heart rate monitor; and the negative predictive value (inactives) is the proportion of inactives indicated by the questionnaire who actually are inactive. Having this in mind the accuracy of the test is referred to (a + d)/(a + b + c + d).

Friis and Sellers (1996) also added that sensitivity and specificity are stable components of the screening test, but predictive values change with different prevalence rates, that is (a +c)/(a + b + c + d). The prevalence rate has a negative relationship with negative predictive value and a positive relationship with positive predictive value. It is stated that the positive predictive is determined by the prevalence of the condition of interest in the population being tested and by the sensitivity and the specificity of the test. A screening test performs well, with moderately high specificity (90%), if prevalence of the condition in the population

tested is relatively high. At lower prevalences the PPV drops to nearly zero for the same specificity (WHO Expert Committee, 1995).

Figure 3.2

Sensitivity, specificity, positive, and negative predictive values, and prevalence

Result based on screen	Activity state (truth)			
	Active	Inactive	Total	
Active	Real Actives (a)	False Actives (b)	a + b	Predictive value (Active) a/(a + b)
Inactive	False Inactives (c)	Real Inactives (d)	c +d	Predictive value (Inactive) a/(c +d)
	a + c	b + d	a + b + c + d	
Sensitivity: Real actives/all Active = a/(a + c) Prevalence: (a +c)/(a + b + c + d)			Specificity: Real Inactives/All Inactive = d/(b + d) Accuracy: a + d/(a + b + c + d)	

In summary the variety of the methods of physical activity measurements led to insufficient comparable data on physical activity. The variability of the methods include direct or indirect assessment and the use of different instruments to measure the level of physical activity, and the variety of criteria for classification of physical activity level.

Some of the physical activity measurement methods have not been used in the present study to measure the physical activity of adolescents. These methods are measurement of VO_2, Calorimetry and behavioural observation. The rationale behind it is that the measurement of VO_2 needs special staff, and special facilities. It is also too intrusive for adolescents and it is expensive. Calorimetr`y is very expensive, intrusive for adolescents and needs special equipment. Behavioural observation has also not been used in this study because it is useful only in a very small sample. It also needs trained staff which requires more time than scheduled for this dissertation. There can also be severe selection bias, and required direct observation of subjects can have an influence on the subjects' behaviour.

Therefore, the combination of methods which will be used in the present study includes survey, activity diary, heart rate monitor and anthropometric

measurements. The survey methods can be used in a large sample size. It is useful for estimating the duration and frequency of each activity on a recall period. An activity diary is used in this study as it is a direct method of assessment of physical activity performed on a given period. An activity diary is also useful for validation of the physical activity measured by survey. Heart rate monitoring has been used in this study as it is an objective way of measuring physical activity level. It is also more practical and less time consuming than direct observation. The heart rate monitor provides continuous records that may reflect the intensity and duration of daily activity. It can be used as a tool for assessing moderate to vigorous activity. Although the heart rate monitor is expensive, this method is not too intrusive for adolescents, and special laboratory methods and techniques are not needed.

Little is known about the validity of the physical activity questionnaires for adolescents. Validation studies, if any, have been conducted in adults and the elderly. Activity questionnaires used, have shown to be valid in adults, but may not be appropriate for assessing physical activity in adolescents. Physical activity diaries and heart rate monitors are thought to be useful for construct or indirect validity testing of the physical activity questionnaire in adolescents. As valid and reliable methods of assessing physical activity among adolescents are lacking there is insufficient evidence on physical activity of adolescents.

Since there is no standard criterion variable or gold standard, the validation of physical activity questions can be done only through indirect validity. Indirect validity of the physical activity questions can rely upon the physical activity diary, heart rate monitor and body composition. To find out the validity of the questionnaire and diary or heart rate monitor the Kappa agreement test and screening test can be used.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

The total study consists of two major parts. The first part is a Multi-instrument Study which is the main part of this research. The second part is the Illawarra-wide survey which refers to the physical activity section of the Illawarra Area Youth Health Survey study. In order to clarify both studies the methodology of the Multi-instrument Study will be explored and the methodology of the Illawarra Youth Health Survey will be examined as well. The study design, sample and its site, methods of measurements, hypotheses and the data collection process of the Multi-instrument Study are introduced in part 4.2. Dependent and independent variables and statistical analysis are also discussed. The pilot study will also be examined. The methodology related to the Illawarra Youth Health Survey data collection is discussed in part 4.3.

4.2 Multi-instrument Study

The 'Multi-instrument Study'(MIS) comprised four different instruments including a questionnaire, an activity diary, the use of a heart rate monitor, and anthropometric instruments. This section examines the population and the sampling method, the measurements, and the pilot study for each measurement.

4.2.1 Sampling/Population

In this study students from Year 8 and Year 10 of two local high schools in the Illawarra area were the target. The schools were the Holy Spirit College and Wollongong High School. These high schools are a non-government and a state high school respectively.

The rationale behind selection of these schools as the sample sites is as follow:

A. Holy Spirit College was chosen based on the assumptions that:

1. The pilot study of the Illawarra Youth Health Survey was conducted in May 1996 in this school.
2. It is representative of non-governmental high schools that have been included in the Youth Health Survey in the Illawarra Area.
3. It can be reasonably representative of non-governmental schools, especially Christian schools, in the Illawarra Area.
4. Students enrol in this school from all over the Illawarra Area, not just the geographic proximity. Therefore, the population of the school is representative of the greater Illawarra Area

B. Wollongong High school was chosen based on the assumptions that:

1. The majority of the Illawarra Area's population lives in Wollongong city (IRIS, 1996). Therefore, the population of the school can be reasonably representative of the Illawarra Area.
2. It was going to be one of the sample sites of the Illawarra Area Youth Health Survey in November 1996.

Approval of the study was gained from the Human Research Ethics Committee of the University of Wollongong in March 1996 (Appendix A). The agreement of the principals for their schools' participation was sought by letters from the University of Wollongong and the Illawarra Area Public Health Unit (Appendix B). These letters included information about the aims of the study, the proposed methods of data collection, a contact number and a request for approval of their schools' participation. The letters were taken directly to the school by the researcher at arranged times to confirm whether or not they agreed to participate, and to obtain the name of a liaison person with whom to discuss and from whom to gain assistance in the administration of those aspects of data collection that had

to be carried out in their schools.

The actual participation by students in the schools was voluntary. The parents of the respondents were informed of the demands that were going to be put upon them. These demands had been assessed from the pilot studies. The pilot study showed that the nature of the study would be time consuming and would need the full cooperation of the subjects (see section 4.2.3).

Following the principals approval, introductory meetings were arranged with the Head teachers of Physical Education at both schools. Decisions regarding method of approaching the subjects were based on the information received at these meetings, taking into account the rules and facilities of the schools.

At Holy Spirit College, consent forms (Appendix C) were distributed in the Physical Education classes. At Wollongong High School the information was distributed to the students in either Physical Education classes or Mathematics classes, depending on the grade of the students.

All potential respondents received information regarding the aims of the study, a brief description of its contents and assurance of the confidentiality and anonymity of all subjects' responses. The parents of respondents were informed that they were under no obligation to take part and that their children could withdraw from the study at any time. The students and parents were also given the option (YES/NO) of withdrawing from any individual part of the study, including the self-report questionnaire, self-record activity diary; heart rate monitor; and anthropometric (skinfolds, height and weight) measurements. Parents and students consent forms also contained the contact number of the researcher for additional details about the study, and a contact number of the Human Research Ethics Committee of the University of Wollongong for any questions related to the conduct of the study.

Following the distribution of the consent forms, an open letter to the

parents in the school's newsletter (Appendix B), was published explaining the purpose of the study, a brief description of its contents and an assurance of the confidentiality and anonymity of participating children. Later the students were informed that a certificate of appreciation and a T-shirt would be given to those who fully participated in all stages of the study (Appendix B). The signed consents were collected from the Physical Education teachers' office but were contained in anonymous envelopes to reduce the possibility of the students being pressured to participate.

In all 615 students were contacted. The population characteristics are presented in Table 4.1. It can be seen that fairly equal numbers of pupils were approached in both schools.

TABLE 4.1

Population by school and year

HIGH SCHOOLS	TOTAL
HOLY SPIRIT	
year 10	128
Year 8	158
TOTAL	286
WOLLONGONG	
Year 10	153
Year 8	176
TOTAL	329
TOTAL HIGH SCHOOLS	
Year 10	281
Year 8	334
TOTAL	615

4.2.2 Method of Data Collection

The data collection or measurement method comprised four separate components. It included a self-report questionnaire; a self-recorded physical activity diary; a heart rate monitor; and anthropometry. The self-report questionnaire examined factors such as demographic background, physical activity levels, perceptional variables, social variables, environmental variables

and barriers to participation in physical activity. The self-recorded physical activity diary was maintained for 12 hours a day over a period of one week. The heart rate monitor was used for monitoring the heart rate for 12 hours a day for a period of one week, while the subjects maintained an activity diary. Anthropometric measurements were obtained using a skinfold caliper to measure skinfold thickness, and bathroom scale and cloth tape measure to establish weight and height.

4.2.2.1 Questionnaire

The questionnaire (Appendix D) had 4 sections, most of which had a closed-ended structure and a few open-ended questions. Questions 1 to 9, 29 and 30 addressed personal characteristics; questions 10 to 15 asked about physical activities and leisure time habits; questions 16 - 18 were about social factors; questions 19, 20 and 23 aimed to specify the type of activity; questions 21, 22, 32 included environmental aspects; question 24, 25 to 28 addressed feeling and perception, their feelings about physical education classes, and their perception about their own health, body size, the way they look and fitness.

The questionnaire used in this study was based on a questionnaire that is being used to assess physical activity levels for epidemiological studies (Wold et al., 1994). These questions were also used in the World Health Organisation's cross-national surveys among European school children during 1985-86 and 1989-1990 (Anderson and Wold 1992; Wold et al., 1994). These questions include demographic questions (sex, age, father's and mother's occupation, place of living) and physical activity questions consisting question 11, 13, 25, 21, 22, 26 and 27 (Appendix D).

Three questions (19, 20 and 23) were added to establish the type of activity engaged in, the time spent, and the motivation for each type of activity. To ascertain the type of activity, several potential activities were presented,

requiring a yes or no response. Alternative answers for the time spent on any particular activity in a week were week days, weekend, both, and never. The alternative reasons for engaging in these activities were "for transportation", "to improve health', "for competition", "to be with friends", or "none".

Question 31 was asked to determine the relative significance of reasons for being physically active. A list of alternative reasons was given, and the answering categories were 'very important', 'fairly important', and 'not important'.

Question 4 asked about the subject's country of birth. In order to determine and categorize the country of birth of the respondents a twofold classification scheme was used including Australia and other countries. This system of classification is commonly used in Australia, owing to its multicultural nature.

Question 5 was about the language background. The determination of the language category of the subjects was made by a threefold classification scheme including English, English and other, and Other. This classification is commonly used in Australia as it is a multicultural country.

Question 6 and 7 was about the occupation of the parents. The Australian Standard Classification of Occupation or ASCO was used to classify the occupation of both parents of the respondents (ABS, 1996). There are eight major groups with a ninth additional code as follows:

1. Managers and administrators
2. Professionals
3. Associate professionals
4. Tradespersons and related workers
5. Advanced clerical and service workers
6. Intermediate clerical, sales and service workers
7. Intermediate production and transport workers
8. Elementary clerical, sales and service workers

9. Labourers and related workers

Since there was not enough data in each category, parent occupation was classified as three categories based on occupational prestige (Australian institute of Health and Welfare, 1992). Manager, professional and associate professional were classified as one category (high class). The second category (middle class) included advanced clerical; intermediate clerical, sales and service workers; intermediate production and transport workers. Elementary clerical, sales and service workers; labourers and unemployed were included in a third category (low class). Housewives were named as "housewife".

Question 8 asked about the suburb where the subjects live. Question 9 determined the year the subjects were in at school, and question 10 identified the subject's membership in sporting clubs.

Question 11 determined the level of activity outside school hours, subjects were asked: Outside school hours: How many times a week do you usually exercise, in your free time, so much that you get out of breath or sweat?

This question just measures usual activity and only the outside school hours (leisure time). It is necessary to keep in mind the international physical activity guidelines for adolescents (see Chapter two section 2.5) – therefore, answers were categorized thus: every day and 4-6 times a week are 'high activity level'; 2-3 times a week amounts to a 'moderate activity level'; less than or once a week was defined as 'low activity level/inactive'. This question is used for comparability with the World Health Organization cross-national surveys on health behaviour in school-aged children (Chapter Three).

Question 12 was used to confirm the times of activity per week claimed in question 11 and to estimate whether the subject spent at least 20 minutes each time. This will help to compare their activity to the International Physical Activity Guidelines for Adolescents (Chapter Two).

Question 13 recorded the total number of hours of activity per week.

Question 14 was added to determine the hours spent walking per week that may not have been recognised as such.

After receiving approval from the Ethic Committee, permission was sought from the School Principals by formal letter (Appendix B). Depending on the rules of the schools, the questionnaires were administered either by a Physical Education teacher or with the cooperation of a Physical Education teacher.

The questionnaire was completed in class, and the children were not allowed to see each others' responses. The time allowed to complete the questionnaire was ample so that students were not rushed. Those students who were willing to continue with the other measurements (keeping an activity diary and using a heart rate monitor), were asked to write their name on a removable flap on the envelope. These students were followed up via the coded flaps which were removed in the school. The same code was then used for diary, heart rate, and anthropometric data.

4.2.2.2 Activity Diary

An activity diary was used to measure the type of activity and to validate the physical activity questions, which include questions 11, 12 and 13 which were also used in the Youth Health Survey. The activity diary contained seven pages; one day for each page. Within each page, the 12 hours per day were divided into ten minute intervals and regular activities were recorded (Appendix F).

Each of the students who volunteered, and who had parental agreement, was asked to keep an activity diary. They were also contacted to arrange a time and venue to be given instructions. Following a demonstration and instruction, subjects were asked to draw time lines based on their activities and the time of activity (Appendix F).

The students were divided into two groups: those who were participating in heart rate monitoring and those who were not participating. Subjects who

agreed to keep a heart rate monitor for one week had a different schedule that will be introduced in section 4.2.2.3.

The diaries were distributed after direct contact with their family to confirm their address, their participation, and to arrange a starting date for keeping the diary. The diary and a contact number were given to subjects participating in the activity diary and the questionnaire only (28 students). Each evening around 8 PM the daily page was to be collected from their given address (home). Daily data collection was designed to ensure complete diaries, and would allow for any questions to be answered. However, after two or three days, these students had no difficulties and preferred to contact the researcher during the week if needed. A certificate of appreciation was given to those who had completed their activity diary.

Since it was not feasible for the researcher to collect all the diaries in one week, the students were divided into two groups. Year 8 students completed the diary the first week after completing the questionnaire, and Year 10 started the second week following the questionnaire completion.

4.2.2.3 Heart Rate Monitoring

In this study three microcomputer devices were used to collect data on heart rate intensity levels and the duration of physical activity. Two were 'Polar Sport Tester Heart Rate Monitors' and the third was a 'Polar Vantage NV Heart Rate Monitor' (Appendices E and F) manufactured by Polar Electro OY in Finland. Both Heart Rate Monitors (HRMs) consist of a chest band with a sensor-transmitter unit, and a wrist monitor. The chest band is an adjustable, elastic belt which is secured around the chest of the subject. The sensor-transmitter automatically senses the electrical impulses from the electrodes and transmits that information to the wrist monitor. The wrist monitor is worn like a wrist watch and is a receiver-microcomputer/memory unit, receiving and storing heart rate

data. The Polar Sport Tester wrist monitor stores up to 33 hours of memory. The watch was set to record the heart rate with a chosen interval. Sixty seconds was chosen resulting in measurements at each minute that subjects were being monitored, and the Polar Vantage NV can store up to 134 hours of memory with the same interval. The data from the wrist monitors can be downloaded into a computer for further analysis by the polar interface unit.

Since the number of heart rate monitoring devices was limited, twenty five of the 35 volunteers consenting students were randomly selected based on their grade and gender. There was access to two devices in the first two weeks, and three devices as of week three. Therefore, two to three students were scheduled to monitor their heart rates whilst keeping an activity diary. Heart rate monitoring was conducted during the nine weeks from the last week of July to the first week in October 1996.

The Polar Vantage NV has a coded transmitter. During the heart rate measurement, transmission can be coded by bringing the wrist receiver next to the Polar mark on the transmitter for a moment. This protects it from receiving the heart rates from others who are being monitored. In this study when two students' heart rates were being monitored in the same class and at the same time one of them wore the Polar Vantage NV and the other used the Polar Sport Tester.

It was necessary to go to the subject's home to exchange the heart rate monitor and the diary. Each student was contacted either by telephone or at school to confirm their address and the starting week. The subject's privacy was thereby protected through prior arrangement of time and place, and by the permission of both subjects and parents.

Clear instructions and a demonstration in the use of the heart rate monitoring (Appendix E) and completing the activity diary (Appendix F) were given. The importance of an accurate operation over a seven day period was stressed to the subjects.

The heart rate monitor was used to monitor the heart rate for 12 hours a day for a period of one week during the same time as the subjects maintained an activity diary. The programmed heart rate monitors were worn by the subjects every day from about 8 AM at either their home or at school, depending on their own request on weekdays and weekends.

The heart rate monitors were collected each day together with the activity diary for that day. Each night the heart rate data was downloaded to the computer through the Polar interface related to the specific Polar software. The reprogrammed heart rate monitors were returned to the subjects the next morning. Subjects were instructed to refrain from getting the monitors wet.

4.2.2.4 Anthropometric Measurements

All those keeping the activity diary agreed to participate in the anthropometric measurement (52 subjects). These included skinfold measurements, height and weight. These measurements were carried out at the students' homes, as far as possible. The time for the anthropometric measurements was based on the schedule of student participation. Illustrated instructions regarding the measurement of skinfold thicknesses were provided to all parents and subjects prior to the actual measurement (Appendix G). This provided parents and subjects with an opportunity to choose a suitable venue for the measurements, according to or in respect of their culture.

Skinfold assessment is a reliable method for the measurement of body fat composition and fitness assessment in adolescents. The body fat levels of the participants in heart rate monitoring and diary completion were examined using measures of skinfold thickness. This assessment was carried out by measuring skinfolds on the triceps, biceps, subscapular, and medial calf sites.

The four sites were measured sequentially. The triceps skinfold was measured on the mid-acromial-radial distance on a vertical fold on the posterior

surface of the arm. The biceps skinfold was measured on the mid-acromial-radial distance on a vertical fold on the anterior surface of the arm. This measurement was made while the arm was dangling downward and slightly away from the trunk with the palm facing forward. The subscapular skinfold was measured on the diagonal fold (at a 45° angle) 1 cm below the lower angle of the right scapula. Finally, the medial calf skinfold was measured on the medial right calf (between the knee and the ankle) at the maximum circumference (Appendix G). Measurements were taken in accordance with the recommendations of Gore and Edward (1992), Nader (1995); Kikuchi et, al. (1995) and the American College of Sport Medicine (1995). The measurement procedure also followed that of the Fitness of Australians Pilot Survey (Commonwealth Dept. of Arts, Sport, Environment and Territories, 1992).

For the purpose of this study a skinfold includes a double layer of skin and the underlying adipose tissue, but not the muscle. All skinfolds were obtained by a pinching, slightly rolling action of the left thumb and index finger. The skinfold was raised precisely at the marked site with firm pressure, and the pinch was maintained while reading the caliper. The caliper was applied at right angles to the skinfold so that the near edge of the pressure plate was 1 cm laterally from the controlling thumb and index finger, and halfway between the crest and the base of the fold. The full spring pressure of the instrument was released. The reading was made two seconds after the application of the jaw pressure by counting the time after releasing the caliper trigger. Three measurements were obtained at each site in rotational order rather than taking a continuous reading at each site. Rotation of measurement sites was carried out to allow the skin to return to its normal position and thickness. All measurements were recorded to the nearest 1 millimeter. A fourth reading was obtained if all three scores were not within 1 mm to 2 mm of each other. All three measurements were recorded on a skinfold sheet (Appendix G). The mean of three consistent skinfold measurements was

calculated for each subject at each site. A second trained person recorded the values measured in order to facilitate the process and minimize observer bias. The recorder repeated each skinfold score to the measurer (the researcher) in order to minimize transcription error.

The precision and accuracy of the skinfold measurements were supported through the measurer's experience and the type of caliper used. The likelihood of error was minimized by the researcher developing a high degree of accuracy and precision in skinfold measurement through personal practice under the tuition of a lecturer of the university, expert in the procedure. The caliper used was the Holtain Skinfold Caliper (Appendix G), made in the UK with a given precision of 0.2 mm. This caliper is considered a high quality instrument, which provides standardised pressure at all jaw openings (Heyward, 1991)

Heights and weights were measured directly with subjects wearing light clothing and no shoes. Weights were measured to the nearest 1 kg. A precisely calibrated scale was used to measure the weight of subjects. The accuracy of the bathroom scale was measured with a gold standard (an AND FW-150K electronic scale with a precision of 20 grams) in the Department of Biomedical Science of the University of Wollongong. For weight measurement the scale was placed on a hard and level surface. The reliability of the measurement was confirmed by repeating the measurement for both height and weight.

Height was measured using a tape measure, with the subjects standing on a flat and hard surface, and with the heels together and the back square against the wall to which a metric tape had been fixed. Head was kept erect and spine was fully extended. The measurement was made to the nearest 1 cm.

From the height and weight a body mass index (BMI) was calculated as weight/height^2 ,as weight (kg) divided by height (m) squared. Adolescents with BMI >30 (in Kg/m^2) are considered overweight.

The reports from the skinfold measurements were used to estimate the

percent of body fat in subjects using skinfold equations developed by Slaughter et al., (1988) (Table 4.2).

TABLE 4.2

Prediction skinfold equations for children

Method	Gender	Equation
Skinfolds		
Σtriceps + calf (ΣSKF<35 mm)	Girls (13-16 years)	% BF = 0.610 (ΣSKF) + 5.1
Σtriceps + subscapular (ΣSKF>35 mm)	Boys (13-16 years)	% BF = 0.783 (ΣSKF) + 1.6
	Girls (13-16 years)	% BF = 0.546 (ΣSKF) + 9.7
(ΣSKF<35 mm)	Boys (13-14 years)	% BF = 1.21 (ΣSKF) - 0.008 $(\Sigma SKF)^2$ + 3.4
	Boys (15-16 years)	% BF = 1.21 (ΣSKF) - 0.008 $(\Sigma SKF)^2$ + 5.5

ΣSKF = sum of skinfolds (mm)

These presented body fat results were then classified according to Figure3.1 (Chapter3).

All students who had participated in the study, by completing the questionnaire, recording an activity diary, wearing a heart rate monitor, and participating in anthropometric measurement were given an appreciation certificate (Appendix H) and a health promotion T-shirt.

4.2.3 Pilot Study

All data-gathering instruments were tested to see how long it took participants to complete them, to check that all questions and instructions were clear, and to enable the researcher to remove any items which were unlikely to yield useable data. The design was tested on a group similar to the one that would form the population of the study (Bell, 1993; Foddy, 1995). In this study, the pilot for the questionnaire was carried out on 20 students (10 students from year 8 and 10 students from year 10). The response to the pilot study questionnaire was 100 percent. From the comments made by these pilot subjects, no alteration or

modifications were needed to the format of individual items.

The heart rate monitor was piloted on 4 students (2 year 8 and 2 year 10) with similar characteristics to the sample. One problem was the loosening of the chest band in very slim year 8 students. To solve this problem a safety pin was utilized to tighten the chest band. The receiver unit should usually be covered with tape to prevent tampering and accidental damage. However, with this procedure, some data from heart rate monitoring can be lost. The researcher judged that it would be wiser to leave the receiver uncovered. This allowed the subject to inform the researcher whenever the heart rate monitor stopped functioning. This was the case when the battery became depleted or when the heart rate monitor stopped for any other reason.

The Activity Diary was also piloted by those subjects who wore a heart rate monitor for the pilot study. The pilot study demonstrated that collection of data at the end of each day, and the researcher taking time to answer all questions on the first day of (diary) recording would minimize recall bias. It was also shown that filling out a diary for one whole week would need the full cooperation of the pupils.

4.3 Illawarra Youth Health Survey

This section addresses the population, sampling, measurements, and the pilot study of the Illawarra Youth Health Survey (IYHS) as conducted by Illawarra Public Health Unit (IPHU 1997). The physical activity part of the Youth Health Survey questionnaire was used to evaluate the validity of the physical activity questions and to estimate the level of activity of the adolescents in grades 8 and 10 in the whole of the Illawarra.

4.3.1 Sampling /Population

A cross-sectional design was used to obtain representative samples of three age groups of adolescents in the Illawarra Health Area. The area is comprised of the local Government areas of Wollongong, Shellharbour, Kiama and Shoalhaven. In this study students from year 6 (final year of primary school), Year 8 and Year 10 (high school) of this area were the target sample.

Sampling was a cluster sampling defined by school, with every class within each school year being sampled at the selected schools. The target sample size was 1600 students, that is about 800 per school year. Assuming an average of 28 students per high school class with 4 classes in each year it was estimated that 8 high schools would be needed in the whole region to achieve the target sample size ($28 \times 4 \times 8 \times 2 = 1792$).

After obtaining approval for the study from the Department of School Education, lists of all government schools and all non-government (Catholic and independent) schools throughout the Illawarra were obtained from the Department. From the list of 22 High schools (15 government and 7 non-government), 8 high schools were randomly selected. The school selection procedure involved allocating each high school with a number and using a 'Table of Random Numbers' (abbreviated Table from 'Geigy Scientific Tables' in Daly et al., 1991 cited in IPHU 1997) to select the required number of schools.

The principals of the 8 selected high schools including three non-government (two Catholic high schools, and one independent high school) and five government high schools were sent a letter informing them of the survey's aims, proposed method of administration and content (Appendix I) and requesting approval for their schools' participation. Each principal was then contacted by telephone to confirm whether or not they agreed to participate and to obtain the name of a teacher to act as a liaison person to assist with administration of the survey in their school.

Parental consent for student participation in the survey was gained passively with parents being informed of the schools intention to participate in the survey via a letter accompanying the school newsletter 2 weeks before the proposed survey date (see Appendix I). This letter included the purpose of the survey, a brief description of its contents and assurance of the confidentiality and anonymity of children's responses. Parents were also provided with a contact number of a member of the survey team for additional details about the survey and were also given the option to refuse to allow their child to participate by contacting the school.

4.3.2 Questionnaire

The questionnaire used in the Youth Health Survey followed the WHO HBSC (Health Behaviours in School-Aged Children) instrument, including questions in 'core' areas such as physical activity, smoking, alcohol use, dental hygiene, eating habits, psychosocial functioning and social isolation, and injury incidence. The physical activity part of the Youth Health Survey (questions 10 and 11, Appendix I) was used in the Multi-instrument Study to validate the physical activity questions and to measure the level of activity of Grade 8 and 10 adolescents in the Illawarra. Some determinants of physical activity such as age; gender; feeling about Physical Education class; their own body size, their health; and hours of TV viewing and playing computer were also used in the evaluation. This refers to questions 1-4, 6, 12, 13, 15, 16, 25 and 32 (Appendix I) the IYHS questionnaire.

4.4 Statistical Analysis

Epi-info, polar sport tester, and polar vantage NV softwares were used for the preliminary data entry depending on the source of data. All data were converted to SAS (Statistical Analysis System package) for IBM for further

statistical analysis. The data collected for the Illawarra Youth Health Survey was obtained from the Illawarra Public Health Unit after conversion to SAS from SPSS (Statistical Package for the Social Sciences).

4.4.1 Data Management and Coding

The data collected were linked in the computer using each individual's subject code as personal identification. For the physical activity variables, the subjects were categorized into three sub-groups according to the score of each scale using the following:

- **Questionnaire Data:** The level of activity in a week (outside the school hours) as recorded in the questionnaire (questions 11 and 12, Appendix D) was categorised according to the number of times and its duration (at least 20 minutes each time). Exercise ≥ 4-6 times a week was referred to as 'high activity level'. Exercise 2-3 times a week was defined as 'moderate activity level', and exercise ≤ once a week was deemed to be 'low activity level or inactive'.
- **Diary Data:** The level of activity in a week was categorised according to the type, the number of times and its duration (at least 20 minutes each time). These activities included walking, climbing, tennis, basketball, football, baseball/softball, jumping rope, running, soccer, skateboarding, swimming, cycling, surfing, dancing, and netball all of which are considered as moderate to vigorous activity. Therefore, subjects who engaged in any of these activities for at least 20 minutes and ≤ 4-6 times a week were considered to be 'highly active'. Those who performed any of these activities 2-3 times a week were defined as 'moderately active'. Subjects who have practiced any of theses activities less than once a week were categorised in 'low activity level or inactive'.

  Duration of the moderate to vigorous activity per week was also measured

by summing the hours spent on the activities.

- **Heart Rate Monitor Data:** Heart rate has been categorised into three levels of activity which is based on the specified percentage of heart rate max reserve (HRR). These levels are 'Low Intensity Activity', 'Moderate Intensity Activity' and 'High Intensity Activity'. 'Low Intensity Activity' is that activity occurring at less than 50% of Heart Rate Reserve (HRR). Moderate Intensity Activity, involves activity at 50% to 60% of HRR, which causes mild breathlessness. 'High Intensity Activity', which is called vigorous activity involves activity at ≥ 60% HRR.

  To allow the calculation of the HRR, the following measurements were taken:

  1. RHR defined as the mean of 5 minimum heart rates in a day.
  2. MHR (Maximum heart rate), defined as Maximal heart rate = 220 - age.
  3. Maximum HR Reserve defined as MHR -RHR or (220 - age - RHR).

  Given these, the MHR (Maximum heart rate) for adolescents aged 13, 15, and 16 are 207, 205, and 204 beats per minute respectively. Consequently, the Moderate Intensity of Activity of a 16 year old adolescent with a resting heart rate of 54 was measured as follows:

  A. 50% HRR = RHR + 50% (Maximum HR Reserve)

  = 54 + 50% (204 - 54) = 129

  B. 60% HRR = RHR + 60% (Maximum HR Reserve)

  = 54 + 60% (204 - 54) = 144

  C. Moderate Intensity of Activity: 129-144

A computer diary application program has also been used to calculate the moderate level of activity based on an individual's resting and maximal heart rate. The result of manual and computer calculations was the same. Consequently, this

researcher preferred to use the computer diary application to calculate the moderate level of activity for each individual.

4.4.2 Statistical method

Firstly, descriptive statistics such as frequency distribution, mean, and standard deviation of variables were produced. Differences between groups and an overview of results were obtained. The relationship between variables and effects on the dependent variable (physical activity) were studied including analysis of interaction.

1. Differences between groups were tested with t-test and Chi-square tests, and Fisher's Exact tests were performed as needed. The uncorrected Chi-square (χ^2) test was used to determine whether there was any association between physical activity and independent variables. ANOVA was used to assess the association between anthropometric data and physical activity. It was also used to determine the difference between the means of resting heart rate among groups.
2. The relationship between physical activity and independent variables was explored by the use of the correlation coefficient.
3. A Catmod Logistic regression model was used to evaluate the probability of being physically active given certain independent determinants including demographic variables (age, gender and language spoken); social variables (significant others, membership in sporting clubs, and taking part in sport competition); perceptional variables (the subjects' feeling about their own health, body size and fitness). References in models were arbitrarily chosen (for example, age 16, female, very fat, and not very healthy in Table 5.94). A model with all key main effects was fitted for each group of variables (demographic, social, perceptional, and

environmental); the fitness of the model was evaluated using the non-significance likelihood ratio as tested with the Chi-square. This was followed with the estimation of the odds ratio (OR) and confidence interval (CI) using the following equations:

$$OR = \exp^{(estimate)} = e^{estimate}$$

$$CI = \exp^{(estimate \pm 1.96\ (SE))} = e^{estimate \pm 1.96\ (SE)}$$

Where "e" is a natural number equal to 2.718293.

4. Statistical significance for all analyses was defined as $p < 0.05$. However, the significance level of 0.01 is defined as highly significant and the level of 0.05 - 0.10 is defined as moderately significant. Since in this study both a small sample (the Multi-instrument Study) and large sample (the Illawarra Youth Health Survey) are used, the final conclusion is based on both statistical significance and common sense. There are two rationales behind this decision. Firstly, with a large data set or with a small amount of variation in the data, the p-value may indicate statistical significance where the difference is not practically relevant. Secondly, in small data sets or when there is a large amount of variation the p-value may indicate non-significant differences when the difference is important (Schlotzhauer & Littell, 1991).

4.4.3 Evaluation of Validity

Since a few questions were new it was necessary to check the validity of the instrument prior to collection of data. Therefore, the first step was to confirm the content validity of the questionnaire and the activity diary through the literature review. Assessment of the content validity of the questionnaire was conducted by placing the instrument before a panel of experts on the research topic and drawing upon the expertise of professionals from the Health Promotion Units and Public Health Units of the Illawarra Area Health Service. An item

analysis was conducted by this panel. Each expert was asked to provide comments and criticisms concerning the clarity, length, relevance and content validity of the questionnaire. The judgement of three additional experts, two from the University of Wollongong and one from the University of New South Wales, was also sought. The content validity of the questionnaire was further confirmed by a discussion panel of colleagues of one of the experts in Finland. Areas of concern were revised and adjusted according to various recommendations and a further review of the literature. The result was to include a question on the hours of cycling per week. Following these adjustments, the pilot study was used to evaluate the reliability of the instrument.

The relationship between the self reported intensity of physical activity and the measured intensity of physical activity by the diary and the heart rate monitor was used to validate the physical activity questions of the IYHS. The agreement between the results from the diary and the heart rate monitor with the questionnaire was tested with the K (Kappa) coefficient of agreement (Morton and Dobson, 1989).

The evaluation of the validity of the questions 11, 12 and 13 were also estimated using the screening test. The values of active and inactive indicated by the heart rate monitor were considered to be true values. The percent of the sensitivity was estimated by dividing the real actives by all actives, and the percent of specificity was estimated by dividing the true inactives by all inactives. Positive predictive value (PPV) was also examined (see Chapter 3 Figure 3.2).

4.5 The Hypotheses of the Study

The hypotheses are:

1. Adolescents in years 8 and 10 in the Illawarra area are less physically active than the 'International Physical Activity Guide Lines for Adolescents' would recommend.
2. The level of physical activity of adolescents with different personal characteristics including age, sex, ethnicity and parents' occupation differ significantly.
3. There is a correlation between physical activity and perceptional factors including feeling about their own health, their own body such as their size, and the way they look and their fitness.
4. There is a correlation between physical activity and social variables including peer, family and teacher influences and competition.
5. There is an association between adolescent physical activity and the number of hours per week spent watching television.
6. There is an association between adolescent physical activity and environmental variables such as opportunities including time, facilities for physical activity and watching television.
7. The intensity of self reported physical activity in the questionnaire is positively correlated to the intensity of physical activity self-recorded by the adolescents in their diary.
8. The intensity of physical activity in the diary is positively correlated to the monitored intensity of physical activity by the Heart Rate Monitor.
9. The intensity of physical activity as recorded by the Heart Rate Monitor is positively correlated to the self reported intensity of physical activity in the questionnaire.
10. The duration of physical activity per week recorded in the diary is positively correlated to the self-reported duration of physical activity by

the adolescents.

11. There is an association between physical activity and fatness, estimated by the skinfold thickness.

CHAPTER FIVE

RESULTS

5.1 Introduction

This chapter is comprised of an introduction and four parts. The second section (5.2) will develop the findings of the 'Multi-instrument Study' (MIS) (see Chapter Four 4.2). The findings obtained from each of the instruments used in the study will be presented. In the third part (5.3) findings obtained using three instruments are used to validate the physical activity questions. The fourth part (5.4) consists of descriptive and inferential analyses of physical activity data from the Illawarra Youth Heath Survey (IYHS) questionnaire (see Chapter Four section 4.3 and Appendix I). In the fifth section (5.5) the findings from the Multi-instrument Study and Youth Health Survey are compared to assess similarities. In part one, descriptive and inferential statistics are used to present the personal characteristics of respondents and their measurements in terms of frequency and percentage, mean and standard deviation. Associations between the level of physical activity and personal characteristics and perceptional factors, social variables and environmental variables are assessed using the chi-square test ($\chi 2$), Fisher's exact test, t-test, analysis of variance, kappa test (K) and screening test. Where some of the expected counts in the cells were less than 5, Fisher's exact test was used. A Catmod logistic regression model was used to evaluate the probability of being physically active given the presence of multiple independent determinants.

The degree of agreement on the level of physical activity measured by each of two instruments was determined using the K statistic. The agreements were assessed between questionnaire and activity diary, questionnaire and heart

rate monitor, and activity diary and heart rate monitor separately. The screening tests are also used to evaluate the validity of the physical activity questions.

In all the Tables presented the absolute numbers are shown first, the percentage is given in brackets.

5.2 The Multi-instrument Study

The Multi-Instrument Study (MIS) uses four measurement tools. These instruments are a self-reported questionnaire, a self-recorded one-week activity diary; a heart rate monitor and anthropometric measurements such as skinfolds and measurements of height and weight. An overview of the characteristics of the study population is presented. Inferential statistics are employed to determine the association between the level of physical activity, personal characteristics, perceptional factors, social variables (significant others and competition) and environmental variables. The correlation of intensity and duration of self-reported physical activity in the questionnaire with independent variables will be explored. For this purpose, variables were treated as measured or converted to nominal, ordinal or interval scales, according to the nature of the collected data. The intensity of physical activity is categorised to allow comparison with the data from the questionnaire, the diary and the heart rate monitor.

5.2.1 Questionnaire

5.2.1.1 Sample Size

In this study, a sample of 196 willing students from years 8 and 10 at two schools signed the consent forms to complete a questionnaire about their usual physical activity questionnaire. Respondents comprised 100 of 334 Year 8 students (30 percent) and 96 of 281 Year 10 students (34.2 percent).

TABLE 5.1

Response rate by school and grade

High schools	Total	Sample No	(%) of total per year per school	(%) of sample in school
Holy Spirit				
Grade 10	128	30	(23.4)	(49.2)
Grade 8	158	31	(19.6)	(50.8)
Total	286	61	(21.3)	(100)
Wollongong				
Grade 10	153	66	(43.1)	(48.9)
Grade 8	176	69	(39.2)	(51.1)
Total	329	135	(41.0)	(100)
Total high schools				
Grade 10	281	96	(34.2)	(49.0)
Grade 8	334	100	(29.9)	(51.0)
Total	615	196	(31.9)	(100)

Note: ( ) percent.

TABLE 5.2

Age of questionnaire participants by school

School	13	14	15	16	Total
Holy Spirit College	23 (37.7)	8 (13.1)	18 (29.5)	12 (19.7)	61 (100)
Wollongong High School	40 (29.6)	31 (23.0)	35 (25.9)	29 (21.5)	135 (100)
Total	63 (32.2)	39 (19.9)	53 (27.0)	41 (20.9)	196 (100)

Note: ( ) percent.
df = 3 $\chi 2$ value = 3.16 P = 0.36.

The $\chi 2$ test showed there is no significant difference between the respondents' age in each school.

TABLE 5.3

Gender of questionnaire participants by school

School	Male	Female	Total
Holy Spirit College	28 (45.9)	33 (54.1)	61 (100)
Wollongong High School	56 (41.5)	79 (58.5)	79 (100)
Total	84 (42.9)	112 (57.1)	196 (100)

Note: ( ) percent.
df = 1 $\chi 2$ value = 0.33 P = 0.56.

Table 5.3 shows that there were more females (57.1 percent) than males (42.9 percent) participating in the study. However, this difference was not significant.

5.2.1.2 Personal Characteristics of the Subjects

TABLE 5.4

Age and gender of questionnaire participants

Age	Male	Female	Total
13	30 (47.6)	33 (52.4)	63 (100)
14	16 (41.0)	23 (59.0)	39 (100)
15	19 (35.8)	34 (64.2)	53 (100)
16	19 (46.3)	22 (53.7)	41 (100)
Total	84 (42.9)	112 (57.1)	196 (100)

Note: ( ) percent.
df = 3 $\chi 2$ value = 1.90 P = 0.60.

A third of subjects are 13 years. Table 5.4 indicates more than half of the participants in all ages are female.

TABLE 5.5

Country of birth and language spoken of questionnaire participants

Country	Language					
	English		Other		Total	
Australia	149	(76.0)	25	(12.8)	174	(88.8)
Other	7	(3.6)	15	(7.6)	22	(11.2)
Total	156	(79.6)	40	(20.4)	196	(100)

Note: ( ) percent
df = 1 $\chi 2$ value = 34.82 P = 0.001.

The $\chi 2$ test indicates an expected association between the country of birth and language spoken at home.

TABLE 5.6

Parental occupation of questionnaire participants

Occupation	Mother	Father
Manager and administrators	1 (0.6)	16 (9.8)
Professionals	57 (32.0)	38 (23.2)
Associate professionals	7 (3.9)	8 (4.9)
Tradespersons and related workers	3 (1.7)	35 (21.3)
Advanced clerical and service workers	16 (9.0)	6 (3.7)
Intermediate clerical, sales and service workers	23 (12.9)	9 (5.5)
Intermediate production and transport workers	1 (0.6)	8 (4.9)
Elementary clerical, sales and service workers	5 (2.8)	-
Labourers and related workers	13 (7.3)	39 (23.8)
Housewife	52 (29.2)	-
Unemployed	-	5 (3.0)
Total	178 (100)	164 (100)
Missing	18	32

5.2.1.3 Level of Activity and Personal Characteristics

This part focuses on the actual physical activity, which is derived from the answer to the question on the weekly frequency of exercise by respondents outside school hours for at least 20 minutes, so that they get out of breath or sweat. As indicated in the method section, activity is classified as high when respondents exercise outside the school hours for 4-6 times per week or more; 2-3 times a week amounts to a 'moderate activity level'; less than or once a week was defined as 'low activity level/inactive'.

TABLE 5.7

Activity level of questionnaire participants by school and grade

School	High	Moderate	Low	Total
Holy Spirit College *				
Grade 8	12 (38.7)	14 (45.2)	5 (16.1)	31 (100)
Grade 10	13 (43.3)	9 (30.0)	8 (26.7)	30 (100)
Total	25 (41.0)	23 (37.7)	13 (21.3)	61 (100)
Wollongong High School **				
Grade 8	37 (53.6)	18 (26.1)	14 (20.3)	69 (100)
Grade 10	29 (43.9)	21 (31.8)	16 (24.3)	66 (100)
Total	66 (48.9)	39 (28.9)	30 (22.2)	135 (100)
Total ***				
Grade 8	49 (49.0)	32 (32.0)	19 (19.0)	100 (100)
Grade 10	42 (44.0)	30 (31.0)	24 (25.0)	96 (100)
Total	91 (46.4)	62 (31.6)	43 (22.0)	196 (100)

Note: ( ) percent. Association between the level of activity and grade is tested within each school and also in total sample.
* df = 2 $\chi 2$ value = 1.80 P = 0.40.
** df = 2 $\chi 2$ value = 1.26 P = 0.53.
*** df = 2 $\chi 2$ value = 1.10 P = 0.57.

Table 5.7 demonstrates that 78 percent of the respondents were physically active (46.4 percent high and 31.6 percent moderate). It also indicates that about 22 percent of adolescents have low activity or might be inactive.

In addition, Table 5.7 indicates that 41 percent of subjects from Holy Spirit College are in the high activity category, as are 48.9 percent of the Wollongong High School students. This difference is not significant.

The content of Table 5.7 makes it apparent that there is no difference between the levels of activity in grade 10 students in the two schools. In both

schools the majority of the grade 10 students are highly active. Grade 8 students from Holy Spirit College are moderately active (45.2 percent), while the majority of Grade 8 students in Wollongong High School are highly active (53.6 percent). The $\chi 2$ test indicates no significant association between grade and level of activity in either school.

TABLE 5.8

Activity level of questionnaire participants by age

Activity level	13	14	15	16	Total
High	29 (46.0)	22 (56.4)	20 (37.7)	20 (48.8)	91 (46.4)
Moderate	19 (30.0)	13 (33.3)	21 (39.6)	9 (21.9)	62 (31.6)
Low	15 (24.0)	4 (10.3)	12 (22.6)	12 (29.3)	43 (22.0)
Total	63 (100)	39 (100)	53 (100)	41 (100)	196 (100)

Note: ( ) percent
df = 6 $\chi 2$ value = 7.66 P = 0.26.

According to Table 5.8 more subjects aged 14 (56.4 percent) are highly physically active than other groups. A low level of activity is more prevalent in age 16 (29.3 percent) than among other age groups. The $\chi 2$ test indicates no significant association between physical activity and age. Table 5.8 shows that 46.4 percent of adolescents are highly active, 31.6 percent are moderately active and 22 percent are little active or inactive.

TABLE 5.9

Level of physical activity by gender of questionnaire participants

Physical activity	Male	Female	Total
High	53 (63.0)	38 (34.0)	91 (46.4)
Moderate	16 (19.0)	46 (41.0)	62 (31.6)
Low	15 (18.0)	28 (25.0)	43 (22.0)
Total	84 (100)	112 (100)	196 (100)

Note: ( ) percent
df = 2 $\chi 2$ value = 17.27 P = 0.001.

The majority (63 percent) of the males are highly active while 34 percent of females are active at this level (see Table 5.9). Table 5.9 also indicates that 25 percent of females and 18 percent of males engage in a low-level activity or may

not be active. The $\chi 2$ test shows a highly significant association between gender and physical activity.

TABLE 5.10

Level of activity by country of birth of questionnaire participants

Level of activity	Australia	Other	Total
High	83 (47.7)	8 (36.4)	91 (46.4)
Moderate	55 (31.6)	7 (31.8)	62 (31.6)
Low	36 (20.7)	7 (31.8)	43 (22.0)
Total	174 (100)	22 (100)	196 (100)

Note: ( ) percent.
df = 2 $\chi 2$ value = 1.64. P = 0.44.

Table 5.10 demonstrates that 20.7 percent of adolescents whose country of birth is Australia are inactive or have a low activity level. The $\chi 2$ test indicates that there is no significant association between country of birth and level of activity.

TABLE 5.11

Level of activity of questionnaire participants by language

Activity level	English	Other	Total
High	73 (46.8)	18 (45.0)	91 (46.4)
Moderate	50 (32.0)	12 (30.0)	62 (31.6)
Low/Inactive	33 (21.2)	10 (25.0)	43 (22.0)
Total	156 (100)	40 (100)	196 (100)

Note: ( ) percent
df =2 $\chi 2$ value = 0.28 P = 0.87.

Table 5.11 indicates that 21.2 percent of those subjects who have an English speaking background have a low level of activity and 25 percent of the subjects who have another language background have usually a low level of activity or are inactive. However, there was no significant association between language background and level of activity.

TABLE 5.12

Activity level of questionnaire participants by father's occupation

Activity level	Fathers' occupation			
	High class	Mid class	Low class	Total
High	27 (46.6)	27 (43.6)	24 (54.6)	78 (47.6)
Moderate	17 (29.3)	18 (29.0)	17 (38.6)	52 (31.7)
Low	14 (24.1)	17 (27.4)	3 (6.8)	34 (20.7)
Total	58 (100)	62 (100)	44 (100)	164 (100)

Frequency missing = 32
df =4 $\chi 2$ value =7.35 P = 0.11.

There is no significant association between the adolescent's level of activity and their father's occupation.

TABLE 5.13

Activity level of questionnaire participants by mother's occupation

Activity level	Mothers' occupation				
	High class	Mid class	Low class	Housewife	total
High	23 (53.4)	29 (44.6)	7 (38.9)	22 (42.3)	81 (45.5)
Moderate	10 (23.3)	25 (38.5)	7 (38.9)	16 (30.8)	58 (32.6)
Low	10 (23.3)	11 (16.9)	4 (22.2)	14 (26.9)	39 (21.9)
Total	43 (100)	65 (100)	18 (100)	52 (100)	178 (100)

Frequency missing = 18
df =6 $\chi 2$ value =4.36 P = 0.62.

Table 5.13 indicates that the majority of highly active adolescents are among those whose mothers have a high occupation class. There was no significant association between mothers' occupations and the adolescents' levels of activity.

Overview of Personal Characteristics and Physical Activity

There was no significant association between the level of physical activity and demographic variables such as age, grade, location of school, country of birth, language and parental occupation. Gender was highly associated with the adolescents' levels of physical activity (Table 5.14). The majority (63%) of the males are highly active whilst female are more frequently engaged in moderate level of activity (41 percent) (Table 5.9).

TABLE 5.14

Physical activity and personal characteristics

Variable	Score	Df	$\chi 2$ value	P value
Age	13 14 15 16	6	7.66	0.26
Grade	Year 8 Year 10	2	1.10	0.57
Gender	Male Female	2	17.27	0.001
Country of birth	Australia Other	2	1.64	0.44
Language	English Other	2	0.28	0.87

$P < 0.05$ significant.
Activity classification: high, moderate and low

5.2.1.4 Physical Activity and Adolescents' Perception of Their Own Health and Body

TABLE 5.15

Activity level of questionnaire participants by perception of their health

Activity level	Very healthy	Quite healthy	Not very healthy	Total
High	29 (72.5)	57 (44.9)	5 (17.3)	91 (46.4)
Moderate	8 (20.0)	41 (32.3)	13 (44.8)	62 (31.6)
Low	3 (7.5)	29 (22.8)	11 (37.9)	43 (22.0)
Total	40 (100)	127 (100)	29 (100)	196 (100)

Note: ( ) percent df = 4 $\chi 2$ value = 21.79 P = 0.001.

Table 5.15 indicates that adolescents who perceive their body as healthy are more active (72.5%) than those who perceive themselves as quite healthy (44.9 percent) and a lot more than those who perceive themselves as not healthy (17.3 percent). It is interesting to find that a proportion of adolescents who perceive themselves as very healthy have a low level of activity. Table 5.15 also demonstrates that subjects who perceive they are not very healthy are engaged in moderate or low activity levels (44.8 percent and 37.9 percent) and only 17.3 percent of these adolescents are highly active. The $\chi 2$ test indicates that there is a

significant association between the level of physical activity and the adolescents' perception of their own health.

TABLE 5.16

Activity level of questionnaire participants by perception of their body size

Activity level	Thin	About right size	Fat	Total
High	14 (56.0)	56 (58.3)	19 (27.5)	89 (46.9)
Moderate	5 (20.0)	23 (24.0)	30 (43.5)	58 (30.5)
Low	6 (24.0)	17 (17.7)	20 (29.0)	43 (22.6)
Total	25 (100)	96 (100)	69 (100)	190 (100)

Note: ( ) percent. Six participants who do not think about it were excluded. Thin ('Much too thin' plus a 'bit too thin'). Fat (A bit too fat' plus 'much too fat). df = 4 $\chi 2$ value = 16.98 P = 0.002.

Table 5.16 indicates that the majority of those who feel they are thin (56 percent) are highly active. It can be also seen that most of those who feel their body is about the right size (58.3 percent) are highly active, while those who feel they are fat are mostly (43.5 percent) moderately active. Only 17.7 percent of those who feel their body is about the right size have a low level of activity. The corresponding percentages for those who feel they are thin and fat are 24 and 29 respectively.

TABLE 5.17

Activity level of questionnaire participants by perception of their looks

Activity level	Good looking	About average	Not good looking	I don't think about it	Total
High	15 (55.6)	43 (53.8)	17 (30.9)	16 (47.0)	91 (46.4)
Moderate	5 (18.5)	23 (28.7)	25 (45.5)	9 (26.5)	62 (31.6)
Low	7 (25.9)	14 (17.5)	13 (23.6)	9 (26.5)	43 (22.0)
Total	27 (100)	80 (100)	55 (100)	34 (100)	196 (100)

Note: ( ) percent Good looking ('very good looking' plus 'quite good looking'). Not good looking ('not very good looking' plus 'not at all good looking').
df = 6 $\chi 2$ value = 10.85 P = 0.09.

Table 5.17 demonstrates that the majority of the students (55.6 percent) who feel they look very or quite good are highly active, similar to those who feel they look about average (53.8 percent), while the students who feel they are not good looking are mostly in the moderate activity category (45.5 percent). These associations were moderately significant.

TABLE 5.18

Activity level of questionnaire participants by perception of their fitness

Activity level	Very fit	Fit	Average	Not very fit	Total
High	18 (69.2)	43 (65.1)	21 (28.0)	3 (17.6)	85 (46.2)
Moderate	4 (15.4)	17 (25.8)	31 (41.3)	7 (41.2)	59 (32.1)
Low	4 (15.4)	6 (9.1)	23 (30.7)	7 (41.2)	40 (21.7)
Total	26 (100)	66 (100)	75 (100)	17 (100)	184 (100)

Note: ( ) percent. Twelve students gave no response for fitness level and were not included
df = 6 $\chi 2$ value = 33.06 P = 0.001.

It is apparent from Table 5.18 that the majority of participants feel either very fit, fit or average. Few think of themselves as unfit. This Table also shows that the majority of the adolescents who perceive themselves as very fit or fit are highly active (69.2% and 65.1%). It also indicates that smaller proportions of adolescents who perceive themselves as average or not very fit are highly active (28.0% and 17.6%). The $\chi 2$ test indicates there is highly significant association between the level of physical activity and the adolescents' own perception of their fitness.

Overview of Perceptional Characteristics and Physical Activity

There was a highly significant associations between the adolescents' perceptions of their health and body size and the level of physical activity. A moderately significant association was found between their perception of the way they look and the level of physical activity. There is a highly significant association between the level of physical activity and the adolescents' own perception of their fitness (Table 5.19).

TABLE 5.19

Association between the perceptional variables and physical activity

Variable	Score	Df	$\chi 2$ value	P value
Perception of their health	Very healthy Quite healthy Not very healthy	4	21.79	0.001
Perception of their body size	Thin About right size Fat	4	16.98	0.002
Perception of their looks	Good looking About average Not good looking I don't think about it	6	10.85	0.09
Perception of their fitness	Very fit Fit Average Not fit	6	33.06	0.001

$P < 0.05$ significant
Activity classification: high, moderate and low

5.2.1.5. Physical Activity and Social Factors

In this part the findings and associations between the social factors such as significant others, membership in sporting clubs and taking part in sport competition with the respondents level of physical activity is explored. The $\chi 2$ test was carried out to show the relationship between the significant others and physical activity with exclusion of the last category: 'I do not know/I do not have".

TABLE 5.20

Physical activity habits of significant others of questionnaire participants

Significant others	Every week [Active]	<every week [Inactive]	I do not know/I do not have	Total
Father	73 (37.2)	78 (39.8)	45 (23.0)	196 (100)
Mother	74 (37.8)	92 (46.9)	30 (15.3)	196 (100)
Brother	89 (45.4)	29 (14.8)	78 (39.8)	196 (100)
Sister	70 (35.7)	51 (26.0)	75 (38.3)	196 (100)
Friend	137 (69.9)	33 (16.8)	26 (13.3)	196 (100)
Teacher	39 (19.9)	24 (12.2)	133 (67.9)	196 (100)

Note: ( ) percent.

Table 5.20 demonstrates that the majority of the subjects have friends who are active (69.9 percent). It is also clear that 45.4 percent of all subjects have

brothers who are physically active every week. However, of the relevant subjects (excluding the column I don't have/I don't know) 75 percent had bothers who are physically active. Only 19.9 percent of the teachers that the respondents like, are physically active. Note that 67.0 percent do not know what their teacher does or they do not have a favorite teacher which implies 61.9 percent of teachers whose activity are known (63 teacher) by the subjects, are active. About a third of their mothers and fathers are physically active. It is interesting to note that 46.9 percent of mothers are not physically active.

TABLE 5.21

Level of physical activity of questionnaire participants by physical activity habits of fathers

Activity level	Every week	< every week	Not at all	I don't have/I don't know*	Total
High	38 (41.7)	21 (23.1)	13 (14.3)	19 (20.9)	91 (46.4)
Moderate	25 (40.3)	13 (21.0)	11 (17.7)	13 (21.0)	62 (31.6)
Low	10 (23.3)	8 (18.6)	12 (27.9)	13 (30.2)	43 (22.0)
Total	73 (37.2)	42 (21.4)	36 (18.4)	45 (23.0)	196 (100)

Note: * Not included in the Chi-square test. ( ) percent. df = 4 $\chi 2$ value = 6.19 P = 0.18

The majority of adolescents who are highly or moderately active are those whose fathers take part in sport or other physical activities every week, while for most of those who have a low level of activity, their fathers are not doing sport or other physical activities (Table 5.21). There was not a significant association between the fathers' activity and the students' activity.

TABLE 5.22

Level of physical activity questionnaire participants by gender and physical activity habits of fathers

Activity level of adolescents	Physical activity habits of fathers			
	Every week Active	< Every week Inactive	I don't have/I don't know *	Total
Female[a]				
≥ 2-3 times a week Active	38 (84.4)	31 (68.9)	15 (68.2)	84 (75.0)
< 2-3 times a week Inactive	7 (15.6)	14 (31.1)	7 (31.8)	28 (25.0)
Total	45 (100)	45 (100)	22 (100)	112 (100)
Male[b]				
≥ 2-3 times a week Active	25 (89.3)	27 (81.8)	17 (73.9)	69 (82.1)
< 2-3 times a week Inactive	3 (10.7)	6 (18.2)	6 (26.1)	15 (17.9)
Total	28 (100)	33 (100)	23 (100)	84 (100)
Overall[c]				
≥2-3 times a week Active	63 (86.3)	58 (74.4)	32 (71.1)	153 (78.1)
< 2-3 times a week Inactive	10 (13.7)	20 (25.6)	13 (28.9)	43 (21.9)
Total	73 (100)	78 (100)	45 (100)	196 (100)

* Not included in the Chi-square test.
a df = 1 $\chi 2$ value = 3.04 P = 0.08
b df =1 $\chi 2$ value = 0.62 P= 0.41 Fisher exact: 2-tailed P= 0.48
c df = 1 $\chi 2$ value = 3.38 P = 0.06

The majority of adolescents who are inactive are those whose fathers do not take part in sport or other physical activities every week. The $\chi 2$ test shows a borderline significant association between the father's activity and the student's activity. The percentage of inactivity is higher in females (31.1 percent) who have inactive fathers than that for males (18.2 percent). There is a significant association between the activity level of female adolescents and their fathers' activity habits.

TABLE 5.23

Activity level of questionnaire participants by physical activity habit of mothers

Activity level of adolescents	Physical activity habits of mothers				
	Every week	< Every week	Not at all	I don't have/I don't know*	Total
High	40 (54.0)	25 (53.2)	14 (31.1)	12 (40.0)	91 (46.4)
Moderate	25 (33.8)	15 (31.9)	15 (33.3)	7 (23.3)	62 (31.6)
Low	9 (12.2)	7 (14.9)	16 (35.6)	11 (36.7)	43 (22.0)
Total	74 (100)	47 (100)	45 (100)	30 (100)	196 (100)

* Not included in the Chi-square test df = 4 $\chi 2$ value = 12.16 P = 0.01

Table 5.23 demonstrates that the largest proportion (54 percent) of those whose mothers are highly active are themselves highly active. It can be also seen that the majority (35.6 percent) of those who reported that their mothers are not at all active are categorized themselves as low active. The $\chi 2$ test showed a positive significant association between mother's activity and the adolescent's activity.

TABLE 5.24

Activity level of questionnaire participants by gender and physical activity habits of mothers

Activity level of adolescents **	Physical activity habit of mothers			
	Every week [Active]	< Every week [Inactive]	I don't have/I don't know*	Total
Female[a]				
Active	37 (82.2)	38 (71.7)	9 (64.3)	84 (75.0)
Inactive	8 (17.8)	15 (28.3)	5 (35.7)	28 (25.0)
Total	45 (100)	53 (100)	14 (100)	112 (100)
Male[b]				
Active	28 (96.6)	31 (79.5)	10 (62.5)	69 (82.1)
Inactive	1 (3.4)	8 (20.5)	6 (37.5)	15 (17.9)
Total	29 (100)	39 (100)	16 (100)	84 (100)
Total[c]				
Active	65 (87.8)	69 (75.0)	19 (63.3)	153 (78.1)
Inactive	9 (12.2)	23 (25.0)	11 (36.7)	43 (21.9)
Total	74 (100)	92 (100)	30 (100)	196 (100)

Note: Percent ( )
* Not included in the Chi-square test. ** Adolescent's activity level: Active is ≥ 2 - 3 times activity per week. Inactive is less than 2 - 3 times activity per week.
a df = 1 $\chi 2$ value = 1.50 P = 0.22.
b df = 1 $\chi 2$ value = 4.21 P = 0.04. Fisher exact: right P= 0.04
c df =1 $\chi 2$ value = 4.34 P = 0.03.

The higher proportion of active female adolescents (82.2 percent) are among those whose mothers take part in sport or other physical activities every

week (see Table 5.24). The percentage of female adolescents who are inactive is greater among those whose mothers are not active (28.3 percent) than for those whose mothers are active (17.8 percent). These associations were not significant

Table 5.24 also demonstrates that the higher proportion of active male adolescents (96.6 percent) is from those whose mothers are physically active. In addition, the percentage of male adolescents who are inactive is greater among those whose mothers are not active (20.5 percent) than for those who have active mothers (3.4 percent). Since some of the expected counts in the cells were less than 5 Fisher's exact test was used. The Fisher's exact test showed a significant positive association between the level of mother's activity and the male adolescent's activity level ($p = 0.04$).

Table 5.24 demonstrates that the largest proportion (87.8 percent) of those whose mothers are active are themselves active. The $\chi 2$ test showed a positive significant association between mother's activity and adolescent's activity.

TABLE 5.25
Activity level of questionnaire participants by activity habit of brothers

Activity level of adolescents	Physical activity habits brothers			
	Every week [Active]	< Every week [Inactive]	I don't have/I don't know*	Total
High	46 (51.6)	14 (48.3)	31 (39.7)	91 (46.4)
Moderate	32 (36.0)	8 (27.6)	22 (28.2)	62 (31.6)
Low	11 (12.4)	7 (24.1)	25 (32.1)	43 (22.0)
Total	89 (100)	29 (100)	78 (100)	196 (100)

Note: Percent ( ) * Not included in the Chi-square test. df = 2 $\chi 2$ value = 2.49 P = 0.28

Table 5.25 indicates that more than half of the students (51.6 percent) whose brothers are physically active are themselves highly active. This Table also shows that a low level of activity among those whose brothers are inactive is twice that of those who have active brothers. The corresponding percentages are 24.1 and 12.4 respectively. There was not a significant association between the adolescent's physical activity and the brother's physical activity.

TABLE 5.26
Activity level of questionnaire participants by gender and physical activity habits of brothers

Activity level of adolescents	Physical activity habit s of brothers			
	Every week [Active]	< Every week [Inactive]	I don't have/I don't know*	Total
Female [a]				
Active	48 (82.8)	12 (80.0)	24 (61.5)	84 (75.0)
Inactive	10 (17.2)	3 (20.0)	15 (38.5)	28 (25.0)
Total	58 (100)	15 (100)	39 (100)	112 (100)
Male [b]				
Active	30 (96.8)	10 (71.4)	29 (74.3)	69 (82.1)
Inactive	1 (3.2)	4 (28.6)	10 (25.7)	15 (17.9)
Total	31 (100)	14 (100)	39 (100)	84 (100)
Overall [c]				
Active	78 (87.6)	22 (75.9)	53 (67.9)	153 (78.1)
Inactive	11 (12.4)	7 (24.1)	25 (32.1)	43 (21.9)
Total	137(100)	33 (100)	78 (100)	196 (100)

Note: Percent ( ) * Excluded from the chi-square test.
a, df = 1 $\chi 2$ value = 0.06 P = 0.80. Fisher exact: 2-tailed P =0.72
b, df = 1 $\chi 2$ value = 6.27 P = 0.01. Fisher exact: 2-tailed P= 0.02
c, df = 1 $\chi 2$ value = 2.34 P = 0.12. Fisher exact:2-tailed P = 0.14

With the exclusion of the last column from the $\chi 2$ test there was just a significant association between the level of activity of females and their brothers' activity levels (see Fisher exact results).

TABLE 5.27
Activity level of questionnaire participants by physical activity habits of sisters

Activity level of Adolescents	Physical activity habits sisters			
	Every week [Active]	< Every week [Inactive]	I don't have/I don't know*	Total
High	34 (48.6)	22 (43.1)	35 (46.6)	91 (46.4)
Moderate	24 (34.3)	15 (29.4)	23 (30.7)	62 (31.6)
Low	12 (17.1)	14 (27.5)	17 (22.7)	43 (22.0)
Total	70 (100)	51 (100)	75 (100)	196 (100)

Note: Percent ( ) * Not included in the Chi-square test. df = 2 $\chi 2$ = 1.86 P = 0.39

It is apparent from the Table 5.27 that there is a similar proportion in each level of activity in relation to the sister's activity habit. This is supported by the $\chi 2$ test, which shows no significant association between the sisters' activity habits and the adolescents' activity habits.

TABLE 5.28

Activity level of questionnaire participants by physical activity habits of friends

Activity level of adolescents	Physical activity habits of friends			
	Every week [Active]	< Every week [Inactive]	I don't have/I don't know*	Total
High	75 (54.7)	6 (18.2)	10 (38.5)	91 (46.4)
Moderate	46 (33.6)	12 (36.4)	4 (15.4)	62 (31.6)
Low	16 (11.7)	15 (45.4)	12 (46.1)	43 (22.0)
Total	137 (100)	33 (100)	26 (100)	196 (100)

Note: Percent ( ) * Not included in the Chi-square test. df = 2 $\chi 2 = 24.16$ P = 0.00.

Table 5.28 indicates that the majority of adolescents whose friends take part in sport or other physical activities every week, are highly active (54.7 percent), while most of those who have inactive friends (45.4 percent), or do not know about their friends' activity (46.1 percent) are categorized as having a low activity level. Table 5.28 also shows that those subjects who do not have friends or they do not know about their physical activity habits, are mostly low level activity adolescents (46.1 percent). The $\chi 2$ test also showed a significant association between the adolescents' level of physical activity and that of their friends ($p = 0.00$).

TABLE 5.29

Activity level of questionnaire participants by gender and physical activity habits of friends

Activity level of adolescents	Every week [Active]	< Every week [Inactive]	I don't have/I don't know	Total
Female [a]				
Active	61 (83.6)	14 (58.3)	9 (60.0)	84 (75.0)
Inactive	12 (16.4)	10 (41.7)	6 (40.0)	28 (25.0)
Total	73 (100)	24 (100)	15 (100)	112 (100)
Male [b]				
Active	60 (93.8)	4 (44.4)	5 (45.5)	69 (82.1)
Inactive	4 (6.2)	5 (55.6)	6 (54.5)	15 (17.9)
Total	64 (100)	9 (100)	11(100)	84 (100)
Overall				
Active	121 (88.3)	18 (54.5)	14 (53.8)	153 (78.1)
Inactive	16 (11.7)	15 (45.5)	12 (46.2)	43 (21.9)
Total	137 (100)	33 (100)	26 (100)	196 (100)

Note: Percent ( )
a, df = 1 $\chi 2$ value = 6.56 P = 0.01.
b, df = 1 $\chi 2$ value = 17.75 P = 0.00. Fisher exact: 2-tailed P= 0.00
c, df = 1 $\chi 2$ value = 20.35 P = 0.00.

Table 5.29 shows the greater percentage (83.6) of the active female subjects are among those whose friends take part in sport or other physical activities every week. This finding can also be seen in male subjects (93.8). The $\chi 2$ test was carried out with exclusion of the last column in both sexes. Results showed a significant association between females' level of activity and that of their friends. A highly significant association was also found (using Fisher's exact test) between the level of activity of males and their friends' activity levels (P< 0.00).

TABLE 5.30

Activity level of questionnaire participants by activity habits of teachers

Activity level of adolescents	Every week [active]	< every week [inactive]	I don't have/I don't know	Total
High	21 (53.8)	12 (50.0)	58 (43.6)	91 (46.4)
Moderate	14 (35.9)	8 (33.3)	40 (30.1)	62 (31.6)
Low	4 (10.3)	4 (16.7)	35 (26.3)	43 (22.0)
Total	39 (100)	24 (100)	133 (100)	196 (100)

Note: Percent ( ) df = 2 $\chi 2$ = 0.55 P = 0.75. Fisher exact: 2-tailed P = 0.82

Although there was no significance association between physical activity of respondents and their teachers' activity habits, subjects who have active

teachers had a higher percentage of high physical activity level (53.8 percent) than others.

TABLE 5.31

Activity level of questionnaire participants and sports club membership

Activity level	No	Yes	Yes but I don't participate *	Total
High	29 (33.0)	59 (57.8)	3 (50.0)	91 (46.4)
Moderate	30 (34.0)	30 (29.4)	2 (33.4)	62 (31.6)
Low	29 (33.0)	13 (12.8)	1 (16.6)	43 (22.0)
Total	88 (100)	108 (100)	6 (100)	196 (100)

Note: Percent ( ) * Excluded from the $\chi 2$ test. df =2 $\chi 2$ value =15.37 P = 0.001

Table 5.31 indicates that adolescents who take part in a sports club were more likely to be highly active (57.8 percent) than those who did not belong to a sports club. The $\chi 2$ test showed there is a significant association between physical activity and membership in sports clubs.

TABLE 5.32

Activity level of questionnaire participants by participation in sport competition

Activity level	Yes	No	Yes, but not any longer	Total
High	67 (53.6)	14 (31.8)	10 (37.0)	91 (46.4)
Moderate	38 (30.4)	14 (31.8)	10 (37.0)	62 (31.6)
Low	20 (16.0)	16 (36.4)	7 (26.0)	43 (22.0)
Total	125 (100)	44 (100)	27 (100)	196 (100)

Note: Percent ( ) df = 4 $\chi 2$ value = 10.60 P = 0.03

Table 5.32 indicates that adolescents who take part in a sports competition were more likely to be highly active (53.6 percent) than those who did not take part in sports competition. The $\chi 2$ test showed there is a significant association between physical activity and taking part in sport competition ($p < 0.05$).

Overview of Social Variables and Physical Activity Level of Adolescents

Social variables include significant others, sport competition and taking part in sport clubs. Adolescents with significant others such as mothers and friends who were physically active were more likely to be physically active themselves than those who had no such model or peer. A significant association was found between the level of mother's activity and adolescent's physical activity ($P = 0.03$). This association was seen particularly among males ($P = 0.04$). In contrast, a highly significant association was seen between the level of activity of friends and both male and female physical activity. Overall there was no significant association between adolescent's level of physical activity and the physical activity of brothers, sisters or the teachers they like. However, there was a moderate association between the adolescents' level of physical activity and the activity level of their fathers ($0.05 < P < 0.10$). This association is particularly seen in female adolescents ($P = 0.08$). A significant association was found between the level of activity in male adolescents and their brothers' activity ($P = 0.01$). A highly significant association was found between physical activity and adolescents' membership in sports clubs (0.001). Also a significant association was found between physical activity of adolescents and taking part in a sports competition.

TABLE 5.33

Level of physical activity of questionnaire participants by social variables

Variable	Score	Adolescents	df	$\chi 2$ Value	P-value
Activity habits of fathers *	every week < every week				
		Overall	1	3.38	0.06
		Male	1	0.62	0.48 [f]
		Female	1	3.04	0.08
Activity habits of mothers *	every week < every week				
		Overall	1	4.34	0.03
		Male	1	4.21	0.04 [f]
		Female	1	1.50	0.22
Activity habits of brothers *	every week < every week				
		Overall	1	2.35	0.14 [f]
		Male	1	6.27	0.02 [f]
		Female	1	0.06	0.72 [f]
Activity habits of sisters *	every week < every week				
		Overall	1	1.86	0.17
		Male	1	3.62	0.09 [f]
		Female	1	0.12	0.73
Activity habits of friends *	every week < every week				
		Overall	1	20.35	0.00
		Male	1	17.74	0.00 [f]
		Female	1	6.55	0.01
Activity habits of teachers *	every week < every week				
		Overall	1	0.55	0.46 [f]
		Male [n]	-	-	-
		Female [n]	-	-	-
Membership in sport club**	Yes No	Overall	2	15.37	0.001
Sport competition**	Yes No Yes but not any longer	Overall	4	10.60	0.03

$p < 0.05$ is significant. * Activity level of adolescents is categorized to active (≥ 2- 3 times outside the school hours) and inactive (≤ 2-3 times per week). ** Activity level of adolescents is categorized to high, moderate and low. f = P-value for Fisher's exact test: 2-Tail. n = test was not used since 67 percent do not know what their teacher do or even they do not have a favorite teacher.

5.2.1.6. Environmental Factors

The results relating to the environmental factors such as time spent watching television and playing video-games, and barriers of cost of sport facilities, access to transport, time, access to sport facilities and separate swimming pool in relation to the respondents' activity levels are shown in this part.

TABLE 5.34

Physical activity level of adolescents by time spent watching TV

Activity level	< 4 hours	≥ 4 hours	Total
High	73 (51.8)	18 (32.7)	91 (46.4)
Moderate	43 (30.5)	19 (34.6)	62 (31.6)
Low	25 (17.7)	18 (32.7)	43 (22.0)
Total	141 (100)	55 (100)	196 (100)

Note: Percent ( )
df = 2 $\chi 2$ value = 7.35. P = 0.02.

Table 5.34 indicates that less than one third of adolescents watch TV 4 hours or more a day. Adolescents who watch TV for 4 or more hours a day are more likely to be inactive (32.7 percent) than the other group (17.7). This table also demonstrates that more than half of those who watch TV less than 4 hours a day are highly active. The association between the number of hours spent watching TV and activity level was significant.

TABLE 5.35

Activity level of questionnaire participants by time spent playing video games per week

Activity level	< 1 hour	≥ 1-3 hours	Total
Active	102 (76.1)	51 (82.2)	153 (78.1)
Inactive	32 (23.9)	11 (17.8)	43 (21.9)
Total	134 (100)	62 (100)	196 (100)

Note: Percent ( ) df = 1 $\chi 2$ value =0.93 P = 0.33

The number of hours per week spent playing video games is not associated with specific categories of the adolescents' physical activity.

TABLE 5.36
Activity level of questionnaire participants and feelings about cost of sports facilities

Activity level	Very important	Fairly important	Not important	Total
High	8 (47.1)	28 (37.8)	55 (52.4)	91 (46.4)
Moderate	4 (23.5)	26 (35.2)	32 (30.5)	62 (31.6)
Low	5 (29.4)	20 (27.0)	18 (17.1)	43 (22.0)
Total	17 (100)	74 (100)	105 (100)	196 (100)

Note: Percent ( ).
df = 4 $\chi 2$ value =5.07 P = 0.28.

Table 5.36 indicates that the cost of sport facilities is not associated with the level of physical activity. 52.4 percent of those who are highly physically active rate it as not important.

TABLE 5.37

Activity level of questionnaire participants and access to transport

Activity level	Very important	Fairly important	Not important	Total
High	7 (31.8)	32 (51.6)	52 (46.4)	91 (46.4)
Moderate	8 (36.4)	19 (30.7)	35 (31.25)	62 (31.6)
Low	7 (31.8)	11 (17.7)	25 (22.32)	43 (22.0)
Total	22 (100)	62 (100)	112 (100)	196 (100)

Note: Percent ( )
df = 4 $\chi 2$ value = 3.03 P = 0.55.

Table 5.37 demonstrates that for the majority of the subjects (112 students) access to transport is not important. Those who reported access to the transport is fairly important are more highly active (51.6 percent) compared to other groups. There is no significant association between the level of activity and the barrier of access to transport.

TABLE 5.38

Activity level of questionnaire participants and time

Activity level	Very important	Fairly important	Not important	Total
High	10 (40.0)	25 (36.8)	56 (54.4)	91 (46.4)
Moderate	7 (28.0)	24 (35.3)	31 (30.1)	62 (31.6)
Low	8 (32.0)	19 (27.9)	16 (15.5)	43 (22.0)
Total	25 (100)	68 (100)	103 (100)	196 (100)

Note: Percent ( )
df = 4 $\chi 2$ value = 7.65. P = 0.10.

Table 5.38 demonstrates that respondents who reported that availability of time is very important had a high percentage (54.4) of highly physically active adolescents among them. There is no significant association between the availability of time and the physical activity level.

TABLE 5.39

Activity level of questionnaire participants and access to sport facilities

Activity level	Very important	Fairly important	Not important	Total
High	12 (44.4)	24 (49.0)	55 (45.8)	91 (46.4)
Moderate	9 (33.4)	16 (32.6)	37 (30.8)	62 (31.6)
Low	6 (22.2)	9 (18.4)	28 (23.3)	43 (22.0)
Total	27 (100)	49 (100)	120 (100)	196 (100)

Note: Percent ( )
df = 4 $\chi 2$ value = 0.55 P = 0.96.

Respondents who perceived access to sport facilities as important were less likely (44.4 percent) to be highly physically active than other groups but, this was not significant (Table 5.39).

TABLE 5.40

Activity level of questionnaire participants and separate swimming pool

Activity level	Very important	Fairly important	Not important	Total
High	5 (41.7)	7 (46.6)	79 (46.7)	91 (46.4)
Moderate	5 (41.7)	4 (26.7)	53 (31.4)	62 (31.6)
Low	2 (16.6)	4 (26.7)	37 (21.9)	43 (22.0)
Total	12 (100)	15 (100)	169 (100)	196 (100)

Note: Percent ( )
df = 4 $\chi 2$ value = 0.87 P = 0.92.

Only 27/196 respondents perceived the availability of a separate swimming pool as important. Among those a high percentage was moderately or highly physically active (Table 5.40).

Overview of the Environmental Variables and their Relative Significance to Physical Activity Level in Adolescents

The environmental variables include barriers of access to facilities and levels of television viewing and playing video games. No significant association was observed between physical activity and three subclasses (important, fairly important and not important) of possible barriers (cost, access to transport, time, access to facilities and availability of a separate swimming pool). No significant association was found between physical activity and the number of hours per week spent playing video games. A significant association was found between the number of hours spent watching television based on data from the MIS

questionnaire (Appendix D). Those who view more than 4 hours television a day are most likely to be physically inactive.

TABLE 5.41

Association between physical activity and environmental variables

Variable	Category	df	$\chi 2$ value	P value
Television	< 4 hours	2	7.35	0.02
	≥4 hours			
Video-games	< 1 hour	6	5.81	0.44
	1-3 hours			
	4-6 hours			
	7-9 hours			
Barriers :				
Cost of sport facilities	Very important	4	5.07	0.28
	Fairly important			
	Not important			
Access to transport	Very important	4	3.03	0.55
	Fairly important			
	Not important			
Time	Very important	4	7.65	0.10
	Fairly important			
	Not important			
Access to sport facilities	Very important	4	0.55	0.96
	Fairly important			
	Not important			
Access to separate swimming pool	Very important	4	0.87	0.92
	Fairly important			
	Not important			

$P < 0.05$ is significant
Activity levels: high, moderate and low.

5.2.1.7 Adolescent's Feeling About Physical Education Class

TABLE 5.42

Activity level of questionnaire participants and their feeling about physical education lessons

Feeling about physical education lessons	High	Moderate	Low	Total
I like them too much	18 (48.7)	12 (32.4)	7 (18.9)	37 (100)
I like them	43 (54.4)	18 (22.8)	18 (22.8)	79 (100)
I neither like nor dislike them	19 (36.5)	24 (46.2)	9 (17.3)	52 (100)
I dislike them/ I do not attend	11 (39.3)	8 (28.6)	9 (32.1)	28 (100)
Total	91 (46.4)	62 (31.6)	43 (22.0)	196 (100)

df = 8 $\chi 2$ value = 12.97 P = 0.11 Contingency Coefficient = 0.24.

Table 5.42 demonstrates that most who are highly active (54.4 percent and 48.7 percent) like their Physical Education class. The corresponding percentage

for those who dislike Physical Education is 36.5. However, those associations were not significant.

5.2.1.8 Type of Physical Activity

In this part, results of the combination between hours of undertaking exercise and the types of usual physical activity are explored. It is followed by the results of usual hours of walking and cycling outside the school hours.

TABLE 5.43

Activity level of questionnaire participants and hours of exercise per week

Activity level	1/2 hour	1 hour	2-3 hours	4-6 hours	≥ 7 hours
High	5 (17.2)	12 (27.9)	14 (29.2)	28 (66.7)	32 (94.2)
Moderate	8 (27.6)	14 (32.6)	28 (58.3)	11 (26.2)	1 (2.9)
Low	16 (55.2)	17 (39.5)	6 (12.5)	3 (7.1)	1 (2.9)
Total	29 (100)	43 (100)	48 (100)	42 (100)	34 (100)

Note: Percent ( ) df = 8 $\chi 2$ value = 84.56 P = 0.001.

Table 5.43 shows that about two thirds of respondents undertake exercise 2-3 hours or more a week outside the school hours. According to Table 5.34, the more hours spent exercising the more highly active the subjects are. It also can be seen that the percentage of low activity increases as the hours spent exercising decrease. The $\chi 2$ test indicates a highly significant association between the hours of exercise and the level of activity

TABLE 5.44

Activity level of questionnaire participants and time spent cycling per week

Activity level	None	1/2 hour	1 hours	2-3 hours	≥ 4-6 hours	Total
High	24 (38.1)	19 (41.3)	14 (45.2)	17 (53.1)	17 (71.0)	91 (46.4)
Moderate	18 (28.6)	15 (32.6)	15 (48.4)	9 (28.1)	5 (21.0)	62 (31.6)
Low	21 (33.3)	12 (26.1)	2 (6.4)	6 (18.8)	2 (8.0)	43 (22.0)
Total	63 (100)	46 (100)	31 (100)	32 (100)	24 (100)	196 (100)

df = 10 $\chi 2$ value = 19.91 P = 0.03.

Findings indicate that one third of participants (63/196 students) do not spend any time cycling (see Table 5.44). This Table also demonstrates that the percentage of high activity increases with an increasing number of hours spent cycling per week.

The corresponding percentages for none, 1/2 hour, 1 hour, 2-3 hours and 4 or more than four hours are 38.1, 41.3, 45.2, 53.1 and 71 respectively. The $\chi 2$ test shows a significant positive association between hours of cycling and the level of activity (P = 0.03).

TABLE 5.45

Activity level of questionnaire participants and time spent walking per week.

Activity level	None/1/2 hour	1 hours	2-3 hours	≥ 4-6 hours	Total
High	14 (48.3)	13 (30.2)	39 (49.4)	25 (57.1)	91 (46.4)
Moderate	10 (34.5)	17 (39.6)	24 (30.4)	11 (28.6)	62 (31.6)
Low	5 (17.2)	13 (30.2)	16 (20.2)	9 (14.3)	43 (22.0)
Total	29 (100)	43 (100)	79 (100)	45 (100)	196 (100)

Note: ( ) percent.
df =6 $\chi 2$ value =7.74 P = 0.32.

Table 5.45 indicates that the majority of those who are highly active walk 2-3 hours a week. This table also indicates that the proportion of those who are highly active and walk 4 -6 hours or more per week (57.1 percent) is higher than that for any other participants. However, none of these associations is significant.

TABLE 5.46

Activities usually participated in outside school hours

Type of activity	Male [n=84]		Female [n=112]		Total [n=196]	
Walking	58	(69.0)	93	(83.1)	151	(77.0)
Gymnastics	5	(6.0)	7	(6.3)	12	(6.1)
Volleyball	4	(4.8)	3	(2.7)	7	(3.5)
Horse-back riding	2	(2.4)	4	(3.6)	6	(3.0)
Climbing	13	(15.5)	12	(10.7)	25	(12.8)
Tennis	17	(20.2)	18	(16.1)	35	(17.8)
Baseball	7	(8.3)	4	(3.6)	11	(5.6)
Basketball	26	(31.0)	15	(13.4)	41	(20.9)
Surfing	27	(32.1)	10	(8.9)	37	(19.0)
Football	23	(27.4)	19	(17.0)	42	(21.4)
Jumping	5	(6.0)	16	(14.3)	21	(10.6)
Running/Jogging	30	(35.7)	47	(42.0)	77	(39.3)
Soccer	28	(33.3)	19	(17.0)	47	(23.9)
Skateboarding	19	(22.6)	10	(8.9)	29	(14.8)
Swimming	21	(25.0)	34	(30.4)	55	(28.1)
Cycling	39	(46.4)	26	(23.2)	65	(33.1)
Dancing	6	(7.1)	28	(25.0)	43	(17.3)
Watching or playing Video-games	44	(52.4)	24	(21.4)	68	(34.6)
Watching TV	57	(67.9)	80	(71.4)	137	(70.0)
Netball	3	(3.6)	18	(16.1)	21	(10.7)
Other	12	(14.3)	25	(22.3)	37	(18.8)
None	- -	- - -	1	(0.9)	1	(0.5)

Note: Percent ( ). Some adolescents participate in more than one activity.

It is apparent from the Table 5.46 that walking is the major usual activity among participants (77 percent). Overall the list of the major usual activities in descending order includes walking, running (39.3 percent), cycling (33.1 percent), swimming (28.1 percent), and soccer (23.9 percent). Among males, the order of major activities is walking (69 percent), cycling (46.4 percent), running (35.7 percent), soccer (33.3 percent), surfing (32.1 percent), basketball (31.0 percent) and football (27.4 percent). Whilst the order of major activities among females is walking (83.0 percent), running (42.0 percent), swimming (30.4 percent) and dancing (25.0 percent). Accordingly the top 14 self-reported physical activities are explored in Table 5.47. Percentages of playing video and watching TV as passive physical activities are also presented and are 34.6 and 70 respectively.

TABLE 5.47

Top 14 self-reported physical activities outside the school hours for males and females

Male	Rank	Female
Walking	1	Walking
Cycling	2	Running/Jogging
Running/Jogging	3	Swimming
Soccer	4	Dancing
Surfing	5	Cycling
Basketball	6	Soccer
		Football (touch)
Football	7	Tennis and netball
Swimming	8	Jumping
Skateboarding	9	Basketball
Tennis	10	Climbing/Hiking
Climbing	11	Skateboarding
		Surfing
Baseball	12	Gymnastics
Dancing	13	Horse-back riding
		Baseball
Jumping and Gymnastics	14	Volleyball

Overview of Type of Physical Activity

There was a highly significant association between the hours spent a week exercising and the level of activity. There is an association between hours spent cycling and the level of activity reported in the self-reported questionnaire. Hours

of walking per week were not significantly associated with the level of activity. Among the types of usual physical activity outside the school hours, walking is the major usual activity among participants. Overall the list of the major usual activities in descending order includes walking (77.0 percent), running (39.3 percent), cycling(33.1 percent), swimming (28.1), and soccer (23.9). Among males the order of major activities is walking (69 percent), cycling (46.4 percent), running (35.7 percent), soccer (33.3 percent), surfing (32.1 percent), basketball (31.0) and football (27.4). Whilst the order of major activities among females is walking (83.0), running (42.0), swimming (30.4 percent) and dancing (25.0). However, the percentages of playing video and watching TV as passive activities are also 34.6 and 70 respectively.

5.2.1.9 Reasons for Participation in Physical Activity

The findings from the question of how important various reasons for participation in physical activity are to the respondents (Question 31, Appendix D) are summarized in Table 5.48. The association between the level of physical activity and three subclasses (important, fairly important and not important) are tested by the $\chi 2$ test.

Table 5.48 indicates that the majority of highly active participants (60.2 percent) are those who participate in sport because they perceive it as a way for them to find new friends and to look good. The other significant association is to lose weight though sport.

TABLE 5.48

Activity level of questionnaire participants and reasons for participating in sport

Reasons	Activity level	Very important	Fairly important	Not important
To have fun	High	78 (48.4)	13 (37.1)	--
	Moderate	50 (31.1)	13 (34.3)	--
	Low	33 (20.5)	10 (28.6)	--
To be good at sport				
	High	33 (53.2)	42 (50.6)	16 (31.4)
	Moderate	18 (29.0)	23 (27.7)	21 (41.2)
	Low	11 (17.8)	18 (21.7)	14 (27.4)
To win				
	High	23 (54.8)	27 (51.9)	41 (40.2)
	Moderate	9 (21.4)	15 (28.8)	38 (37.3)
	Low	10 (23.8)	10 (19.3)	23 (22.5)
To make new friends **				
	High	53 (60.2)	28 (35.4)	10 (34.5)
	Moderate	20 (22.7)	33 (41.8)	9 (31.0)
	Low	15 (17.1)	18 (22.8)	10 (34.5)
To improve my health				
	High	72 (49.7)	13 (33.3)	6 (50.0)
	Moderate	47 (32.4)	13 (33.3)	2 (16.7)
	Low	26 (17.9)	13 (33.3)	4 (33.3)
To see my friends				
	High	42 (50.6)	37 (43.0)	12 (44.5)
	Moderate	22 (26.5)	32 (37.2)	8 (29.6)
	Low	19 (22.9)	17 (19.8)	7 (25.9)
To get a good shape				
	High	63 (47.0)	21 (43.7)	7 (50.0)
	Moderate	45 (33.6)	14 (29.2)	3 (21.4)
	Low	26 (19.4)	13 (27.1)	4 (28.6)
To look good*				
	High	31 (50.00	43 (55.1)	17 (30.3)
	Moderate	19 (30.7)	20 (25.7)	23 (41.1)
	Low	12 (19.3)	15 (19.2)	16 (28.6)
To enjoy the feeling of using my body				
	High	34 (56.7)	43 (46.2)	14 (32.6)
	Moderate	17 (28.3)	29 (31.2)	16 (37.2)
	Low	9 (15.0)	21 (22.6)	13 (30.2)
To be a sports star				
	High	18 (54.5)	20 (51.3)	53 (42.7)
	Moderate	9 (27.3)	11 (28.2)	42 (33.9)
	Low	6 (18.2)	8 (20.5)	29 (23.4)
To please my parents				
	High	16 (55.2)	17 (44.7)	58 (44.9)
	Moderate	8 (27.6)	13 (34.2)	41 (31.8)
	Low	5 (17.2)	8 (21.1)	30 (23.3)
To lose weight ***				
	High	20 (32.3)	34 (47.9)	37 (58.7)
	Moderate	22 (35.4)	26 (36.6)	14 (22.2)
	Low	20 (32.3)	11 (15.5)	12 (19.1)

Note: percent ( ) * Moderate statistical association df =4 $\chi 2$ value = 8.61 P = 0.07. ** Significant df =4 $\chi 2$ value = 14.38 P = 0.006 Contingency Coefficient = 0.26 Phi Coefficient = 0.27. *** Significant df = 4 $\chi 2$ value = 11.97 P = 0.01.

5.2.2. Diary

In this part, personal characteristics of the subjects filling out an activity diary will be explored. The intensity (level of activity) and duration of activity measured by the activity diary will also be reported. Fifty-two subjects from those who have filled in the questionnaire (196) were willing to keep a diary to record their activity for 12 waking hours per day (8:30 AM to 8:30 PM) for one week. All were included in the study and all filled the diary. Since the sample is smaller, the statistical analysis is more limited.

TABLE 5.49

Diary participants by age and gender

Age	Male	Female	Total
13	8 (38.1)	9 (29.0)	17 (32.7)
14	5 (23.8)	6 (19.4)	11 (21.2)
15	4 (19.1)	6 (19.4)	10 (19.2)
16	4 (19.1)	10 (32.2)	14 (26.9)
Total	21 (100)	31 (100)	52 (100)

Note: Percent ( )
df =3 $\chi 2$ value =1.24 P = 0.74.

According to the Table 5.49 two thirds of participants completing the activity diary are female (31 students). The major percentage of male participants were 13 years old (38.1 percent), whilst the highest percentage of female participants were 16 years old (32.2 percent).

TABLE 5.50

Diary participant's activity level by age

	Age				
Activity level	13	14	15	16	Total
High	12 (70.6)	8 (72.7)	4 (40.0)	6 (42.9)	30 (57.7)
Moderate	4 (23.5)	2 (18.2)	0 (0.0)	3 (21.4)	9 (17.3)
Low	1 (5.9)	1 (9.1)	6 (60.0)	5 (35.7)	13 (25.0)
Total	17 (100)	11 (100)	10 (100)	14 (100	52 (100)

Note: Percent ( )
df = 6 $\chi 2$ value = 13.4 P = 0.03.

According to Table 5.50 the majority of the participants completing the activity diary are highly active (57.7 percent). This Table also demonstrates that

subjects who are 13 and 14 and 16 years old are mostly in the category of high physical activity level (70.6%, 72.7% and 42.9%), while the majority (60%) of subjects who are 15 years old are less active. There was a significant difference between the physical activity level among the different ages. These differences can be seen between the age group 13-14 and 15-16. Since there were a few cells with expected counts of less than 5, the Fisher's exact test (2 tail) was also employed. The result was similar (P = 0.03).

TABLE 5.51

Activity level of diary participants by grade

Activity level	Grade 8	Grade 10	Total
High	18 (69.2)	12 (46.2)	30 (57.7)
Moderate	6 (23.1)	3 (11.5)	9 (17.3)
Low	2 (7.7)	11 (42.3)	13 (25.0)
Total	26 (100)	26 (100)	52 (100)

Note: Percent ( )
df = 2 $\chi 2$ value = 8.43 P = 0.01.

It is apparent from the Table 5.51 that an equal number of participants from each grade completed the activity diary. Table 5.51 indicates that 69.2 percent of grade 8 and 46.2 per cent of grade 10 subjects who completed the activity diary are highly active. The percentage of those with low activity is higher among Grade 10 subjects than that for year 8 participants. The Fisher's exact test (2-tail) showed a significant association between the level of activity and grade (P = 0.01)

TABLE 5.52

Activity level of diary participants by gender

Activity level	Male	Female	Total
High	17 (81.0)	13 (41.9)	30 (57.7)
Moderate	3 (14.2)	6 (19.4)	9 (17.3)
Low	1 (4.8)	12 (38.7)	13 (25.0)
Total	21 (100)	31 (100)	52 (100)

Note: Percent ( ).
df = 2 $\chi 2$ value = 9.26 P = 0.01.

It is clear from the Table 5.52 that 81 percent of the males who completed the activity diary are highly active. The corresponding percentage for females is 41.9 percent. One fourth of females are in the low activity category. A significant difference was found between males and females relating to the physical activity level ($p = 0.01$). The Fisher's exact test also showed a significant difference between males and females relating to the level of physical activity ($p = 0.001$)

5.2.3 Heart Rate Monitor

Thirty-five students were willing to wear a heart rate monitor that would record their heart rate to determine their level of physical activity. Twenty-five students were selected stratified for gender and grade. One of the students was excluded from the analysis as a result of being ill during the study. It took nine weeks to collect the heart rate data.

TABLE 5.53

Resting heart rate by age and sex as measured by heart rate monitor

Sex	N	Mean ± std	Std error	Range
Male	11	61 ± 9.3	2.8	47 – 75
Female	13	66 ± 6.3	1.7	54 – 75

P = < 0.05

Variance	T-value	Df	Prob > |T|
Equal	- 0 1.54	22	0.13

Differences between the means (Table 5.53) of resting heart rate among male and female were tested using the Student-t test. The t-test indicates that the resting heart rate averages for males and females are not significantly different at the 5% significant level.

TABLE 5.54
Participants in heart rate monitoring by age and gender

Age	Male	Female	Total
13	3 (27.3)	3 (23.1)	6 (25.0)
14	3 (27.3)	3 (23.1)	6 (25.0)
15	3 (27.3)	4 (30.7)	7 (29.2)
16	2 (18.1)	3 (23.1)	5 (20.8)
Total	11 (100)	13 (100)	24 (100)

An approximately equal percentage from each age and sex participated in the heart rate monitoring data collection (Table 5.54).

TABLE 5.55
Participants in heart rate monitoring by level of activity and gender

Activity level	Male	Female	Total
High	4 (36.4)	3 (23.1)	7 (29.2)
Moderate	7 (63.6)	6 (46.1)	13 (54.2)
Low	-	4 (30.8)	4 (16.6)
Total	11(100)	13 (100)	24 (100)

Note: Percent ( )

Table 5.55 indicates that the majority of the participants in heart rate monitoring were categorized as moderately active (54.2 percent). This table also shows none of the males were in the low activity category.

5.2.4 Evaluation of Representativeness of Participants

TABLE 5.56
Evaluation of representativeness of diary participants' for questionnaire

	Diary	Questionnaire	Total	$\chi 2$	df	p-value
Gender						
Males	21 (40.4)	63 (43.7)	84 (42.9)			
Females	31 (59.6)	81 (56.3)	112 (57.1)			
Total	52 (100)	144 (100)	196 (100)	0.18	1	0.67
Age						
13	17 (32.7)	46 (31.9)	63 (32.2)			
14	11 (21.2)	28 (19.4)	39 (19.9)			
15	10 (19.2)	43 (29.9)	53 (27.0)			
16	14 (26.9)	27 (18.8)	41 (20.9)			
Total	52 (100)	144 (100)	196 (100)	2.88	3	0.41
Activity level*						
Active	41 (78.8)	112 (77.8)	153 (78.1)			
Inactive	11 (21.2)	32 (22.2)	43 (21.9)			
Total	52 (100)	144 (100)	196 (100)	0.02	1	0.87

* Based on self-reported questionnaire(q12 Appendix D).

Table 5.57 indicates no significant difference between diary participants and questionnaire participants with regard to their gender, age and activity level ($p > 0.05$). Accordingly, the diary participants are representative of the questionnaire participants.

TABLE 5.57

Evaluation of representativeness of hear rate participants' for diary

	Diary	Heart rate	Total	$\chi 2$	df	p-value
Gender						
Males	10 (35.7)	11 (45.8)	21 (40.4)			
Females	18 (64.3)	13 (54.2)	31 (59.6)			
Total	28 (100)	24 (100)	52 (100)	0.55	1	0.45
Age						
13	11(39.3)	6 (25.0)	17 (32.7)			
14	5 (17.9)	6 (25.0)	11 (21.2)			
15	3 (10.7)	7 (29.2)	10 (19.2)			
16	9 (32.1)	5 (20.8)	14 (29.9)			
Total	28 (100)	24 (100)	52 (100)	4.02	3	0.26
Activity level*						
Active	22 (78.6)	19 (79.2)	41 (78.9)			
Inactive	6 (21.4)	5 (20.8)	11 (21.1)			
Total	28 (100)	24 (100)	52 (100)	0.00	1	0.96

* Based on self-reported questionnaire(q12 Appendix D)..

Table 5.57 indicates no significant difference between diary participants and heart rate monitor participants with regard to their gender, age and activity level ($p > 0.05$). It can be said that the heart rate monitor participants are representative of the diary participants.

5.2.5 Anthropometry

The subjects participating in anthropometry are those who have participated in the self recorded activity diary. In this section findings from measurements of skinfolds, are explored. The BMI calculated from the self-reported height and weight is also explored here.

TABLE 5.58
Anthropometric characteristics of subjects

Characteristics	Mean ± sd	Range	No	Instrument participants
BMI = weight (kg)/height^2 (m^2)				Questionnaire
Male	21.3 ± 3.3	15.7 – 33.3	80	
Female	20.0 ± 2.4	14.7 – 25.4	105	
Overall	20.3 ± 2.9	14.7 – 33.3	185	
BMI(kg/m^2)				Diary & direct measurement of height & weight.
Male	22.2 ± 3.6	17.3 –35.0	21	
Female	22.2 ± 3.1	17.1 – 29.3	31	
Overall	22.2 ± 3.3	17.1 – 35.0	52	
Body fat				Skinfold caliper and activity diary
Male	21.1 ± 6.4	8.8 – 38.4	21	
Female	21.9 ± 6.4	12.5 – 35.9	31	
Overall	19.6 ± 7.4	8.8 – 38.4	52	

A worthy point of the Table 5.58 is the self-reported under-estimation of body mass index for males and females.

TABLE 5.59
Activity and BMI of participants in the diary

Activity	N	Mean ± std	Std error	Range
Active	39	21.8 ±3.3	0.5	17.1 - 35.0
Inactive	13	23.5 ± 2.9	0.8	18.7 – 29.3

P <0.10

Variance	T	Df	Prob > |T|
Equal	-1.7	50	0.09

P<0.10

Differences between the means (Table 5.59) of BMI among active adolescents and inactive adolescents were tested using the Student-t test. The t-test indicates that the BMI averages for active and inactive are significantly different at the 10 % significance level.

TABLE 5.60

Activity and body fat percentage of participants in the diary

Activity	N	Mean ± std	Std error
Active	39	17.7 ± 6.9	1.1
Inactive	13	25.3 ± 6.1	1.7

P <0.10

Variance	T	Df	Prob > |T|
Equal	-3.49	50	0.001

Differences between the means (Table 5.60) of body fat percentages among active adolescents and inactive adolescents were tested using the Student-t test. The t-test indicates that the body fat percent averages for active and inactive participants are significantly different.

TABLE 5.61

Level of fatness and feeling of subjects about their body size

	Feeling about body size**			
Fatness*	Thin	Average	Fat	Total
Low	5 (55.6)	16 (64.0)	4 (22.2)	25 (48.1)
Optimal	4 (44.4)	7 (28.0)	6 (33.3)	17 (32.7)
Fat	-	2 (8.0)	8 (44.5)	10 (19.2)
Total	9 (100)	25 (100)	18 (100)	52 (100)

Note: Percent ( ). Fatness measured by skinfold thickness, and using skinfold equation (chapter 3 Figure 3.1).

*Fatness level measured by skinfold thickness:
Low percentage body fat = low
Optimal percentage body fat = optimal
Moderate high and high percent body fat = fat

**Reported feeling about their own Body size
Much too thin and a bit too thin = thin
About right size = Average
A bit too fat + much too fat = fat.

Table 5.61 indicates that 44.5 percent of those who feel their body is fat are categorized as fat with skinfold measurement. The majority of those who feel their body is average are categorized as having a low percentage of body fat with the skinfold measurement. The $\chi 2$ test shows a significant association between the perception of body size and the fatness level measured by skinfold test (P <0.001). Since 56% of the cells have expected counts of less than 5 the Fisher's exact test has been used to measure the association between these two variables

and there was a significant association between the perceived body size and fatness measured by skinfold thickness.

The assessment of fatness through the skinfold thickness and questionnaire agreed for 22 (5 + 7 + 8 see Table 5.61) out of 52 students, that is, a 42.3% agreement rate. The assessment value of K (Kappa) is 0.34, with a 95% confidence interval of 0.1518 to 0.5385 indicating poor agreement. The Kappa test indicates agreement between the skinfold thickness and the questionnaire in measuring the fatness among subjects.

TABLE 5.62

Level of physical activity by fatness estimated by skinfold equations

Activity level [a]	Fatness*				
	Low	Optimal	Mod. High	High	Total
Active	24 (96.0)	11 (64.7)	1 (20.0)	3 (60.0)	39 (75.0)
Inactive	1 (4.0)	6 (32.3)	4 (80.0)	2 (40.0)	13 (25.0)
Total	25 (100)	17 (100)	5 (100)	5 (100)	52 (100)

*Based on Figure 3.1 (chapter 3). df = 3 $\chi 2$ value = 15.5 P = 0.001.

Table 5.62 demonstrates that 96 percent of those in the low category of fatness are active. There was a significant association between level of fatness estimated by skinfold thickness and level of activity.

5.3 Assessment of Validity

In this part, the findings from the questionnaire, the activity diary and the heart rate monitor, regarding the measurements of times and duration of activity per week will be compared (based on the questions 11, 12, 13 of the questionnaire, Appendix D). To measure the validity of these questions, the association between the diary, the questionnaire and the heart rate monitor are examined. The agreement between intensity and duration of self-reported physical activity in the questionnaire (questions 11-13 appendix D) with the results from the self-recorded activity diary, the heart rate monitor, and anthropological measurements will be explored. and the level of agreement among

the three instruments will be examined. The result from the evaluation of a screening test including sensitivity and specificity of questionnaire and diary will be explored.

5.3.1 Frequency of Activity Estimated by Three Instruments (Assessment of the Agreement for Question 11).

Q11: Outside school hours: How many times a week do you usually exercise in your free time, so much that you get out of breath or sweat?

TABLE 5.63

Frequency of activity per week as recorded in questionnaire and diary

Questionnaire	Diary		
	≥ 2-3 times a week [Active]	< 2-3 times a week [Inactive]	Total
≥2-3 times a week [Active]	37 (86.0)	6 (14.0)	43 (100)
<2-3 times a week [Inactive]	3 (33.3)	6 (66.7)	9 (100)
Total	40 (77.0)	12 (23.0)	52 (100)

Note: Percent ( ). Fisher exact: 2-tailed P = 0.00 K = 0.46. 95% Confidence intervals (CI) on Kappa = 0.17 to 0.76. Sensitivity of the questionnaire to measure frequency of activity per week = 37/40 = 0.92 (95% CI 0.84 to 1) Specificity of the questionnaire to measure frequency of activity per week = 6/12 = 0.50 (95% CI 0.23 to 0.77). Prevalence = 0.77 PPV = 0.86

Table 5.63 demonstrates that 86 percent of those who reported themselves active in the questionnaire were also measured as active with the activity diary. This table also indicates that 66.7 percent of those who reported themselves to be inactive in the questionnaire were also inactive as measured by the diary. The Fisher's exact test showed a significant association between diary and questionnaire (p = 0.00).

The assessment of activity through the diary and questionnaire agreed for 43 (37 + 6 see Table 5.63) out of 52 students, that is an 82.7% agreement rate. The assessment value of Kappa is 0.46, with a 95% confidence interval or 0.17 to 0.76. The Kappa test indicates a moderate agreement between the diary and questionnaire for measuring the number of times of activity.

Evaluation of the validity of the question 11 was also examined using the screening test. The values of active and inactive as indicated by the heart rate monitor are considered as true values. Sensitivity and specificity of the questionnaire are measured through comparison with these true values. The sensitivity of the question 11 (its ability to identify correctly those who are active) was 92%, and specificity of the question 11 (its ability to identify those who are not active) was 50%.

TABLE 5.64

Times of activity per week as recorded in heart rate monitor and diary

Diary	Heart rate monitor		
	≥ 2-3 times a week [Active]	< 2-3 times a week [Inactive]	Total
≥2-3 times a week [Active]	17 (85.0)	1 (25.0)	18 (75.0)
<2-3 times a week [Inactive]	3 (15.0)	3 (75.0)	6 (25.0)
Total	20 (100)	4 (100)	24 (100)

Note: Percent ( ) Fisher exact: 2-tailed P = 0.03 K = 0.5. 95% Confidence intervals (CI) on Kappa = 0.08 to 0.91. Sensitivity of the diary to measure frequency of activity = 17/20 = 0.85 (95% CI 0.71 to 0.99). Specificity of the diary to measure frequency of activity 3/4 = 0.75 (95% CI 0.33 to 1). Prevalence = 0.83 PPV = 0.94

According to the Table 5.64 the majority of active respondents as measured by the heart rate monitor (85 percent) are also estimated to be active with the diary. The Fisher's exact test indicates a significant association between the level of activity as measured by these two instruments ($p < 0.05$).

In addition the assessment of activity with the diary and heart rate monitor (Table 5.64) agreed for 20 (17 + 3) out of 24 students, that is an 83.3% agreement rate. The assessment value of Kappa is 0.50, with a 95% confidence interval or 0.08 to 0.91. The Kappa test indicates a moderate agreement between the diary and the heart rate monitor for measuring the number of times of activity.

Evaluation of the validity of question 11 was also examined using the screening test. The values of active and inactive indicated by the heart rate monitor are considered as true values. Sensitivity and specificity of the diary was

measured through comparison with these values. The sensitivity or the ability of the diary to identify correctly those who are active was 85%, and its specificity or its ability to identify correctly those who are inactive was 75% (see Table 5.64).

TABLE 5.65

Frequency of activity per week as recorded in heart rate monitor and questionnaire

	Heart rate monitor		
Questionnaire	≥ 2-3 times a week [Active]	< 2-3 times a week [Inactive]	Total
≥ 2-3 times a week [Active]	18 (90.0)	2 (10.0)	20 (100)
<2-3 times a week [Inactive]	2 (50.0)	2 (50.0)	4 (100)
Total	20 (83.3)	4 (16.7)	24 (100)

Note: Percent ( ) Fisher exact: 2-tailed P = 0.11. K = 0.40 95% Confidence intervals (CI) on Kappa = -0.08 to 0.88. Sensitivity of the questionnaire 11 = 18/20 = 0.90 (95% CI = 0.79 to 1) Specificity of the questionnaire = 2/4 = 0.50 (95% CI = 0 to 1). Prevalence = 0.83 PPV = 0.90

Table 5.65 shows that 90 percent of those who were estimated as active by the questionnaire are also active as measured by the heart rate monitor. This Table also indicates that 50 percent of the subjects who were categorized by the questionnaire as inactive, were also estimated as inactive by the heart rate monitor. The Fisher's exact test indicates there is not a significant association between the two measurements for estimating the level of activity ($p > 0.05$).

Furthermore, the assessment of activity by the questionnaire and heart rate monitor (Table 5.65) agreed for 20 (18 + 2) out of 24 students, that is an 83.3% agreement rate. The assessment value of Kappa is 0.40, with a 95% confidence interval of - 0.08 to 0.88. The Kappa test indicates a moderate agreement between the heart rate monitor and the questionnaire for measuring the number of times of activity.

Evaluation of the validity of the question 11 was also examined using the screening test. The values of active and inactive, as indicated by the heart rate monitor are considered as true values. Sensitivity and specificity of the

questionnaire are measured through comparison with these true values. The sensitivity of question 11 (its ability to correctly identify correctly those who are active) was 90%, and specificity of the question 11 (its ability to identify those who are not active) was 50%.

5.3.2 The Level of Activity Measured With the Three Instruments

Q12: (Q12 of the Multi-instrument Study and 10 of the IYHS): Outside school hours : In the free time that you have in a normal week, how many times do you usually exercise for at least 20 minutes that makes you out of breath or sweat?

TABLE 5.66

Level of activity as indicated in the questionnaire and heart rate monitor

Questionnaire	Heart rate monitor		
	≥ 2-3 times/week [Active]	< 2-3 times/week [Inactive]	Total
≥ 2-3 times a week [Active]	16 (80.0)	2 (50.0)	18 (75.0)
< 2-3 times a week [Inactive]	4 (20.0)	2 (50.0)	6 (25.0)
Total	20 (100)	4 (100)	24 (100)

Fisher exact: 2-tailed P = 0.25 K = 0.25. 95% Confidence intervals (CI) on Kappa = -0.18 to 0.68. Sensitivity of questionnaire = 0.80 (95% CI = 0.65 to 0.95). Specificity of the questionnaire = 0.50 (95% CI = 0 to 1). Prevalence = 0.83 PPV = 0.89

Table 5.66 demonstrates that the majority (80 percent) of adolescents who were estimated as active by the heart rate monitor, were categorized as active by the questionnaire. In addition 50 percent of those who reported to be inactive also have been classified as inactive by the heart rate monitor. However, the Fisher's exact test shows there is not a significant association between the level of physical activity as measured by the questionnaire and the heart rate monitor.

The content of Table 5.66 makes it apparent that the proportion of observed agreement (16 + 2)/24 between the heart rate monitor and questionnaire for measurement of activity level is 0.75. The K (Kappa) test indicates there is a low level of agreement between the activity level measured by the questionnaire

and the heart rate monitor (K = 0.25). With a 95 % confidence interval the value of K is between -0.18 and 0.68.

Considering the values indicated by the heart rate monitor as real values, using the screening test, the sensitivity and specificity of the questionnaire was measured in comparison with these true values. The sensitivity of question 12 (its ability to correctly identify correctly those who are active) was 80%, and specificity of question 12 (its ability to identify those who are not active) was 50%.

TABLE 5.67

Level of activity as indicated in the between questionnaire and diary

Questionnaire	Diary		
	≥2-3 times/week [active]	< 2-3 times/week [inactive]	Total
≥ 2-3 times a week [Active]	37 (94.9)	6 (46.1)	43 (82.7)
< 2-3 times a week [Inactive]	2 (5.1)	7 (53.9)	9 (17.3)
Total	39 (100)	13 (100)	52 (100)

Note ( ) percent Fisher exact: 2-tailed P = 0.00. K = 0.54. 95% Confidence intervals on Kappa = 0.27 to 0.82. Sensitivity of the questionnaire to measure frequency activity per week = 37/39 = 0.95 (95% CI =0.88, 1). Specificity of the questionnaire to measure frequency of activity per week = 7/13 = 0.54 (95% CI = 0.29, 0.75). Prevalence = 0.75 PPV = 0.86

Table 5.67 indicates that that 94.9 percent of adolescents who were active assessed by the activity diary, are also active according to the questionnaire. In addition, the majority of those (53.9 percent) who were estimated as being inactive by the activity diary, are also inactive according to the questionnaire. Accordingly 44 (37 active and 7 inactive) out of 52 subjects have given the same answer in both diary and questionnaire. The Fisher's exact test also shows there is a significant association between the self-report questionnaire and self-recorded activity diary for the measurement of activity level (p = 0.00).

Table 5.67 indicates that the observed agreements between the two instruments is 44 (7 + 37). The assessment of activity through the diary and heart rate monitor agreed for 44 out of 52 students. That is an 84% observed agreement

rate. The assessment value of Kappa is 0.54, with a 95% confidence interval of 0.27 to 0.82. Therefore there is a moderate agreement between the questionnaire and diary concerning the level of activity (Q12 Multi-Instrument study and Q10 Illawarra Youth Health Survey).

Considering the values indicated by the diary as real values, using the screening test, the sensitivity and specificity of the questionnaire was measured in comparison with these true values. The sensitivity of the question 12 (its ability to identify those who are active) was 94% and specificity of question 12 (its ability to correctly identify those who are not active) was 54%.

TABLE 5.68

Level of activity as indicated in the diary and heart rate monitor

Diary	Heart rate monitor		
	≥ 2-3 times/week [Active]	< 2-3 times/week [Inactive]	Total
≥ 2-3 times a week [Active]	16 (80.0)	1 (25.0)	17 (70.8)
< 2-3 times a week [Inactive]	4 (20.0)	3 (75.0)	7 (29.2)
Total	20 (100)	4 (100)	24 (100)

Note: Percent ( ) Fisher exact: 2-tailed P = 0.05 K = 0.42. 95% Confidence intervals on Kappa = 0.01 to 0.82. Sensitivity of the diary to measure frequency of activity per week for a minimum of 20 minutes = 16/20 = 0.80 (95% CI = 0.65, 0.95). Specificity of the diary to measure frequency of activity per week for a minimum of 20 minutes 3/4 = 0.75 (95% CI = 0.34, 1). Prevalence = =0.83 PPV = 0.94

The majority of subjects (80 percent) who are highly active, based on heart rate monitor, have also recorded that they are active in their activity diary (see Table 5.68). It can be seen that 75 percent of those who are found to be inactive by the heart rate monitor are also recorded to be inactive in the diary. The Fisher's exact test show that there is a significant association between the intensity of physical activity, as measured by the diary, and the heart rate monitor.

It is apparent from Table 5.68 that the level of activity of 19 (3 + 16) out of 24 subjects as measured by the diary and heart rate monitor is the same. That is a 79 percent observed agreement rate. The K test is used in order to find how

closely the levels of activity measured by the self-recorded activity diary agree with the levels of activity measured with the heart rate monitor. The value of K indicates that the instruments were able to agree moderately concerning the level of activity of the subjects (K= 0.42). With 95% of the confidence interval the value of K is between 0.01 and 0.82. Therefore, there is a moderate level of agreement between the diary and heart rate monitor.

Evaluation of the validity of the question 12 was also examined using the evaluation of a screening test. The values of active and inactive indicated by the heart rate monitor were considered to be true values. Sensitivity and specificity of the diary is measured in comparison with these true values. The sensitivity of the question 12 (its ability to correctly identify those who are active) was 80%, and specificity of the question 12 (its ability to identify those who are not active) was 75%.

5.3.3 Duration of Activity Per Week as Measured With the Three Instruments (Q13): Outside school hours: how many hours a week do you usually exercise in your free time so much that you get out of breath or sweat?

TABLE 5.69

Duration of activity as indicated in the questionnaire and the diary

	Diary		
Questionnaire	≥ 2-3 hours/week	< 2-3 hours/week	Total
≥ 2-3 hours/week	32 (84.2)	4 (25.6)	36 (69.2)
< 2-3 hours/week	6 (15.8)	10 (71.4)	16 (30.8)
	38 (100)	14 (100)	52 (100)

Note: Percent ( ) Fisher exact: 2-tailed P = 0.001. K = 0.53. 95% Confidence intervals on Kappa = 0.28 to 0.78. Sensitivity of the questionnaire to measure hours of activity per week = 32/38 = 0.84 (95% CI =0.75, 0.93). Specificity of the questionnaire to measure hours of activity per week = 10/14 = 0.71 (95% CI = 0.48, 0.94). Prevalence = 0.73 PPV = 0.89.

Table 5.69 shows that for 71.4 percent of those who reported in the questionnaire that they exercise less than 2 - 3 hours a week, the same result was found in the diary. It was also found that 84.2 percent of subjects who usually exercise 2 - 3 hours or more had the same result in the diary. The $\chi 2$ test indicates a significant association between the duration of activity as measured by the diary and questionnaire ($p = 0.001$). The Fisher's exact test also indicates a significant association between the duration of activity as measured by the diary and questionnaire ($p = 0.001$).

In addition, the assessment of activity by the diary and questionnaire agreed for 42 (10 +32) out of 52 student (Table 5.69). That is an 80.8% agreement rate. The assessment value of K (Kappa) is 0.53. With a 95% confidence interval, this value is between 0.28 to 0.78.

Evaluation of the validity of question 13 was also examined using the evaluation of a screening test. The values of active and inactive as indicated by the diary were considered to be true values. The sensitivity of the question 12 (its ability to correctly identify those who do ≥ 2-3 hours physical activity a week)

was 84%, and specificity of the question 13 (its ability to identify those who do less than 2-3 hours physical activity a week) was 71%.

TABLE 5.70

Duration of activity per week as indicated by the diary and heart rate monitor

	Heart rate monitor		
Diary	≥ 2-3 hours/week	< 2-3 hours/week	Total
≥ 2-3 hours/week	14 (82.4)	1 (14.3)	15 (62.5)
< 2-3 hours/week	3 (17.6)	6 (85.7)	9 (37.5)
Total	17 (100)	7 (100)	24 (100)

Note: Percent ( ) Fisher exact: 2-tailed P = 0.002. K= 0.63. 95% Confidence intervals on Kappa = 0.30 to 0.95. Sensitivity of the diary to measure ≥ 2-3 hours of activity = 14/17 = 0.82 (95% CI = 0.64, 1). Specificity of the diary to measure hours of activity < 2-3 hours per week = 6/7 = 0.86 (95% CI = 0.61, 1). Prevalence = 0.71 PPV = 0.93.

According to Table 5.70 the same result was found with the heart rate monitor for 82.4 percent of those who usually exercise more than 2 - 3 hours a week as reported in the activity diary. In addition the same result was found for the 85.7 percent of those who were estimated to do exercise less than 2 -3 hours a week. The Fisher's exact test indicates a significant association between the duration of activity as measured by the diary and the heart rate monitor.

The assessment of duration of activity per week through the diary and heart rate monitor agreed for 20 (14 + 6) out of 24 students (Table 5.70). That is an 83.3% agreement rate. The assessment value of Kappa is 0.63, with a 95% confidence interval of 0.30 to 0.95. Therefore there is a strong agreement between the duration of activity as measured by the diary and heart rate monitor (Q13).

Evaluation of the validity of question 13 was also examined using the evaluation of a screening test. The values of active and inactive as indicated by the diary were considered to be true values. The sensitivity of the question 13 (its ability to correctly identify those who do ≥ 2-3 hours physical activity a week)

was 82%, and specificity of the question 13 (its ability to correctly identify those who do less than 2-3 hours physical activity a week) was 86%.

TABLE 5.71

Duration of activity in the questionnaire and heart rate monitor

	Heart rate monitor		
Questionnaire	≥ 2-3 hours/week	<2-3 hours/week	Total
≥ 2-3 hours/week	14 (82.3)	2 (28.6)	16 (66.7)
< 2-3 hours/week	3 (17.7)	5 (71.4)	8 (33.3)
Total	17 (100)	7 (100)	24 (100)

Note: Percent ( ) Fisher exact: 2-tailed P = 0.02. K = 0.52.
95% Confidence intervals on Kappa = 0.15 to 0.88 Sensitivity = 0.82 (95% CI = 0.64, 1).
Specificity = 0.71 (95% CI = 0.51, 1). Prevalence = 0.71 PPV = 0.87.

Table 5.71 demonstrates that 82.3 percent of those who usually exercise more than 2 - 3 hours a week, as indicated by the heart rate monitor, had the same result with the questionnaire. In addition, it was found that 71.4 percent of those who were estimated to do exercise less than 2 - 3 hours a week, as indicated by the heart rate monitor, had the same result with the questionnaire. The Fisher's exact test indicates a significant association between the duration of activity as measured with the questionnaire and heart rate monitor ($p = 0.02$).

The assessment of activity with the questionnaire and heart rate monitor agreed for 19 out of 24 students. This is a 79.2% agreement rate. The assessment value of Kappa is 0.52, with a 95% confidence interval of 0.15 to 0.88. There is a moderate agreement between the heart rate monitor and the questionnaire in measuring the duration of activity per week.

Evaluation of the validity of the question 13 was also measured using the evaluation of screening tests. The values of active and inactive as indicated by the heart rate monitor were considered to be true values. Sensitivity and specificity of the questionnaire was measured in comparison to these values. The sensitivity of the question 13 (its ability to correctly identify those who are active) was 14/17 = 82% and the specificity of the question 13 (its ability to identify those who are not active) was 5/7 = 71%.

Overview of the Agreement Between the Three Instruments

The agreement between the three instruments in measuring activity level based on times of moderate to vigorous activity per week (Question 11 and 12, Appendix D) and duration of activity per week (question 13, Appendix D) is summarized in table 5.72.

There is relatively a good agreement between three instruments (questionnaire, diary and heart rate monitor). The prevalence rates, positive predictive values and sensitivities of questions 11-13 (Appendix D) are relatively high as indicated by all three instruments (Tables 5.63- 5.71). The poor agreement between heart rate monitor and questionnaire (Kappa = 0.25) for question 12 is probably because of small sample size.

It can be said that as the specificity is quite uncertain, those who are not active may not have been picked up with great certainty. This is explained by the small number of inactives and reasonably high predictive value. However, the sensitivity is reasonably high. As a consequence, those who are active have been picked up well. Thus, having wide confidence intervals for Kappa can be the result of small numbers of inactives.

TABLE 5.72

Agreement rate between the instruments for measurement of the activity level

Instruments	Screening test			Kappa value (95% CI)
	Sensitivity (95% CI)	Specificity (95% CI)	PPV	
QUESTION 11				
HRM and Questionnaire	90% (0.79, 1.00)	50% (0.01, 0.99)	0.90	0.40 (- 0.08, 0.88)
HRM and Diary	85% (0.71, 1.00)	75% (0.33, 1.00)	0.94	0.50 (0.08, 0.91)
Diary and Questionnaire	92% (0.84, 1.00)	50% (0.22, 0.78)	0.86	0.46 (0.17, 0.76)
QUESTION 12				
HRM and Questionnaire	80% (0.65, 0.95)	50% (0.01, 0.99)	0.89	0.25 (- 0.18, 0.68)
HRM and Diary	80% (0.65, 0.95)	75% (0.34, 1.00)	0.94	0.42 (0.01, 0.82)
Diary and Questionnaire	95% (0.88, 1.00)	54% (0.29, 0.75)	0.86	0.54 (0.27, 0.82)
QUESTION 13				
HRM and Questionnaire	82% (0.64, 1.00)	71% (0.51, 1.00)	0.87	0.52 (0.15, 0.88)
HRM and Diary	82% (0.64, 1.00)	86% (0.60, 1.00)	0.93	0.63 (0.30, 0.95)
Diary and Questionnaire	84% (0.75, 0.93)	71/% (0.48, 0.94)	0.89	0.53 (0.28, 0.78)

Note: ( ) 95% confidence interval on Kappa value. PPV = positive predictive value

5.3.4 Additional data

Table 5.73 details additional data obtained from the ANOVA test. This field of investigation lies outside the parameters of this thesis, but the data is included here for the benefit of any researcher who may find it useful.

TABLE 5.73

Summary of ANOVA

Source	Dependent variable	Df for model/df for Error	ANOVA SS	No	Mean	Mean square	F value	P-value
Fitness	Resting HR	2/21	1.04	24	64	0.52	0.01	0.99
Fitness	Weight (M)	2/39	997.1	42	60.8 Kg	498.5	3.65	0.03
Fitness	Weight (R)	2/170	583.6	173	56.5 Kg	291.7	2.70	0.07
Looking	Weight (R)	5/178	4050.3	184	53 Kg	810.1	3.01	0.01
Body size	Resting HR	2/21	616.2	24	64	308.1	7.2	0.004
Body size	Weight (R)	5/178	4803.7	184	53 Kg	960.7	3.62	0.004
Body size	Weight (M)	2/49	1823.5	52	60.5 Kg	911.7	6.86	0.002
Fatness	Resting HR	3/20	46.6	24	64	15.5	0.21	0.88
Fatness	Weight (M)	3/48	1736.5	52	60.5 Kg	578.8	4.21	0.01
Fatness	Weight (R)	3/48	1157.0	52	57.6 Kg	385.6	2.62	0.06

$P < 0.05$ SS = sum of square R =reported M= measured

Differences between the average weight, as measured by the researcher, for three levels of perception of their fitness (very fit + fit, average, not very fit), were tested using the ANOVA test (Table 5.73). It indicates that the mean weight is significantly different between the levels of perceived fitness ($p < 0.05$).

Differences between the average weight as recorded by respondents for three levels of perception of their fitness (very fit + fit, average, not very fit) were tested using the ANOVA test. It indicates that the mean weight is moderately significantly different between the levels of perceived fitness ($0.05 < p < 0.10$).

Differences between the mean resting heart rates for three levels of perception (very fit + fit, average, not very fit) of fitness were tested using the ANOVA. It indicates that the mean resting heart rate is not significantly different among the levels of perceived fitness.

There were no significant differences between the mean resting heart rates for four levels of fatness as measured by the skinfold test.

This is also the case for the means of weight and the levels of their feeling about the way they look ($p = 0.01$).

Table 5.73 also showed a high significant difference between the means of resting heart rate for different levels of their feeling about their body size ($p = 0.004$). This is also the case for the means of reported weight and measured weight by the researcher for different feelings about their body sizes ($p < 0.01$).

Differences between the mean weights as reported by respondents for three levels of feeling about their looking were tested using the ANOVA test. It indicates that the mean weight is significantly different between the levels of feelings about how they look ($p = 0.01$).

There was a moderate significant difference between weight, reported in the questionnaire for different levels of fatness measured by the skinfold test ($p = 0.06$). A significant difference was found between the means of measured weights and for the different levels of fatness as measured by skinfold test ($p = 0.01$).

5.4 Youth Health Survey

5.4.1 Sample Size

Data received from the Youth Health Survey as conducted by the Illawarra Public Health Unit was for six of the eight selected high schools (75 percent). Two high schools did not agree to participate. The participating students comprised three governmental and three non-governmental high schools, and 939 of 1241 year 8 students (75.2 percent) and 878 of 1140 year 10 students (77.0 percent).

TABLE 5.74

Sample size used from the Youth Health Survey (IYHS)

	Total 8 schools	Participants 6 schools	Response 6 schools
Grade 8	1241	939 (75.2)	843 (89.8)
Grade 10	1140	878 (77.0)	702 (80.0)
Total	2381	1817 (76.3)	1545 (85.3)

Note: Percent ( )

From a total of 1817 (939 + 878) students, from the 6 participating schools, 1545 (85.3 percent) filled in the questionnaire. Response rates for students Year 8 and Year 10 were 89.8 and 80.0 percent respectively (Table 5.74).

From these, 48 subjects (21 year 8 and 27 year 10) who did not answer any of the questions 1 - 4, 10 - 13, 15, 25, and 32 of the IYHS (Appendix I) were excluded in this report. Therefore, information regarding questions addressed here, plus question 16, related to 1497 students (822 grade 8 and 675 grade 10) out of a sample of 1545 subjects of Youth Health Survey was analyzed in this part of the present study (Table 5.74).

5.4.2 Demographic Characteristics

TABLE 5.75

Participants of IYHS by grade and gender

	Gender		
Grade	Male	Female	Total
8	489 (32.7)	333 (22.2)	822 (54.9)
10	406 (27.1)	269 (18.0)	675 (45.1)
Total	895 (59.8)	602 (40.2)	1497 (100)

Note: percent ( ).

Table 5.75 demonstrates that 54.9 percent of respondents are grade 8 and 45 percent are grade 10. This Table also indicates that the majority of participants are male (59.8 percent). Females comprised 40.2 percent of the participants.

TABLE 5.76

Participants of IYHS by age

Age	Frequency	Percent
13	438	29.3
14	374	25.0
15	364	24.3
16	321	21.4
Total	1497	100

Note: Percent ( ).

Table 5.76 indicates that a third of subjects are 13 years old. About a fifth are age 14, and about one fourth are 15 years old and one fifth of them are 16 years old.

TABLE 5.77

Participants of IYHS by language

Language	Frequency	Percent
English	1268	84.7
Other	229	15.3
Total	1497	100

It is apparent from Table 5.77 that the majority (84.7 percent) of adolescents speak English at home, and only 15.3 percent speak another language.

TABLE 5.78

Participants of IYHS by frequency of physical activity and age

Frequency	13	14	15	16	Total
Every day	124 (28.3)	137 (36.6)	91 (25.0)	77 (24.0)	429 (28.6)
4-6 times a week	128 (29.2)	106 (28.3)	78 (21.4)	89 (27.7)	401 (26.8)
2-3 times a week	122 (27.8)	95 (25.4)	114 (31.3)	94 (29.2)	425 (28.4)
Once a week	41 (9.4)	23 (6.1)	50 (13.7)	37 (11.5)	151 (10.1)
Once a month	7 (1.6)	2 (0.5)	12 (3.3)	6 (1.9)	27 (1.8)
Less than once a month	8 (1.8)	6 (1.6)	7 (2.0)	6 (1.9)	27 (1.8)
Never	8 (1.8)	5 (1.3)	12 (3.3)	12 (3.8)	37 (2.5)
TOTAL	438 (100)	374 (100)	364 (100)	321(100)	1497 (100)

Note: Percent ( )
df = 18 $\chi 2$ value = 45.47.

Table 5.78 illustrates that the percentage of adolescents who are undertaking physical activity 2 to 3 times per week or more outside school hours is quite high (more than 80 percent). This level of physical activity is higher among the 14-year age group. However this level of activity is lower in

adolescents of 15 years. There is a significant association between age and the frequency of physical activity per week outside school hours.

TABLE 5.79

Activity level of IYHS participants by age

Activity level	13	14	15	16	Total
High	252 (57.5)	243 (65.0)	169 (46.4)	166 (51.7)	830 (55.4)
Moderate	122 (27.9)	95 (25.4)	114 (31.3)	94 (29.3)	425 (28.4)
Low	64 (14.6)	36 (9.6)	81 (22.3)	61 (19.0)	242 (16.2)
Total	438 (100)	374 (100)	364 (100)	321 (100)	1497 (100)

Note: Percent ( )
df = 6 $\chi 2$ value = 35.51 P = 0.001.

According to Table 5.79, the majority of respondents are categorized as having a high level of activity. About 1 out of 6 adolescents have a low level of activity (16.2 percent). The majority in each age group is categorized as highly active. The corresponding percentages for ages 13, 14, 15 and 16 are 57.5, 65, 46.4 and 51.7 respectively. Adolescents who are 14 years old have a greater level of high activity among them than the other ages. The $\chi 2$ test showed a significant association between age and the level of activity (p= 0.001 df = 6).

TABLE 5.80

Participants of IYHS by frequency of physical activity and grade

Frequency	Grade 8	Grade 10	Total
Every day	267 (32.5)	162 (24.0)	429 (28.6)
4-6 times a week	235 (28.6)	166 (24.6)	401 (26.8)
2-3 times a week	217 (26.4)	208 (30.8)	425 (28.4)
Once a week	66 (8.0)	85 (12.6)	151 (10.1)
Once a month	9 (1.1)	18 (2.7)	27 (1.8)
Less than once a month	14 (1.7)	13 (1.9)	27 (1.8)
Never	14 (1.7)	23 (3.4)	37 (2.5)
TOTAL	822 (100)	657 (100)	1497 (100)

Note: Percent ( )
df = 6 $\chi 2$ value = 31.25 P = 0.001.

Table 5.80 illustrates that 28.6 percent of participants are undertaking daily physical activity outside school hours. Differences in the frequency of participation in physical activity by grade were evident. A large proportion of grade 8 (32.5 percent) undertake daily physical activity whilst a large proportion

(30.8) of grade 10 usually only exercise 2-3 times a week outside school hours. These differences were significant.

TABLE 5.81

Activity level of IYHS participants by grade

Activity level	Grade 8	Grade 10	Total
High	502 (61.1)	328 (48.6)	830 (55.4)
Moderate	217 (26.4)	208 (30.8)	425 (28.4)
Low/inactive	103 (12.5)	139 (20.6)	242 (16.2)
Total	822 (100)	675 (100)	1497 (100)

Note: Percent ( )
df = 2 $\chi 2$ value = 27.86 P = 0.001.

Table 5.81 demonstrates that the majority of grade 8 and grade 10 students are highly active. More year 8 students are highly active than year 10 students. The corresponding proportions are 61.07 and 48.59 percent respectively. This table also indicates that only 12.5% of year 8 students are in the lowest category of physical activity, while the corresponding proportion for year 10 is 20.6 percent. The $\chi 2$ test also indicates a highly significant difference between the level of activity among year 8 and year 10 students (p= 0.001 df = 2).

TABLE 5.82

Participants of IYHS by frequency of physical activity and gender

Frequency	Male	Female	Total
Every day	315 (35.2)	114 (18.9)	429 (28.6)
4-6 times a week	256 (28.6)	145 (24.1)	401 (26.8)
2-3 times a week	196 (21.9)	229 (38.0)	425 (28.4)
Once a week	73 (8.2)	78 (13.0)	151 (10.1)
Once a month	14 (1.5)	13 (2.2)	27 (1.8)
Less than once a month	16 (1.8)	11 (1.8)	27 (1.8)
Never	25 (2.8)	12 (2.0)	37 (2.5)
TOTAL	895 (100)	602 (100)	1497 (100)

Note: Percent ( )
df = 6 $\chi 2$ value = 78.83 P = 0.001.

corroborate Table 5.82 indicates that about one third (28.6 percent) of the adolescents are undertaking daily physical activity. There is an evident difference between males and females for participation in daily physical activity. There is a difference by sex in the frequency of participation in exercise (p = 0.001). This

difference can be seen in daily activity which is more frequent in males than in females, and in 2-3 times a week activity that is more frequent in females than in males.

TABLE 5.83

Activity level of IYHS participants by gender

Activity level	Male		Female		Total	
High	571	(63.8)	259	(43.0)	830	(55.4)
Moderate	196	(21.9)	229	(38.1)	425	(28.4)
Low	128	(14.3)	114	(18.9)	244	(16.2)
Total	895	(100)	602	(100)	1497	(100)

Note: Percent ( )
df = 2 $\chi 2$ value = 65.83 P = 0.001.

Table 5.83 indicates that there are more highly active males (63.8 percent) than females (43.0 percent). There is more moderate and low activity level among females than males. The $\chi 2$ test shows a highly significant difference between gender and level of activity. This difference is greater for the high activity level (p = 0.001)

TABLE 5.84

Participants of IYHS by frequency of physical activity and language

Frequency	English	Other	Total
Every day	363 (28.6)	66 (28.8)	429 (28.6)
4-6 times a week	352 (27.8)	49 (21.4)	401 (26.8)
2-3 times a week	360 (28.4)	65 (28.4)	425 (28.4)
Once a week	124 (9.8)	27 (11.8)	151 (10.1)
Once a month	19 (1.5)	8 (3.5)	27 (1.8)
Less than once a month	26 (2.0)	1 (0.4)	27 (1.8)
Never	24 (1.9)	13 (5.7)	37 (2.5)
TOTAL	1268 (100)	229 (100)	1497 (100)

Note: Percent ( )
df = 6 $\chi 2$ value = 22.03 P = 0.001.

Table 5.84 demonstrates that a significant difference was seen between the frequency of physical activity of English speaking and non-English speaking adolescents (P = 0.001). This difference can be seen practically in those who never participate in physical activity, that is 5.7 percent for non-English speaking and 1.9 percent for English speaking. Differences in the other categories are small.

TABLE 5.85

Activity level of IYHS participants by language

Activity level	English	Other	Total
High	715 (56.4)	115 (50.2)	830 (55.4)
Moderate	360 (28.4)	65 (28.4)	425 (28.4)
Low	193 (15.2)	49 (21.4)	242 (16.2)
Total	1268 (100)	229 (100)	1497 (100)

Note: Percent ( )
df = 2 $\chi 2$ value = 5.90 P = 0.05.

According to Table 5.85 the proportion of those with a non-English background who have a low level of activity is greater than that for those with an English speaking background (21.4% vs 15.2%). This table also demonstrates that there is no difference between English speaking and non-English speaking adolescents for the proportions of the respondents who are moderately active. More than half of both groups are highly active. However, the proportion of high activity levels among those with an English speaking background is higher than that for a non-English speaking background. The $\chi 2$ test showed a significant difference between the level of activity of English speaking adolescents and those with a non-English speaking background ($p = 0.05$).

Evaluation of the Probability of Being Physically Active as Predicted by the Demographic Variables

A Catmod logistic regression model was used to evaluate the probability of being physically active as explained by the demographic variables as independent determinants including age, gender and language spoken. A model with all key main effects was fitted for all these variables. The fitness of the model was evaluated with the non-significant likelihood ratio as tested with the Chi-square (Tables 5.86-5.87).

TABLE 5.86

Maximum-likelihood analysis-of-variance for demographic variables

Source	Df	Chi-square	P-value
Intercept	1	258.04	0.00
Age	3	23.08	0.00
Gender	1	6.17	0.01
Language	1	6.36	0.01
Likelihood ratio	10	9.20	0.51

TABLE 5.87

Analysis of maximum-likelihood estimates for demographic variables

Effect	Parameter	Estimate	Std. error	Chi-square	P-value	OR	CI 95%
Intercept	1	1.49	0.09	258.04	0.00		
Age	2 (age 13)	0.10	0.12	0.80	0.37	1.11	0.89 to 1.40
	3 (age 14)	0.55	0.14	14.58	0.00	1.73	1.30 to 2.30
	4 (age 15)	-0.41	0.11	12.81	0.00	0.66	0.52 to 0.82
Sex	5 (male)	0.18	0.07	6.17	0.01	1.19	1.03 to 1.36
Language	6 (English)	0.23	0.09	6.36	0.01	1.25	1.05 to 1.49

Reference category: age 16, female, non-English.

Analysis-of-variance (Table 5.86) shows that the model fits since the likelihood-ratio goodness-of-fit test is non-significant. It also shows that age, gender and language are significant factors with respect to activity in the presence of the other factors. Looking at Table 5.87 it can be seen that adolescents aged 15 are less likely to be active than other groups.

5.4.3 Environmental Factors

TABLE 5.88

Activity level of IYHS participants by time spent watching television

Activity level	<1/2 hour	1/2 - 1 hour	2-3 hours	4 or more hours	Total
High	40 (61.5)	188 (61.2)	336 (54.7)	266 (52.0)	830 (55.4)
Moderate	15 (23.1)	77 (25.1)	192 (31.3)	141 (27.6)	425 (28.4)
Low	10 (15.4)	42 (13.7)	86 (14.0)	104 (20.4)	242 (16.2)
Total	65 (100)	307 (100)	614 (100)	511 (100)	1497 (100)

Note: Percent ( )
df = 6 $\chi 2$ value = 15.65 P = 0.01.

Table 5.88 indicates that of those who spend less than 1/2 hour or 1/2-1 hour per day watching television, the majority are in the highly active category (61.5 and 61.2 percent). In addition Table 5.88 indicates that one-third (511 out of 1497) of students watched 4 or more hours of television each day. This table

also demonstrates that the proportion of low activity for those who spend 4 hours or more watching TV is higher (20.4 percent) than for others. The $\chi 2$ test also showed a significant negative association between TV viewing and level of activity (df = 6 p = 0.01). A significant association was also found between the hours spent watching TV and level of physical activity if the items are dichotomized into 4 hours or more a week and less than 4 hours (df =2 p = 0.006).

TABLE 5.89

Activity level of IYHS participants by time spent playing video/computer per week

Time per week	High	Moderate	Low	Total
<1 hour	500 (60.3)	257 (60.4)	132 (54.5)	889 (59.4)
1-3 hours	197 (23.7)	108 (25.4)	55 (22.73)	360 (24.0)
4-6 hours	79 (9.5)	30 (7.1)	26 (10.74)	135 (9.0)
≥ 7-9 hours	54 (6.5)	30 (7.1)	29 (11.98)	113 (7.6)
total	830 (100)	425 (100)	242 (100)	1497 (100)

Note: Percent ( ) df = 6 $\chi 2$ value =12.15 P = 0.05.

According to Table 5.89 there is a decline in the percentage of high activity level as the time spent playing video or computer games increases. This table also indicates that 22.7 percent of low actives play video games for four hours or more, compared to 16 percent of high active groups. The $\chi 2$ test indicates a borderline significant association between the level of activity and time spent playing video or computer games (p = 0.05)

5.4.4 Perceptional Factors

TABLE 5.90

Activity level of IYHS participants and their perception of health

Activity level	Very healthy	Quiet healthy	Not very healthy	Total
High	318 (77.7)	482 (51.9)	30 (18.8)	830 (55.4)
Moderate	69 (16.9)	296 (31.9)	60 (37.5)	425 (28.4)
Low	22 (5.4)	150 (16.2)	70 (43.7)	242 (16.2)
Total	409 (100)	928 (100)	160 (100)	1497 (100)

Note: Percent ( )
df = 4 $\chi 2$ value = 210.74 P = 0.001.

Table 5.90 demonstrates that the highest percentage of high level activity belongs to those who perceive themselves as very healthy (77.75). It can also be seen that low level activity is higher among those who perceive themselves as not very healthy (43.75 percent). The $\chi 2$ test shows a strong association between the level of activity and the perception of adolescents of their own health (p = 0.001).

TABLE 5.91

Activity level of IYHS participants and perception of body size

Perception of body size	High	Moderate	Low	Total
Much thin/a bit thin	121 (60.2)	51 (25.4)	29 (14.4)	201 (100)
About the right size	402 (63.9)	149 (23.7)	78 (12.4)	629 (100)
A bit too fat	180 (44.1)	142 (34.8)	86 (21.1)	408 (100)
Much too fat	36 (35.3)	40 (39.2)	26 (25.5)	102 (100)
I don't think about it	91 (58.0)	43 (27.4)	23 (14.6)	157 (100)
Total	830 (55.4)	425 (28.4)	242 (16.2)	1497(100)

Note: Percent ( )
df = 8 $\chi 2$ value = 59.45 P = 0.001.

Table 5.91 indicates that the majority (63.9 percent) of those who perceive their body to be the right size, are highly active. It can also be seen that the proportion of high activity level is higher as the subjects' perception of their body size changes from thin to the about right size (60.2 and 63.9 respectively). This table also indicates a decline in the proportion of the highly active as the body perception changes from right size to too much fat. The corresponding percentages are 63.9, 44.1, and 35.3 respectively. In addition, the proportion of low activity level subjects increases as the respondents' body size perception

changes from right size to too fat or thin. The $\chi 2$ test also showed a high significant association between perception of body size and level of activity (p= 0.001).

TABLE 5.92

Activity level of IYHS participants and feelings about physical education lessons

	High	Moderate	Low	Total
I like them too much	165 (70.2)	51 (21.7)	19 (8.1)	235 (100)
I like them	294 (58.6)	150 (29.9)	58 (11.5)	502 (100)
I neither like nor dislike them	204 (49.5)	128 (31.1)	80 (19.4)	412 (100)
I dislike them/	50 (36.5)	46 (33.6)	41 (29.9)	137 (100)
I do not attend	10 (43.5)	4 (17.4)	9 (39.1)	23 (100)
Total*	723 (55.2)	379 (28.95)	207 (15.8)	1309 (100)

Note: Percent ( )* No responses (188 subjects) were excluded df=8 $\chi 2$=72.60 P=001

According to the Table 5.92, as the students' feelings about Physical Education classes tend to change from positive to negative as they are less likely to be highly active. The $\chi 2$ test indicates a very highly significant association between the students' feeling about physical education classes and their level of activity (p = 0.001).

Evaluation of Probability of Being Physically Active as Explained by Perceptional Factors

A Catmod logistic regression model was used to evaluate the probability of being physically active, given certain independent determinant of perceptional variables such as the subjects' feelings about their own health and body size together with age and gender. A model with all key main effects was fitted. The fitness of the model evaluated the non-significant likelihood ratio as tested with the Chi-square (Tables 5.93-5.94).

TABLE 5.93

Maximum-likelihood analysis-of-variance for perceptional variables by age and gender

Source	Df	Chi-square	P-value
Intercept	1	209.64	0.0000
Age	3	17.10	0.0007
Sex	1	0.01	0.9254
Body	3	0.35	0.9494
Healthy	2	83.17	0.0000
Likelihood Ratio	79	84.82	0.3068

TABLE 5.94

Analysis of maximum-likelihood estimates for perceptional variables by age and gender

Effect	Parameter	Estimate	Std. error	Chi-square	P-value	OR	CI 95%
Intercept	1	1.62	0.11	209.64	0.00		
Age	2 (aged 13)	0.08	0.12	0.46	0.49	1.08	0.85 to 1.39
	3 (aged 14)	0.49	0.14	10.76	0.00	1.62	1.22 to 2.18
	4 (aged 15)	-0.39	0.12	10.36	0.00	0.67	0.86 to 2.18
Sex	5 (male)	-0.01	0.07	0.01	0.92	0.99	0.85 to 1.16
Body	6 (thin)	0.01	0.17	0.00	0.96	1.00	0.71 to 1.40
	7 (average)	0.04	0.13	0.11	0.74	1.04	0.81 to 1.34
	8 (fat)	-0.06	0.13	0.24	0.62	0.93	0.73 to 1.20
Healthy	9 (very healthy)	1.22	0.16	53.63	0.00	3.38	2.45 to 4.69
	10 (quite healthy)	0.07	0.11	0.37	0.54	1.06	0.86 to 1.30

Reference category: age 16, female, very fat, and not very healthy

Analysis-of-variance (Table 5.93) shows that the model fits since the likelihood-ratio goodness-of-fit test is non-significant. From the Table of maximum-likelihood estimates (Table 5.94) it can be seen that those who feel their body average are more likely to be active. It can also be seen that those who feel their body is fat are less likely to be active than other groups but this is not statistically significant. Adolescents who feel they are very healthy are more than three times as active as those who feel they are not very healthy.

5.4.5 Exercise and Walking

TABLE 5.95

Exercise hours of IYHS participants by gender

Hours of exercise per week	Male	Female	Total
None	56 (6.3)	30 (5.0)	86 (5.7)
About half hour	102 (11.4)	92 (15.3)	194 (13.0)
About 1 hour	128 (14.3)	116 (19.3)	244 (16.3)
About 2-3 hours	232 (25.9)	182 (30.2)	414 (27.6)
About 4-6 hours	190 (21.2)	115 (19.1)	305 (20.4)
7 hours or more	187 (20.9)	67 (11.1)	254 (17.0)
Total	895 (100)	602 (100)	1497 (100)

Note: Percent ( )
df = 5 $\chi 2$ value = 34.10 P = 0.001.

Table 5.95 indicates that 37.4 percent (20.4 + 17.0) of adolescents undertake exercise 4-6 hours or more per week. More males are participating in exercise for 4-6 hours or more (42.1 percent) compared to females (30.2 percent). Males are more likely (1.5 times) than females to exercise 4 or more hours a week. There is a significant difference by sex, in the hours of undertaking exercise (p = 0.001).

TABLE 5.96

Activity level of IYHS participants by hours of exercise per week

Hours of exercise	High	Moderate	Low	Total
None	19 (22.1)	5 (5.8)	62 (72.1)	86 (100)
About half hour	63 (32.5)	51 (26.3)	80 (41.2)	194 (100)
About 1 hour	92 (37.7)	94 (38.5)	58 (23.8)	244 (100)
About 2-3 hours	192 (46.4)	192 (46.4)	30 (7.2)	414 (100)
About 4-6 hours	235 (77.0)	63 (20.7)	7 (2.3)	305 (100)
7 hours or more	229 (90.2)	20 (7.9)	5 (1.9)	254 (100)
Total	830 (55.4)	425 (28.4)	242 (16.2)	1497 (100)

Note: Percent ( )
df =10 $\chi 2$ value = 592.64 P = 0.001.

According to the Table 5.96, the more highly active subjects spent more hours exercising. It can be also seen that the probability of low activity increases as the hours spent exercising decrease. The $\chi 2$ test indicates a very high significant association between the hours of exercise and the level of activity (p = 0.001).

TABLE 5.97

Physical activity level of IYHS participants by walking hours per week

Walking	High	Moderate	Low	Total
None	25 (34.7)	18 (25.0)	29 (40.3)	72 (100)
About 1/2 hour	105 (46.7)	69 (30.7)	51 (22.6)	225 (100)
About 1 hour	192 (52.9)	107 (29.5)	65 (17.6)	363 (100)
About 2-3 hours	247 (53.9)	145 (31.7)	66 (14.4)	458 (100)
About 4-6 hours	141 (64.1)	61 (27.7)	18 (8.2)	220 (100)
7 hours or more	120 (75.5)	25 (15.7)	14 (8.8)	159 (100)
Total	830 (55.4)	425 (28.4)	242 (16.2)	1497 (100)

Note: Percent ( )
df = 10 $\chi 2$ value = 84.99 P = 0.001.

Table 5.97 demonstrates that the more time spent walking per week, the more likely the students are to be highly active. This table also indicates that the probability of low activity increases as the time spent walking shortens. The $\chi 2$ test also indicates a highly significant positive association between the level of activity and hours spent for walking per week (p=0.001).

5.5 Comparison of the Characteristics of Participants in IYHS and MIS

There is some similarity within the characteristics of participants in both studies. The similar characteristics include age, grade and language. A third of subjects are 13 years old in both studies. A fairly similar percentage of grade 8 and grade 10 have participated in both studies. A fairly similar percentage of adolescents from English and non-English speaking background have participated in both MIS and IYHS study (Table 5.98).

TABLE 5.98

Characteristics of participants

MIS	IYHS
Age: one third of subjects are 13 years old .	Age: one third of subjects are 13 years old.
Grade: 51.0 percent of respondents are grade 8 and 49.0 percent are grade 10.	Grade: 54.9 percent of respondents are grade 8 and 45 percent are grade 10.
Language: the majority (79.6 percent) of the respondents have English speaking backgrounds.	Language: the majority (84.7 percent) of adolescents speak English at home, and only 15.3 percent speak other languages.
There was a highly significant association between the self-health perception of adolescents and their perception of body size and the level of physical activity.	There was a highly significant association between the self-health perception of adolescents and their body size and the level of physical activity.

CHAPTER SIX

DISCUSSION & CONCLUSION

6.1 Introduction

Physical activity has many health benefits such as positive health effects on blood pressure, psychological health, prevention of cardiovascular disease and diabetes, promotion of lipid metabolism, prevention of cancer, osteoporosis and support of the immune system. These health benefits can be obtained through appropriate physical activity in the adolescence stage of life as these activities are assumed to be carried over into adulthood. According to this assumption adolescents should be targeted for physical activity promotion (Aaron et al., 1993).

Despite advances in the understanding of physical activity in Australia, insufficient data exists about physical activity in adolescents. In order to plan services and facilities and to evaluate programs, a comprehensive knowledge of the determinants of physical activity is needed (Booth et al., 1995). The level and type of usual physical activity of adolescents needs to be clear. Determinants of physical activity such as personal characteristics, social, perceptional and environmental factors need to be understood. The present study has been undertaken to link some gaps in our knowledge of adolescents' physical activity. In this study adolescents refer to students in school grade 8 and 10 who are aged 13-16 years and enrolled in high schools in the Illawarra area. In addition, there is a growing concern about having valid measures of physical activity (Montoye et al., 1996), as it has been found that little attention has been paid to evaluate the validity of the physical activity questionnaire in adolescents. Therefore, the measurement of the physical activity in adolescents needs to be validated.

The purposes of the current study were two-fold. The first was to investigate the level of physical activity of adolescent students in school grade 8 and 10 in the Illawarra area. The second purpose was to evaluate the validity of widely used physical activity questions (question 11 Appendix D and questions 12-13 Appendix D/questions 10-11 Appendix I). The rationale behind this is that studies on the validity of the physical activity questions were advised in the literature (DiPietro et al., 1993; Freedson, 1992; Aaron et al., 1993).

In section 6.2 of this chapter the focus is on the analysis and explanation of the adolescents' level of activity. The study focused on testing hypotheses, relating the physical activity to personal characteristics, perceptional factors, and social and environmental variables. Since it was assumed that there were some similarities between the participants in the multi-instrument Study (MIS) and Illawarra Youth Health Survey (IYHS), discussion related to relationship between the most independent variables and physical activity is focused on the IYHS results. The discussion about relationships between some other variables and physical activity is based on the MIS findings. This is the case when the variables either do not exist in the IYHS questionnaire or the researcher did not have access to them (such as parents' occupation).

In the third part of the chapter (6.3), findings of the evaluation of the validity of the physical activity questions, will be discussed. This covers the association between the instruments (questionnaire and heart rate monitor, diary and heart rate monitor, questionnaire and diary). The relationship between the anthropometric measurements and physical activity will be discussed in section 6.4. It will be followed by the limitations of the study (6.5) and conclusion (6.6).

6.2 Physical Activity in Adolescents

6.2.1 Adolescents' Level of Physical Activity

According to the international guidelines, all adolescents should be physically active most days as part of their normal routine, and they should be encouraged to engage three or more times per week in activities that last 20 minutes or more and that require moderate to vigorous levels of exertion (Pate et al., 1994).

This thesis assessed the level of physical activity of adolescents outside the school hours. Based on guideline I, which calls for participation in physical activity for 30 minutes or more on most days, say five days then two-three hours would meet this guideline. The result showed that 28.6 percent (Table 5.78) of participants undertake daily physical activity outside school hours. The study also indicates that about 65 percent of respondents (Tables 5.95) undertake exercise 2-3 hours or more per week outside school hours. In other words, 65 percent or 2/3 of adolescents have met guideline I.

The current study also showed that 84 percent of adolescents are undertaking physical activity 3 times per week or more for a minimum of 20 minutes each session of moderate to vigorous activity outside school hours. It can be said that in this sample, adolescents are developing desirable patterns of participation in physical activity that might carry over into adulthood. This finding is consistent with the report of King et al. (1996) that between 41 and 84 percent of adolescents in European countries reported that they exercise vigorously (exercise until they are out of breath or they sweat) two or more times a week.

Sallis & Patric, (1994) state that the minimum level of exercise required to maintain or enhance cardio-respiratory fitness is physical activity sufficient to make one sweaty or breathless. This level of activity should be practiced at least 3 times weekly for a minimum of 20 minutes each time. Keeping in mind that the majority (96 percent) of secondary schools in Western Australia were involved with interschool sport (Shilton et al., 1995), it can be assumed that the participants may

participate at least once per week in their usual physical activity inside school hours. Therefore, participation in physical activity at least 2 to 3 three times weekly for a minimum 20 minutes per session outside school hours is referred to as the minimum level of exercise required to maintain cardio-vascular fitness. Having this in mind it can be said that more than four fifths of adolescents are meeting guideline II, which calls for participation in moderate to vigorous activity for 20 minutes 3 or more days per week. Therefore, the level of physical activity among the adolescents of the Illawarra area was quite desirable.

6.2.2 Personal Characteristics and Physical Activity

There was a significant relationship between the **age** and the frequency of physical activity per week outside school hours (P= 0.001). The proportion of daily physical activity is higher among those aged 14 years, and it is lower in adolescents 15 years old (IYHS). This result is consistent with the report of King et al. (1996) from the 1993-94 WHO cross-national study in the European region that indicated that the level of exercise declined by age 15 in most of the countries. The findings of a few investigations reported in literature that the amount of physical activity declines with increasing age in adolescents (Kemper et al., 1986; Kroesbergen & Haanen, 1995; Bauman, 1992 and Pate et al., 1994). Results from the physical activity section of the Bauman, (1992) study in South Western Sydney also indicated a decline in physical activity participation between ages 11 and 15.

A review of large population-based studies by Pate et al. (1994) also showed that adolescents engage in physical activity for a mean of one hour per day and that activity levels decline with the increasing age of adolescents. The reduction is also more evident in females than in males (Aaron et al., 1993; Pate et al., 1994; Sallis et al., 1992).

A significant association was found between the **grade** and the level of activity (p= 0.001). This result was expected as the level of activity had declined by

age 15 and most of the 15 years old students were in Grade 10. Therefore, decline in physical activity by increasing grade is directly related to age. Differences in the frequency of participation in physical activity were evident by grade. Thirty two percent of grade 8 students undertake daily physical activity whilst 30.8 percent of grade 10 students usually exercise 2-3 times a week outside school hours. More year 8 students are highly (≥ 2-3 times a week outside the school hours) active (61.1) than year 10 students (48.6). The study revealed that 12.5% of year 8 students and 20.6 percent of year 10 students are inactive or have a level of low activity.

There was a significant relationship between the level of activity and **gender** ($p = 0.001$), and there is more high level activity among males (63.8 percent) than among females (43 percent). Although direct comparisons are difficult because of different methods used the data is in general agreement with the results of other studies. The results, in accord with previous findings from the Netherlands (Saris, 1982, Verschuur and Kemper, 1985a) and British children (Armstrong et al., 1990), suggest that girls are less physically active than similarly aged boys. This result is also consistent with the report of King et al. (1996) that indicates that between 62 and 92 percent of boys across the age groups and 41 to 84 percent of the girls reported they exercised vigorously 2 to 3 times a week. The study of Pate et al. (1994) indicates that about two thirds of males and one quarter of females participate in moderate to vigorous activity for 20 minutes 3 or more days a week. The decline in the level of physical activity was also more evident in females than in males (Aaron et al., 1993; Pate et al., 1994; Sallis et al., 1992). Another study on the determinants of sporting behaviour among 456 young people aged 12 to 18 years old conducted by Kroesbergen & Haanen (1995) indicates that activity levels decline with increasing age across adolescence, and this decrease is more marked in females than in males. These results are in agreement with previous research, which has consistently shown that males are more active than

females (Armstrong et al., 1990). Results suggest that the development of new strategies will need to continue if the level of participation required for improving for the general health and fitness of the female population is to be reached.

Insufficient data exists to support the health benefits of physical activity in adolescents. However, assuming that the suspected immediate and prolonged health benefits of the physical activity can be confirmed, physical activity in adolescents may prevent and treat obesity and modify the risk factors of chronic disease (Page, 1995). Having this in mind, it is evident from the study that it could be suggested that female adolescents should be targeted for physical activity intervention.

Despite the importance of **ethnicity** in adolescents' physical activity, few surveys have considered these variables; thus the current study would provide more clarification. The result of the present study indicates a significant difference between the level of activity of English speaking adolescents and those with a non-English speaking background ($p = 0.05$). Adolescents who speak English are 3 times more likely to be active compared with those with a non-English speaking background. The proportion of those with a non-English background those and who have a low level of activity is greater than that for an English speaking background (21.4% versus 15.2%). A clear statement can not be found about the relationship of the level and duration of physical activity of adolescents and ethnicity due to insufficient data. However, the finding from a self-reported physical activity survey conducted in Australia on people aged 15 years and over showed that 41 percent of those born overseas do not participate in a significant level of exercise compared to 33 percent of the Australian born population (Australian Bureau of Statistics, 1993). A few studies suggested that physical activity is more strongly related to socioeconomic status than to race/ethnicity (Sallis, 1993; Sallis et al., 1992; Shephard, 1986). It can be suggested that more research is needed in this

area, as it is possible that those born overseas have a lower socioeconomic class than Australian born.

One of the determinants of physical activity among adolescents is the **parents' occupation** or social class (Sallis, 1993). The present study results showed no statistically significant association between the adolescents' level of activity and parents' occupation. This is not expected, and can be explained by the use of a small data set for this evaluation, namely in the MIS data set. Also, there were 50 cases of 'no response' to this question. As well, since the occupation was a categorical variable, the result may indicate a non-significant association (Schlotzhauer & Littell, 1991).

The probability of being physically active, as predicted by all the demographic variables using the Catmod logistic regression, revealed that age, gender and language combined are statistically significant factors with respect to activity.

6.2.3 Perceptional Factors

The result showed a significant relationship between physical activity and perceptional factors including the respondents' feeling about their own **health** ($p = 0.001$) and their own body, such as their **size** ($p = 0.001$) and **fitness** ($p = 0.001$). The highest percentage of high level activity belongs to those who perceive they are very healthy (77.7), and low level activity is greater among those who perceive they are not very healthy (43.7 percent). The current study also indicated that those who perceive their body is the right size are more highly active than other groups and the proportion of high activity level increases as the subjects' perception of their body size changes from thin to about the right size (60.2, 63.9 respectively). The proportions of high activity decline as the adolescents' body perception changes from the right size to fat and much too fat (63.9, 44.1 and 35.3 respectively).

There was not a significant relationship between the adolescents physical activity and perception about the way they **look** as expected. This can be a consequence of both a small sample size (MIS) and categorical data (Schlotzhauer & Littell, 1991). However, the majority of high level activity is among those who feel they are good looking (55.6 percent). A study on the activity of children (Shephard, 1986) of both sexes, aged 12 to 14 years at two high schools in the Toronto area showed that there are gender difference in their motivation for physical activity with respect to 'looking better' (girls > boys), 'being healthy' and 'having fun' (boys > girls).

There is a very significant relationship between the level of physical activity and the adolescents' own perception of their fitness and the majority of the adolescents who perceive themselves as very fit or fit, are highly active (69.2% and 65.1%).

Lack of statistical significance makes it difficult to explain the findings related to perceptional variables. However, it is believed that self-identified barriers such as perceptions of personal health and body perception can influence adolescent physical activity level. Particularly after the age of 13, children undergo dramatic changes in their bodies that result in the accumulation of fat in girls and of muscle in boys (McDonald, 1991). It is also believed that uncertain psychological barriers such as body perceptions may prevent individuals from participating in regular physical activity and might cause the implementation of physical activity programs in the population to be unsuccessful (WHO Scientific Group, 1994).

The probability of being physically active, as predicted by the perceptional variables using the Catmod logistic regression, revealed that age, gender, feeling about body size and feeling about their own health, when combined, are statistically significant factors with respect to activity. The result also shows that adolescents, who feel they are very healthy, are more than three times more active than those who feel they are quite healthy or not very healthy.

6.2.4 Social Factors

One of the main proposed targets for Australia's Health in the Year 2000 and Beyond is healthy environments including social and physical environments (Nutbeam and Wise, 1993). There is a positive relationship between healthy environment and healthy lifestyle such as active lifestyle. The Kroesbergen & Haanen (1995) report also indicates that social environment is one of the main factors in an active lifestyle. Social factors such as the peer group's and family's physical activity habits also have an effect on adolescent physical activity. Adolescents perform much of their physical activity in a group setting. Parents have the strongest influence on their children's level of physical activity (Sallis et al., 1992; Telama et al., 1994; Shephard 1986; Anderssen & Wold 1992). In the present study social variables include **significant others**, sport competition and taking part in sporting clubs. Adolescents with significant others such as mothers and friends who were physically active, were more likely to be physically active among themselves than those who had no such model or peer. A statistically significant association was found between the level of **mothers' activity** and adolescents' physical activity ($p = 0.03$). This association was seen particularly among males ($p = 0.04$). In contrast, a highly statistically significant association was seen between the level of **friends' activity** and both male and female physical activity ($p = 0.00$ and $P= 0.01$). There was a statistically significant association between the adolescents' level of physical activity and that of their friends ($p = 0.001$). However, there was a positive moderate association between the adolescents' level of physical activity and the level of their **fathers' activity** ($0.05 < p < 0.10$). This association was particularly seen in female adolescents ($p = 0.08$). A significant association was found between the level of activity in male adolescents and their **brothers' activity** ($p = 0.02$). There was no significant

association between adolescents' level of physical activity and their **sisters' activity.**

Although there was no statistical significant association between physical activity and their **teachers' activity** habits, subjects who have a favorite teacher who is active, had a higher percentage of high physical activity level among them (53.8 percent) than others. This can be explained by the result being related to perceived physical activity habits reported by the adolescents. It is also possible that the teachers they like are interested in their student's physical activity and even stimulate them to copy. Therefore, other factors will have to be included in the analysis to produce complete understanding of this issue.

Results showed that significant others, particularly mother and friends, have an important influence on participation in physical activity in adolescents. Since the presented data relies on self-reporting it is interpreted accordingly. Therefore, participants' perception and reporting of significant others' activity levels may not be accurate. Godin, et al. (1986) reported that the level of father's activity as reported by males was not correlated with the fathers' own report but it was correlated with the mothers' own response. There was an association between the female adolescents' reported level of father's activity and fathers' own response but no association was seen with the mothers' own response. This study also presents the findings that among parents for male adolescents, the mother is the main role model. Whilst for females the father is a main role model in physical activity.

According to the 1986 WHO Ottawa Charter for Health Promotion, one of the principles to be followed to achieve health for all by the year 2000 and beyond is that there should be focus on youth as appropriate targets for health promotion (Garrard, 1991). Assuming significant others' physical activity habits are the same as reported by the adolescents, and keeping in mind that the most significant association was between the mothers' activity habit and adolescents activity level,

it seems that the sustained attention to female adolescents' physical activity could greatly improve the likelihood of generating a healthy population, the result of carrying appropriate physical activity into motherhood as a role model.

There was also a significant association between physical activity and other social variables including **membership in a sports clubs** ($p = 0.001$) and **taking part in sports competitions** ($p = 0.03$). Also, a statistically significant association was found between physical activity of adolescents and taking part in a sports competitions. Adolescents who take part in a sports club or competitions (57.8 percent and 53.6 percent) were more likely to be highly active than those who did not take part in these kind of social activities.

6.2.5 Environmental Factors

One of the main goals and targets for Australia's Health in the Year 2000 and Beyond is related to healthy environments (Nutbeam and Wise, 1993). The degree to which adolescents participate in different types of physical activity depends on a number of environmental factors (Telama et al., 1994). Sallis and Simon-Morton (1992) claim that it is important to identify those characteristics of the physical environment that influence the levels of adolescent physical activity in order to help in promoting positive health changes. The current study has assessed the relationship between these environmental variables, including the **barrier to facilities**. However, the findings indicate that, for the majority of participants, these barriers were not important, as no significant association was observed between physical activity and three subclasses (important, fairly important not important) of possible perceived barriers (cost, access to transport, time, access to facilities and separate swimming pool).

As was expected, the result indicates that those who reported the cost of sport facilities as not important, had a high percentage (52.4) of high physical activity among them when compared with other respondents. It was unexpected to

find that respondents who reported that time is very important for physical activity, also had a high percentage (54.4) of high physically active adolescents among them. This can be explained in that those who have participated in the multi-instrument study were all willing students. It seems that despite their perception that time is an important barrier to participating in physical activity, they have other motivations to participate in physical activity. It could also be that time is reported as relevant because, as these are fairly active students, they would like to do more but lack the time. The wide confidence intervals around point estimates due to the small volunteer sample should be considered and therefore, further clarification is needed in this area.

As was expected, respondents who perceived access to sport facilities as important for physical activity, were less likely (44.4) to be highly physically active than other groups however, this was not statistically significant. The result of the current study showed that one sixth of respondents perceived the availability of a separate swimming pool as important and, among those, a high percentage were moderately or highly physically active. This perception may be related to personality but the author believes that this may possibly be due to their ideology and their culture, such as Islam. More research in this area is suggested.

Australia is a multicultural society and some people are Moslem. Nearly 2000 international students, 25 percent of which are Moslem, are studying in the University of Wollongong (Gholamrerzaei, 1995), located in the city of Wollongong in the Illawarra area. Although there was no significant relationship between physical activity and not having separate swimming pools, provision of covered swimming pools with separate swimming hours for males and females would be very important for the minority group. Therefore, it would fit health promotion objectives to provide such a service. Overall, a substantial proportion of the adolescents may not participate in physical activities due to lack of suitable facilities. Although, in recent years Australia has paid more attention to physical

activity and prevention of cardiovascular disease (Owen, et al. 1995), policy makers still need to have a strategy to provide suitable facilities for the physical activity. Further studies are also needed in this area.

There is a decline in the percentage of high level activity as the time spent playing videos or computer games increases. The higher percentage of low actives (22.7 percent) play video/computer games for 4 hours or more a week compared to high active group. There was a borderline significant relationship between the level of activity and time spent playing **videos or computer** games ($p = 0.05$) (IYHS).

The results of this thesis showed that one third of adolescents in both the MIS and IYHS watch TV 4 hours or more a day. This result is consistent with the report by King et al. (1996), that indicates the majority of the European adolescents did not watch TV more than four hours a day. A review of a few studies on TV viewing and physical activity by Pate et al. (1994) showed that the average 10 to 17 year-old spends 3 hours per day watching television

Adolescents who watch TV for 4 or more hours a day are more likely to be inactive than other groups, and more than half of those who watch TV less than 4 hours a day are highly active. There was a significant relationship between hours of watching television and physical activity ($p = 0.01$), and of those who spend less than an hour per day, the majority are in the highly active category (61.5 percent). This result was inconsistent with the study by Shephard (1986), showing no significant relationship between television viewing and physical activity. But, it is consistent with the study by Turker (1986) that showed light television viewers were more physically active than those in either the moderate or heavy television viewing groups. It is not clear whether students who are inactive due to other factors such as obesity are more frequent television viewers, or more frequent television viewing increases the level of inactivity. On the other hand, evidence also showed that there is relationship between adolescents' perceptions of their body size and the level of physical activity. Adolescents who perceived themselves as too fat

reported that they were less active and spent more hours viewing television on school days than other groups (Feltz et al. 1992). More research is needed in this area.

6.2.6 Types of Usual Physical Activity Outside School Hours

From the health promotion perspective, regular physical activity for adolescents should be a priority for health professionals. To improve regular physical activity, individual activities such as walking, running, jogging and jumping rope with moderate-to-vigorous levels should be encouraged, as these activities are more likely to be carried over into adulthood (Stephens et al. 1985; Faucette et al., 1995). Therefore, it can be said that participants take part in those activities which will be lifelong activities. Also, there should be equal emphasis on physical activity program for both males and females (Stoto et al., 1990).

Results of the current study indicate that **walking** is the major usual activity among participants (77%). Overall, the list of the top self-reported usual physical activities outside school hours in descending order are **walking, running/jogging, cycling, swimming, and soccer**. Among males the 14 top activities in order, are walking, cycling, running/jogging, soccer, surfing, basketball, football, swimming, skateboarding, tennis, climbing, baseball, dancing and jumping. Whilst the major activities, in order, among females are walking, running/jogging, swimming, dancing, cycling, soccer/touch football, tennis/netball, jumping, basketball, climbing/hiking, skateboarding/surfing, gymnastics and horseback riding/baseball. The higher prevalence of running and jogging among girls was unexpected as other research does not confirm this for female.

Findings indicate that a third of participants take part in cycling. The result also showed a significant positive relationship between hours of cycling and the level of activity ($p = 0.03$). The result of the present study indicates a strong

significant positive relationship between the level of activity and hours spent walking per week.

6.2.7 Reasons For Participation in Physical Activity.

Perceived reasons for participation in physical activity is one of the most important factors in the participation in physical activity (Wold & Kannas, 1993). Although the reasons people become physically active are complex and dynamic (Caspersen et al., 1985), the current study revealed that among the reasons for participating in sport, '**to make a friend**', '**to look good**' and '**to lose weight**' were significantly associated with the level of physical activity. The majority of highly active participants (60.2 percent) are those who participate in sport because it is perceived as a way for them to find new friends and to look good. Females made up 75% of those reporting they were "too fat" and trying to lose weight. Although the findings may not be comparable with other studies due to different methodology, the results of this thesis were similar from the point of sociability (to make a friend) with a study in Finland which indicates that, one of the main reasons among Finnish pupils of adolescent age (11-19) for participating in physical activity is sociability (Wold & Kannas, 1993).

Social pressure in high schools to lose weight is a fairly recent phenomenon and has been a growing trend over the last two or three decades. To lose weight, as a significant reason for participating in physical activity, can be considered as a protective measure for cardiovascular disease. Nevertheless, care should be taken for those who may be at risk of osteoporosis due to weight loss or at risk of eating disorder (Bacon et al. 1996).

There was no association between physical activity and the desire, to 'have fun', 'win', 'be good at sport', 'improve my health', 'see my friends', 'get in good

shape', 'enjoy the feeling of using my body', 'be a sports star', 'please my parents'. Findings of another study on health behaviour and lifestyle of adolescents aged 11-15 in Finnish pupils showed that 'fun' is a main reason for adolescents' participation in sport. 'Competition' or 'to be a sport star' were not important reasons for participating in sport for older adolescents, and winning decreases in importance as students grow older. Health-related reasons for taking part in sport differ with gender (Wold & Kannas, 1993). This was also the case in the present study.

The present findings imply that health promotion programs aimed at increasing the level of physical activity among children would be more effective if physical activities were designed with socialization and well-being objectives in mind, and with the emphasis on making friends, looking good and losing weight.

6.3 Validity of the Physical Activity Questions

There is not much reliable information about the validity of physical activity questionnaires among adolescents (DiPietro et al., 1992). The current study attempted to evaluate the validity of the questions related to the frequency and the number of hours participating weekly in physical activity outside school hours. To evaluate the validity of the physical activity questions the researcher assumed that the Multi-instrument Study (MIS) sample is representative of the IYHS sample. The rationale behind this was explained in the methodology chapter four, section 4.2.1. The representativity of the MIS sample is also supported by similarities in findings about the characteristics of both MIS and IYHS participants including age, grade, language, feeling about their body size and their health.

This study tested the hypothesis that there is an agreement between three instruments including the questionnaire, the diary and the heart rate monitor for Question 11, 12 and 13 of the Multi-instrument Study (Appendix D). The agreement was tested using the Fisher's exact, the Kappa (K) and screening tests.

The evaluation of the validity of the physical activity questions were examined comparing the results indicated in the questionnaire, the diary and the heart rate monitor using both the Kappa (K) agreement test and the screening test by measuring sensitivity and specificity of the questions. The agreement between intensity and duration of self-reported physical activity in the questionnaire (Questions 11-13 appendix D) with the results from the self-recorded activity diary and the heart rate monitor will be discussed. The result from the screening test, including sensitivity and specificity of the questionnaire and the diary will also be discussed.

6.3.1 Questionnaire and the Heart Rate Monitor

There is no a statistically significant association between the questionnaire and the heart rate monitor for estimating the frequency of activity (Q11) ($p = 0.11$). There is no statistically significant association between the level of physical activity measured by questionnaire (Q12) and the heart rate monitor ($p > 0.25$). A statistically significant association was found between the duration (hours per week) of activity measured by questionnaire (Q13) and the heart rate monitor ($p=0.02$).

The findings revealed that the frequency of physical activity per week indicated by the questionnaire (Q 11) agrees with the heart rate monitor. The level of agreement was $K = 0.40$, but when the participants were asked about both the frequency and the minimum duration of exercise for each session (Q 12) the agreement rates decline ($K= 0.25$), which is a poor agreement (Morton & Dobson, 1989). The level of agreement between the heart rate monitor and questionnaire for measuring the hours of physical activity spent outside school hours (Q 13) was $K = 0.52$.

Considering the values indicated by the heart rate monitor as real values allows use of the screening test. Sensitivity of the question 'that is the ability of the Q 11 to correctly indicate active participants' was moderately high (90%). When

the participants were asked about both the frequency and the minimum duration of exercise (20 minute per week) for each session (Q 12) the sensitivity declines (80%). This decline can also be seen in the sensitivity of Q 13 (82%). This finding may be explained by the rationale that adolescents aged 13 to 16 can recall the frequency of their usual moderate to vigorous activity per week but it would be harder for them to be very precise in remembering the exact duration for each session.

It can be seen that question 12 has less sensitivity than the other questions and it is the only question for which no statistically significant association was found between the level of physical activity measured by questionnaire and the heart rate monitor. This can be partly explained by the fact that the students who have participated in the heart rate monitoring are those who feel they are fit. However, findings indicate the mean resting heart rate is not statistically significantly different among the levels of perceived fitness. This also can be confirmed by the result of the analysis which showed there is no statistically significant difference between the mean resting heart rates for four levels of fatness as measured by the skinfold test ($p > 0.05$). However, a statistically significant difference was found between the mean resting heart rate for different levels of their feeling about their body size ($p = 0.004$). The t-test also indicates that the average resting heart rates for male and female are not statistically significantly different at the 5% statistical significance level. These all support the statement that those who actually participated in the heart rate monitoring have the same level of fitness.

6.3.2 Diary and the Heart Rate Monitor

A statistically significant association was found between level of activity as measured by the diary (Q11) and the heart rate monitor ($p < 0.03$). The association between the intensity of physical activity measured by the diary (Q12) and the heart rate monitor was statistically significant ($p = 0.05$). A statistically significant

association was also found between the duration of activity measured by the diary (Q13) and heart rate monitor (p = 0.00).

The findings revealed that the frequency of physical activity per week indicated by the diary (Q 11) agrees with the heart rate monitor. The level of agreement was K = 0.50. When the participants were asked about both the frequency and the minimum duration of exercise for each session (Q 12) the agreement rates decline (K= 0.42). The level of agreement between the diary and the heart rate monitor for measuring the hours of physical activity spent outside school hours (Q 13) was K = 0.63.

Evaluation of the validity of questions 11-13 was also examined using the screening test. Active and inactive as indicated by the heart rate monitor were considered as true values. Sensitivity of the diary was 85%. A decline was seen in the sensitivity of the diary (80%) when measuring frequency of activity per week for a minimum of 20 minutes. The sensitivity of the diary for question 13 was 82%.

6.3.3 Questionnaire and the Diary

There was a statistically significant association between the diary and questionnaire for questions 11-13 (p = 0.00). The findings indicate that the frequency of physical activity per week indicated by the questionnaire (question 11, Appendix D) agrees with the diary. The level of agreement was K = 0.46. When the participants were asked about both the frequency and the minimum duration of exercise for each session (Q 12) the agreement rate increases (K= 0.54). The level of agreement between the questionnaire and the diary for measuring the hours of physical activity spent outside school hours (Question 13, Appendix D) was K = 0.53.

The sensitivity or the ability of 'the diary to identify correctly those who are active' was 92%, and its specificity or 'its ability to identify those who are inactive

correctly', was 50%. The sensitivity of the question 12 (its ability to correctly identify those who are active) was 95%, and specificity of question 12 (its ability to identify those who are not active) was 54%. The sensitivity of question 13 was 84% and its specificity was 71%.

Overall there were significant associations between the three instruments in measurement of the level of physical activity. These associations suggest that all three instruments can be used to screen adolescents' physical activity. Agreement between the three instruments existed for measuring activity level based on frequencies of moderate to vigorous activity per week (Q 11 and Q12) and duration of activity (Q 13) per week. The validity of the questionnaire being compared to the diary was moderate. It seems question 11 (Appendix D) has greater validity than question 12 in which the duration of moderate to vigorous activity is also included. therefore, question 11 is preferred to be used in adolescents aged 13-16. There is not much reliable information about the validity of the physical activity questionnaires used in adolescents. The present study made it possible to evaluate the validity of the physical activity questions among the adolescents by comparing the questionnaire results with the values indicated by the heart rate monitor and the diary.

6.4 Anthropometric Measurements

In this section, the relationship between the fatness estimated with **skinfold thickness** and level of activity, and reported body measurements will be discussed.

The result indicates there is a statistically significant difference between the mean percentages of body fat estimated by the skinfold test for the levels of activity using t-test ($p= 0.001$). In addition, to find out any relationship between physical activity and the level of fatness, estimated by skinfold equation, the Fisher's Exact test was used and a statistical significant relationship was found between fatness

and physical activity in adolescents ($p = 0.001$). The same results were indicated for the relationship between the level of activity as measured by the heart rate monitor and fatness measured with the skinfold thickness triceps and subscapular ($p= 0.01$), and for the difference between the mean %BF (body fat) for active and inactive participants. This finding is not consistent with the finding of Armstrong et al. (1990), that no significant association was found between the amount of physical activity (heart rate) and the skinfold thickness triceps and subscapular region (Armstrong et al., 1990). However, the relationship between the level of activity indicated in the questionnaire and the body fatness was consistent with the Armstrong et al. (1990) findings ($p > 0.05$). Overall due to methodological differences it is difficult to compare the results.

It was not intended to look at these relationships. But, these findings may help to find out any consistency in the data reported by the adolescents. Findings indicate that the mean measured weight is significantly different ($p < 0.05$) between the three levels of perceived fitness (very fit + fit, average, not very fit). The reported mean weight is also moderately significantly different between the levels of perceived fitness ($0.05 < p < 0.10$). This might be explained by those who feel they are not fit are confusing this with their body weight. This can be confirmed by a statistically significant difference for the mean reported weight between the levels of feeling about how they look ($p = 0.01$).

There is a statistically significant difference between the mean reported weight for different feeling about their body sizes ($p < 0.004$). This is also the case for the mean of weight as measured by the researcher for different feeling about their body sizes ($p < 0.002$). These differences are expected as it shows that the information given by the respondents is consistent. It also shows that the measured weight is very similar to the reported weight. Findings also reveal that there is a statistically significant association between the feeling about body size and fatness level as measured by the skinfold test ($p < 0.001$). However, agreement rate

between the fatness measured by the skinfold test and reported fatness measured by BMI was low (K = 0.34). The explanation could be that adolescents aged 13-16 are really concerned about their body weight, and one of the reasons for participation in physical activity could be to lose weight. This reason was confirmed with the present study.

A statistically significant difference was found between the mean of measured weights and for the different levels of fatness as measured by the skinfold test (p = 0.01) which is really expected. The mean reported weights were also moderately significant for the different levels of fatness measured by the skinfold test (p=0.06). Therefore, adolescents aged 13-16 are aware of their weight. It also seems that those who have a higher weight have also a higher level of fatness.

6.5 Limitations of the study

Limitations of the study would make it difficult to make a broad generalisation of findings.

- The fact that the sample of the MIS was drawn from only two Wollongong high schools might be a limitation. Therefore, this may reduce the ability of the study to draw conclusions on all grades 8 and 10 of the general population of the Illawarra area. However, for most variables there appear to be similar distributions for the MIS and IYHS, so this limitation may not be very severe.
- Physical activity is known to vary by season. Although, in the Illawarra area, the weather is very similar in all seasons, some activities such as surfing are still seasonal. This might have an effect on the results of the type of activity measured.
- Heart rate monitoring and self-record activity diary were undertaken during only 9 weeks (4.5 weeks in winter and 4.5 weeks in spring) on both

weekdays and weekends. This might have an effect on measured level of activity as this reflects on limited seasons.

- The data relied on children's self-report, a method with known reliability and validity limitations. However, the validation indicates that the physical activity questions are moderately valid.
- Due to the limited availability of the heart rate monitor, only 25 students were tested with the units. Such a small sample size decreases the statistical power. However, the results are very consistent.
- There were only 52 students who were willing to participate in filling in the one-week activity diary. These students seem to have been mostly active. This may have reduced the ability of the study to draw conclusions on all active and inactive students as far as they are based on the daily data. As most of the questions relating to determinants are indicated using the IYHS data, this limitation is less severe.
- In this study both large data sets (IYHS) and small ones (MIS) are used. Therefore, it is possible that a p-value in the large study indicates statistical significance where the difference was not relevant. A p-value in the small study might indicate non-significant differences where the difference was practically relevant. Therefore, the final conclusion is based on both statistical significance and on the author's understanding based on the literature (Schlotzhauer & Littell, 1991).

6.6 Conclusion

In the author's knowledge no other published study has used monitoring of the heart rate of adolescents for a one-week period as an evaluation of questionnaire validity in Australia. This study contributes to the knowledge of the

validity of the commonly used physical activity questions by providing objective support for the self-report physical activity questionnaire currently available. The findings of the study indicate that there is moderate to high validity of the questionnaire when used in adolescents aged 13-16. The heart rate monitor, which is an objective and direct method for monitoring physical activity in adolescents supports the questions validity and utility as a self-report method. A low to moderately high agreement (Q12: K= 0.25, Q11: K = 0.40 and Q13: K = 0.52) was found between the questionnaire and heart rate monitor. Regarding the questionnaire as a screening test, examined by the heart rate monitor values, the questionnaire's sensitivity (ability to correctly identify those who are active) is moderate to moderately high (Q12: 80%, Q13: 82% and Q11: 90%).

The heart rate monitor also supports the use of a diary as a self-record method to measure the physical activity among the adolescents aged 13-16. There is moderate to moderately high agreement between the diary and heart rate monitor for measurement of the physical activity of adolescents (Q11: K = 0.50, Q12: K = 42, Q13: K = 0.63). The ability of the diary to correctly identify those who are active is moderate, as tested by its sensitivity (Q11: 85%, Q12: 80%, Q13: 82%) with the values indicated by the heart rate monitor. The ability of the diary to correctly identify those who are inactive is also moderate. Whilst the questionnaire's ability to identify inactive or low active adolescents is low (see Table 5.72).

The diary as a direct self-report also supports the questionnaire. A moderate to moderately high agreement (Q12: K= 0.54, Q11: K = 0.46 and Q13: K = 0.53) was found between the questionnaire and the diary. Regarding the questionnaire as a screening test, examined by the diary values, the questionnaire's sensitivity (ability to correctly identify those who are active) is moderate to moderately high (Q13: 84%, Q11: 92% and Q12: 95%).

This study suggests that adolescents aged 13-16 years could provide moderately to moderately high valid self-reports of physical activities (Questions 11 and 13 Appendix D) but more specific questions such as minutes per session may have a low to moderate validity (Question 12 Appendix D).

The present study moderately supports the use of the questions 11-13 as an activity measurement for children 13 to 16 years old. Since the agreements were of moderate strength, the questions should be used with other measures. This is also the case for the use of the diary. Nevertheless, given the ease of use and cheapest cost, in absence of an accurate measure questions 11-13 seem appropriate to be used in adolescents aged 13-16. However, further evaluation of validity of these questions and developing additional measures can be suggested. This study also suggests additional studies measuring physical activity inside and outside school hours are needed to further assess the validity of the physical activity questions.

A conclusion related to the methodology of the study is that, although prospective diary records require more cooperation from the participants and they may be suitable for 1-3 days (Caspersen, 1989). Nevertheless, based on the authors' experience, the participants of the present study carefully reported all activities in the one-week activity diary. It is also believed that wearing a heart rate monitor may influence the level of physical activity being measured during an initial adjustment period (Caspersen, 1989). This might have been the case in this study but, was not controlled for in the analysis.

Other major findings of the present study related to the physical activity in adolescents include the following:

- A substantial percentage of adolescents (65 percent) do meet guideline I, which calls for participation in physical activity for 30 minutes or more on most days.

- The findings support the conclusion that 84 percent of adolescents meet guideline II, which calls for participation in moderate to vigorous activity for 20 minutes 3 or more days per week. It can be said that in this sample, adolescents are developing some patterns of participation in physical activity that might carry over into adulthood. This relates to the minimum level of physical activity required to maintain or enhance cardio-respiratroy fitness. Therefore, the level of physical activity among the adolescents of the Illawarra area was quite desirable.
- Findings support the conclusion that a substantial proportion of adolescents in the study population obtained adequate amounts of activities during their free time during the study period of seven days (heart rate monitor and a diary activity record).
- Among the personal characteristics, age, grade, gender, language spoken and country of birth are significant factors in relation to the level of physical activity in the Illawarra area. Activity level declines with age, as grade 8 students are more active than grade 10 students. Males are more active than females. Although parents' occupation is an important determinant of physical activity, the low response rate for this categorical variable (MIS) might have generated the non-significant result.
- From the perceptional variables, feelings about their 'health', 'fitness', 'body size' together with their 'feeling about physical education class' were significant determinants of the level of physical activity among the adolescents aged 13-16. A moderate significant association was found between their perception of the way they look and the level of physical activity.

- Among the social variables a statistically significant association was found between the level of mothers' and friends' activity and adolescents' physical activity. A weak association was found between perceived physical activity habits of the father and adolescents' level of physical activity. A significant association was found between the level of activity in male adolescents and their brothers' activity. A high statistically significant association was found between physical activity and adolescents' membership in a sports clubs.
- The nature of the present study does not allow the conclusion that significant others' physical activity habits influence those of the adolescent. Nevertheless, the present study may have consequences for health promotion since the results support the importance of both parent's physical activity habits particularly the mothers', and friends' as determinants of the physical activity in adolescents. In addition, it is recommended that promotion efforts among adolescents should be focussed on peers rather than parents (Godin et al., 1986).
- Due to the small sample size, no significant association was found between the three sub-scales (important, fairly important, not important) of the perceived environmental barriers of the physical activity such as cost, access to transport, time, access to facilities and separate swimming pool. It seems reasonable to suggest that the provision of covered swimming pools with separate swimming hours for males and females would fit with health promotion objectives. Future studies are needed in this area.
- There was a significant relationship between the level of activity and time spent playing videos or computer games and watching TV.
- It is believed that physical activity programs should emphasise aerobic and lifetime activities such as walking, cycling, swimming, tennis, and running,

and decrease time spent on football, basketball and baseball - which do not enhance fitness. There should be equal emphasis on physical activity programs for both males and females (Stoto et al., 1990). The result indicates that walking is the major usual activity among participants. The top self-reported usual physical activities outside school hours in descending order include walking, running/jogging, cycling and swimming. Among males the major activities, in order, are walking, cycling, running/jogging and soccer, whilst the four major activities, in order, among females are walking, running/jogging, swimming and dancing. Therefore, it can be said that participants take part in those activities, which will be lifelong activities such as walking, cycling, jogging/running, and swimming.

- The reasons for participating in sport, to make a friend, to look good and to lose weight were significantly associated with the level of physical activity. The present findings imply that health promotion programs aimed at increasing the level of physical activity among children would be more effective if physical activities were designed with socialisation and well-being objectives in mind, with the emphasis on making friends, looking good and losing weight.
- There was a significant association between the level of activity and fatness estimated by skinfold equations.

With increasing mechanisation and reduced working hours, many individuals will be involved in sedentary lifestyles (Hart, 1984). One has to keep in mind that an active life style in the adolescence stage may carry over into adulthood (Hamburg et al., 1993). Therefore, it is reasonable to suggest that regular physical activity must be encouraged for adolescents so that they will develop the habit of regular physical activity. In addition, attention should be focused on exploring the

determinants of physical activity among adolescents so that appropriate health promotion programs can be designed and implemented to enhance adolescents' level of physical activity. It can be also recommended that public programs related to youth physical activity should also consider the minority ethnic groups regarding both programs and facilities.

With all these doubts, however, it is believed that something was learned and that the findings have both practical implications and conceptual interest. To the best of the author's knowledge, this kind of validity evaluation has not been reported for physical activity of adolescents before.

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APPENDIX A:

Human Ethics Committee Approval

UNIVERSITY OF WOLLONGONG
Office of Research

In reply please quote: DC:KM HE96/05
Further Information: Karen McRae (Ext 4457)

26 March 1996

Ms Fatemeh H Oskouie
60/35 Northfields Avenue
Wollongong NSW 2500

Dear Ms Oskouie,

Thank you for your response to the Committee's requirements for your Human Research Ethics application HE96/05 "As Assessment of the Level of Physical Activity in Adolescents Grade 8 and 10 of the Illawarra".

Your response meets with the requirements of the Committee and your application is now formally approved.

Chairperson
Human Research Ethics Committee

cc. Dr I. Kreis, Supervisor

Address: Northfields Avenue, Wollongong 2522 Australia
Telephone: (042) 213 386 (direct); (042) 213 555 (switchboard) Facsimile: (042) 214 338

APPENDIX B:

Illawarra Area Public Health unit Letter

Principals Letters

Open Letter

How Active You Are

Illawarra Public Health Unit

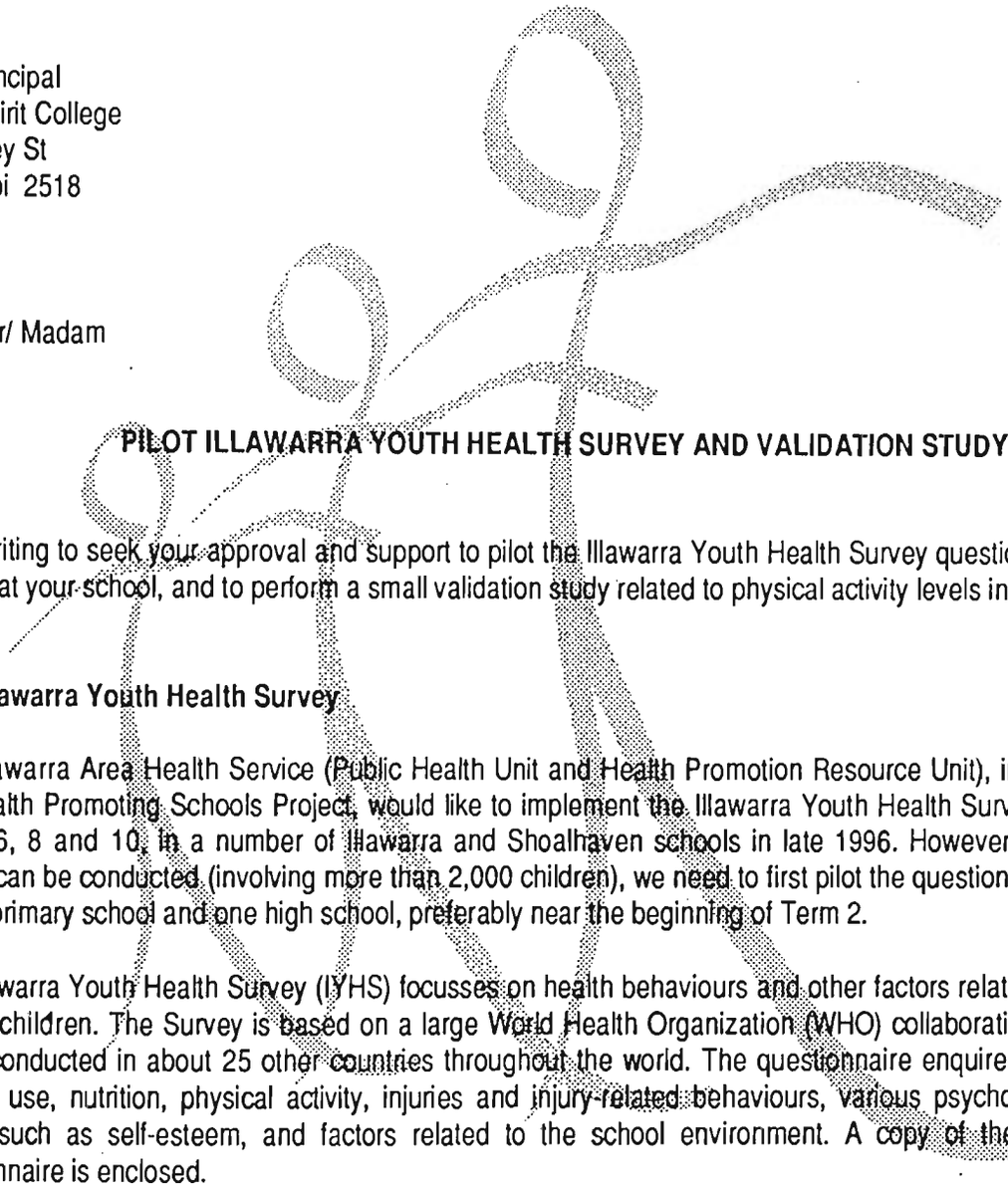
University of Wollongong Illawarra Area Health Service

18 Madoline Street
GWYNNEVILLE NSW 2500
Telephone: (042) 26 4677

(Postal Address)
PO Box 66
KEIRAVILLE NSW 2500
Facsimile: (042) 26 4917

15 April 1996

The Principal
Holy Spirit College
2 Cawley St
Bellambi 2518



Dear Sir/ Madam

PILOT ILLAWARRA YOUTH HEALTH SURVEY AND VALIDATION STUDY

I am writing to seek your approval and support to pilot the Illawarra Youth Health Survey questionnaire in Years 8 and 10 at your school, and to perform a small validation study related to physical activity levels in schoolchildren.

Pilot Illawarra Youth Health Survey

The Illawarra Area Health Service (Public Health Unit and Health Promotion Resource Unit), in conjunction with the Health Promoting Schools Project, would like to implement the Illawarra Youth Health Survey for students in Years 6, 8 and 10, in a number of Illawarra and Shoalhaven schools in late 1996. However, before the main survey can be conducted (involving more than 2,000 children), we need to first pilot the questionnaire and protocol in one primary school and one high school, preferably near the beginning of Term 2.

The Illawarra Youth Health Survey (IYHS) focusses on health behaviours and other factors related to the health of school children. The Survey is based on a large World Health Organization (WHO) collaborative study, which is being conducted in about 25 other countries throughout the world. The questionnaire enquires about: smoking, alcohol use, nutrition, physical activity, injuries and injury-related behaviours, various psychosocial aspects of health such as self-esteem, and factors related to the school environment. A copy of the proposed IYHS questionnaire is enclosed.

The purpose of the Illawarra Youth Health Survey is to enhance the development, implementation and targeting of health promotion strategies, by the health and education systems, and, in particular, intersectoral programs such as the Health Promoting Schools Project.

In the case of the pilot IYHS proposed for your school, we would certainly feedback the results (by age group and sex, not by individual) to the school within a few weeks. We would prepare a brief report which could be included in the school newsletter.

The questionnaire itself should take about 20-30 minutes to complete. The children's responses will be anonymous (no identifying information will be collected from the individual children). We suggest that perhaps the questionnaire could be distributed by the PD/H/PE teachers. I have attached a draft information and instruction sheet for the teachers, as well as the draft questionnaire for the students.

I suggest that we could inform parents about this pilot survey via a school newsletter (draft enclosed), in which we recommend that if they have any queries or objections to their children participating, that they contact the Illawarra Public Health Unit.

Validation study

As mentioned above, in addition to the pilot survey questionnaire, we are also keen to validate questions about physical activity levels. A Doctoral student from the University of Wollongong, Fatemeh Oskouie, would be implementing this study, which would involve about 60-100 children from 2-3 classes.

For these 60-100 children only, a few weeks following the pilot IYHS questionnaire, a letter would be sent home to their parents, asking for consent for their child to complete another questionnaire (focussing on physical activity), and to complete a daily diary for one week about physical activity. In addition, about eight of these children would be asked to wear a wrist monitor and chest band for 12 hours a day for one week to monitor their heart rates, and to have their height, body weight, and skin fold thickness measured. For this validation study, the names of the children would need to be recorded (on the consent forms), and the questionnaire and diary would be coded (so that these results could be correlated). However confidentiality would be assured - only the Doctoral student would be able to view the children's individual responses and results, and only aggregate (non-individually identifiable) data would be reported.

With regard to both of the above, if you are interested and/ or would like further details and discussion, we would be happy to meet with you (and relevant staff) at your convenience. I can be contacted at the Illawarra Public Health Unit on ph: 264677.

I look forward to your response.

Yours sincerely

Dr Victoria Westley-Wise
Director, Illawarra Public Health Unit

Debra Langridge
Health Promotion Resource Uint

Jill Vickery
Health Promoting Schools Project
Health Promotion Resource Unit

Libby Eastment
IYHS Project Manager

Fatemeh Oskouie
Doctoral Student, University of Wollongong

UNIVERSITY OF WOLLONGONG
Department of Public Health & Nutrition

To the principal
Wollongong High School
Lysaght St.
Fairy Meadow NSW 2519

Wollongong, 16 July 1996

Dear Mr Riolo,

Herewith I would like to ask for support for my student Ms Fatemeh Oskouie in her research project concerning the physical activity of adolescents.

As you are undoubtedly aware, physical activity is one of the main determinants of health we know. It is also very clear that the physical activity of adults is a behaviour they learned as children. Therefore, more insight into what high school children do and more importantly, why they may not be as active as we would like them to be, is important.

We realise that schools are often used for research and that you or some of your staff may not be too enthusiastic to participate. We will try to have as little impact as possible and also communicate with the relevant staff as much as possible. For your information, I have included all letters that will be issued including a text to go into the newsletter.

Hoping for a positive response, yours sincerely,

Dr Irene Kreis, MD MSc(epi) PhD FRACPHM
senior lecturer
head, Illawarra Environmental Health Unit

Postal Address: Northfields Avenue, Wollongong, New South Wales, 2522. AUSTRALIA
Telephone (042) 21 3463. Facsimile (042) 21 3486.

UNIVERSITY OF WOLLONGONG
Department of Public Health & Nutrition

The principal
Wollongong High School
Lysaght St.
Fairy Meadow NSW 2519

17 July 1996

Dear Mr Riolo

I am writing to seek your approval to perform some research on the levels of physical activity in years 8 and 10 at your school.

An open letter will be sent home through your newsletter seeking the consent of the students and their parents to complete a questionnaire. After the students complete a questionnaire, a letter will be sent home to them and their parents, asking for consent to complete a diary for one week regarding physical activity. In addition, about 15 of the willing students would be asked to wear a wrist monitor and chest band for 12 hours a day (8 Am to 8 PM) for one week to monitor their heart rates. Their height, body weight, and skinfold thickness would be also measured.

For this study the names of children would need to be recorded (on consent forms and class list), and the questionnaire and diary would be coded (so that these results could be correlated). However, confidentiality would be assured - only the researcher would be able to view the children's individual responses and results, and only aggregate (non-individually identifiable) data would be reported.

In the case of the of the study proposed for your school, I would certainly provide you with feedback of the results (by age group and sex, but not by individual) within a few months. I would also prepare a brief report which could be included in the school newsletter.

With regard to the above, if you are interested and/ or would like further details and discussion, I would be happy to meet with you (and relevant staff) at your convenience. I can be contacted at the Department of Public Health, University of Wollongong on : 214728.

Yours sincerely

Fatemeh H Oskouie

Postal Address: Northfields Avenue, Wollongong, New South Wales, 2522. AUSTRALIA
Telephone (042) 21 3463. Facsimile (042) 21 3486.

UNIVERSITY OF WOLLONGONG
Department of Public Health & Nutrition

The Principal
Holy Spirit College
2 Cawley St
Bellambi 2518

Dear Mr Morris

As you are aware following the pilot survey questionnaire on "Illawarra Youth Health Survey", a study is going to be conducted to validate questions about physical activity and measure the physical activity level in years 8 and 10 at your school.

The parents and students consent form has been given to students on 29th May, 1996 for signing by parent/guardian and return by **3rd of June**. Six students have returned the consent forms. We need at least 80 students to make the study worthwhile.

Would you please assist us by placing the attached reminder in your school newsletter.

Yours Sincerely

Fatemeh Oskouie
University of Wollongong

6 June 1996

Postal Address: Northfields Avenue, Wollongong, New South Wales, 2522. AUSTRALIA
Telephone (042) 21 3463. Facsimile (042) 21 3486.

UNIVERSITY OF WOLLONGONG
Department of Public Health & Nutrition

OPEN LETTER TO PARENTS

On 23/July/1996 students in Years 8 will be asked to participate in a physical activity survey.

This survey will be coordinated by a doctoral student at Wollongong University. It's purpose will be to examine the level of physical activity of adolescents.

As you may be aware, in recent years sedentary living has reduced the level of physical activity in the Australian population. Inactivity increases the risk of heart disease, osteoporosis and many other chronic diseases. Adolescence is an important period for shaping physical activity. Knowledge about adolescents' physical activity could help in the prevention of disease.

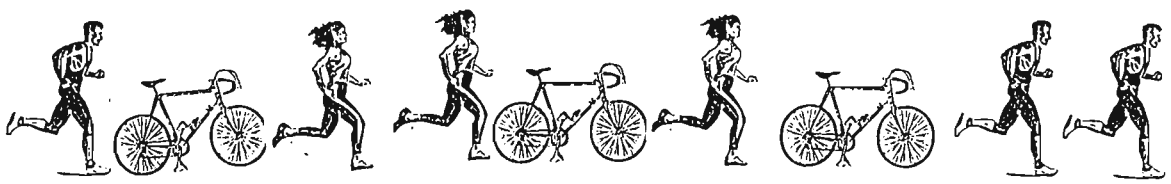
The survey will involve asking willing students from Years 8 to complete a coded questionnaire. This questionnaire will take about 15 minutes to complete in maths class times.

Please note that your child's name, address and response to the questionnaire will be completely anonymous and confidential. The students will not write their names, adresses or any other identifying information on the coded questionnaire form. the completed questionnaire will be sealed in an envelope for forwarding to the researcher. The completed form will be seen only by the researcher.

If you are willing for your child to be involved in this survey please sign in the space below.

Student's name_____Parent's signature_____

If you have any further questions about the conduct of this research please do not hesitate to contact Fatemeh Oskouie on (042) 21 4728 Department of Public Health and Nutrition, University of Wollongong



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UNIVERSITY OF WOLLONGONG
Department of Public Health & Nutrition

HOW ACTIVE ARE YOU?

As you may be aware, in recent years sedentary living has reduced the level of physical activity in the Australia. Inactivity increases the risk of heart disease, osteoporosis and many other chronic diseases. Adolescence is an important period for shaping physical activity in life style behaviour. Knowledge about adolescents' physical activity could help to prevent disease. A study will be conducted using volunteers from this school.

In this study, students from years 8 and 10 have been asked to complete a questionnaire about their usual physical activity and keep a diary which will record her/his activity for 12 hours a day for one week. Some of these students will be randomly selected to wear a watch and chest band which will record their heart rate for the purpose of determining their rate of physical activity. This equipment will be used for 12 hours a day (8 AM to 8 PM) for one week. Measurements of height, body weight and skinfold thickness (which is a gentle pinch) will also be taken.

As the information in this survey is important for future studies into the health of children in the Illawarra area, your co-operation would be much appreciated. Please ask your parents to sign and return their consent forms as soon as possible.

Certificates and prizes will be awarded to those students who cooperate in the success of this study.

If you have any further questions about the conduct of this research please do not hesitate to contact Fatemeh Oskouie on (042) 21 4728 Department of Public Health and Nutrition, University of Wollongong, or the secretary of the Human Research Ethics Committee on (042) 21 4457.

Postal Address: Northfields Avenue, Wollongong, New South Wales, 2522. AUSTRALIA
Telephone (042) 21 3463. Facsimile (042) 21 3486.

APPENDIX C:

Pilot Letter

Parents Consent Form

Student Consent Form

UNIVERSITY OF WOLLONGONG
DEPARTMENT OF PUBLIC HEALTH AND NUTRITION

20th March 1996

Dear student,

Thank you for your participation in the validation of my research questionnaire on the topic of "the level and pattern of physical activity of adolescents in the Illawarra".

In order to verify the validity of the questionnaire, it should be tested on a similar group of Illawarra adolescents. With your valuable assistance I will be able to identify areas of difficulty within the questionnaire. This will help me to construct a final questionnaire which I hope will be easy to read, easy to understand, and not too time consuming.

Please read the questionnaire carefully and feel free to make any comments you wish. You are not expected to answer all the questions. You are free to withhold answers. But please check to see that all questions and instructions are clear. In the case that you experience any problems answering individual questions let me know. It is also important for me to know how long it took you to complete the questionnaire, and which question/s you did not understand.

Please do not hesitate to contact Fatemeh Oskouie (Ms.) on (042) 296752 for any additional information in this regard.

yours sincerely

Fatemeh Oskouie

UNIVERSITY OF WOLLONGONG
Department of Public Health & Nutrition

PARENT/GUARDIAN CONSENT FORM

16 Aug 1996

Dear parent/guardian,

Thank you for your cooperation in giving permission for your child to complete the physical activity questionnaire which was the first stage of my study. As you are aware I am a postgraduate student at Wollongong University carrying out an investigation into the physical activity of adolescents. The aim of this study is to investigate the level and pattern of physical activity of adolescents in the Illawarra. It is also intended to examine the relationships between physical activity and demographic characteristics, social, psychological, and environmental factors.

As you may be aware, in recent years sedentary living has reduced the level of physical activity in the Australian life style. Inactivity increases the risk of heart disease, osteoporosis and many other chronic diseases. Adolescence is an important period for shaping physical activity in life style behaviour. Knowledge about adolescents' physical activity could help to prevent disease

In the second stage of this study, students from year 10 who have completed the questionnaire will be asked to keep a diary which will record her/his activity for 12 hours a day for one week. Some of the willing will be asked to wear a watch and chest band which will record their heart rate for the purpose of determining their rate of physical activity. This equipment will be used for 12 hours a day (8 AM to 8 PM) for one week. Measurements of height, body weight and skinfold thickness (which is a gentle pinch) will also be taken.

As the information in this survey is important for future studies into the health of children in the Illawarra area, your co-operation would be much appreciated. Please sign the attached form and return it to the school.

Please note that your child's name, address, response to the questionnaire and her/his heart rate record and diary will be treated with complete anonymity and confidentiality. Her/his body measurements such as height, weight and skinfold thickness will be treated with complete privacy and confidentiality.

If you have any further questions about the conduct of this research please do not hesitate to contact Fatemeh Oskouie on (042) 21 4728 Department of Public Health and Nutrition, University of Wollongong, or the secretary of the Human Research Ethics Committee on (042) 21 4457

Thank you,

Fatemeh Oskouie

Postal Address: Northfields Avenue, Wollongong, New South Wales, 2522. AUSTRALIA
Telephone (042) 21 3463. Facsimile (042) 21 3486.

PARENT/GUARDIAN CONSENT FORM

For my Child:

[ ] Year 8 [ ] Year 10

Given name..... Date of birth.....

Family name..... Male/Female

Address.....

1. I give permission for my child to complete a diary for the purpose of recording his/her level of physical activity for 12 hours a day for one week	[ ] Yes [ ] No
2. I give permission for my child to wear a wrist monitor and chest band for 12 hours a day for one week for the purpose of monitoring her/his heart rate.	[ ] Yes [ ] No
3. I give permission for my child to participate in the measurements of his/her height and body weight.	[ ] Yes [ ] No
4. I give permission for my child to participate in the skinfold thickness test.	[ ] Yes [ ] No

I understand that:

- my child's name will not be revealed to anyone and any information he/she gives and any recorded information will remain confidential.
- the skinfold thickness test (which involves a gentle pinch) will be carried out in complete privacy if requested.
- I can refuse to let my child participate and can withdraw him/her from the study at any time.
- if I have any further questions, I may contact Fatemeh Oskouie on (042) 21 4728 Department of Public Health and Nutrition University of Wollongong.
- I may contact the secretary of the Human Research Ethics Committee on (042) 21 4457 if I have any questions about the conduct of this research.

Name-..... Date...../...../1996

UNIVERSITY OF WOLLONGONG

DEPARTMENT OF PUBLIC HEALTH AND NUTRITION

STUDENT CONSENT FORM

29 May 1996

Dear student,

I am a postgraduate student at Wollongong University carrying out an investigation into the physical activity of adolescents. The aim of this study is to investigate the level and pattern of physical activity of adolescents in the Illawarra. It is also intended to examine the relationships between physical activity and demographic characteristics, social, psychological, and environmental factors.

As you may be aware, in recent years sedentary living has reduced the level of physical activity in the Australian life style. Inactivity increases the risk of heart disease, osteoporosis and many other chronic diseases. Adolescence is an important period for shaping physical activity in life style behaviour. Knowledge about adolescents' physical activity could help to prevent disease

In this study, students from years 8 and 10 will be asked to complete a questionnaire about their usual physical activity and keep a diary which will record her/his activity for 12 hours a day for one week. Some of these students will be randomly selected to wear a watch and chest band which will record their heart rate for the purpose of determining their rate of physical activity. This equipment will be used for 12 hours a day (8 AM to 8 PM) for one week. Measurements of height, body weight and skinfold thickness (which is a gentle pinch) will also be taken.

As the information in this survey is important for future studies into the health of children in the Illawarra area, your co-operation would be much appreciated. Please sign the attached form and return it to **labelled box** located in student services centre by **3 June 1996**.

Please note that your name, address, response to the questionnaire and her/his heart rate record and diary will be treated with complete anonymity and confidentiality. Body measurements such as height, weight and skinfold thickness will be treated with complete privacy and confidentiality.

If you have any further questions about the conduct of this research please do not hesitate to contact Fatemeh Oskouie on (042) 21 4728 Department of Public Health and Nutrition, University of Wollongong, or the secretary of the Human Research Ethics Committee on (042) 21 4457

Thank you,

Fatemeh Oskouie

STUDENT CONSENT FORM

Given name..... Date of birth.....

Family name..... Male/Female

Address.....

1. I agree to complete a questionnaire prepared by a postgraduate student of Wollongong University as a part of her study.	[ ] Yes [ ] No
2. I agree to complete a diary for the purpose of recording my level of physical activity for 12 hours a day for one week	[ ] Yes [ ] No
3. I agree to wear a wrist monitor and chest band for 12 hours a day for one week for the purpose of monitoring my heart rate.	[ ] Yes [ ] No
4.I agree to participate in the measurement of my height and body weight.	[ ] Yes [ ] No
5. I agree to participate in the skinfold thickness test.	[ ] Yes [ ] No

I understand that:

- my name will not be revealed to anyone, and any information I give together with any recorded information will remain confidential.
- the skinfold thickness test (which involves a gentle pinch) will be carried out in complete privacy if requested.
- I can refuse to participate and can withdraw from the study at any time.
- if I have any further questions, I can contact Fatemeh Oskouie on (042) 21 4728 Department of Public Health and Nutrition University of Wollongong.
- I may contact the secretary of the Human Research Ethics Committee on (042) 21 4457 if I have any questions regarding the conduct of this research.

Name: ..... Date: ...../...../1996

APPENDIX D:

MIS Questionnaire

UNIVERSITY OF WOLLONGONG

DEPARTMENT OF PUBLIC HEALTH AND NUTRITION

Dear student,

Thank you for helping me with my research. By answering these questions you will help me to find out more about physical activity in young people.

Your name will not be revealed to anyone. Your answers will only be looked at by me (the researcher). I promise that no one else (not even your parents or teachers) will see your answers. This is not a test, and you do not have to answer the questions. However, your answers to these questions will benefit others in the Illawarra.

This questionnaire will take about 20 minutes of your time. Please read each question carefully and answer with your own opinion as best as you can. After you have completed the questionnaire, put it in the envelope provided and seal it. You don't need to write your name on the envelope. Then take it to your teacher.

Thank you again,

Fatemeh Oskouie

Please provide the following information by writing or marking the appropriate number on the questionnaire.

1. What is your sex ? (please tick **ONE BOX** like this: ☑)

   Male ☐

   Female ☐

2. What month were you born? _____

3. What year were you born? _____

4. In what country were you born ?

   Australia ☐

   Other (Please specify) _____

5. What language do you speak at home? (please tick **ONE BOX**).

   English ☐

   Other ☐

   English and other ☐

   If you regularly speak a language other than English, please write which language _____

6. What is your father's job? Please write exactly what he does. For example, car mechanic, teacher, dentist, farmer, etc. If you don't know, or if your father is not living with you, there is no need to write anything.

   He is _____

7. What is your mother's job? Please write exactly what she does. For example, teacher, dentist, farmer, etc. If you don't know, or if your mother is not living with you, there is no need to write anything.

   She is _____

8. What suburb or town do you live in? Which postcode does this area have?

   Suburb_____ Postcode_____

9. What year are you in at school? (please tick **ONE BOX**).

   Year 8 ☐ Year 10 ☐

10. Outside school: Are you a member of a sport club? (please tick **ONE BOX** only)

- No ☐
- Yes, I am training in a sport club ☐
- Yes, but I don't participate. ☐

11. Outside school hours: How many times a week do you usually exercise in your free time so much that you get out of breath or sweat? (please tick **ONE BOX** only).

- Every day ☐
- 4-6 times a week ☐
- 2-3 times a week ☐
- Once a week ☐
- Once a month ☐
- Less than once a month ☐
- Never ☐

12. Outside school hours: In the free time that you have in a normal week, how many times do you exercise for at least 20 minutes that make you out of breath or sweat? (please tick **ONE BOX** only).

- Every day ☐
- 4-6 times a week ☐
- 2-3 times a week ☐
- Once a week ☐
- Once a month ☐
- Less than once a month ☐
- Never ☐

13. Outside school hours: How many hours a week do you usually exercise in your free time so much that you get out of breath or sweat ? (please tick **ONE BOX** only)

- None ☐
- About 1/2 hour ☐
- About 1 hour ☐
- About 2-3 hours ☐
- About 4-6 hours ☐
- 7 hours or more ☐

14. Outside school hours: How many hours a week do you usually spend walking for recreation, exercise or to get to and from places? (please tick **ONE BOX** only).

- None ☐
- About 1/2 hour ☐
- About 1 hour ☐
- About 2-3 hours ☐
- About 4-6 hours ☐
- About 7 hours or more ☐

15. Outside school hours: How many hours a week do you usually spend cycling for recreation, exercise or to get to and from places? (please tick **ONE BOX** only).

None	☐	About 2-3 hours	☐
About 1/2 hour	☐	About 4-6 hours	☐
About 1 hour	☐	About 7 hours or more	☐

16. Inside and outside school : Do you take part in sport competitions? (for example, basketball, cricket, hockey, football, soccer etc) (please tick **ONE BOX** only)

Yes	☐
No	☐
I used to but not any longer.	☐

17. Inside and outside school: Do you usually exercise or take part in sport alone or with others? (please tick **ONE BOX** only).

Alone	☐
With others	☐
Some time with others	☐
I do not take part in sports.	☐

18. Below you will find a list of people you know. Do any of them take part in sport or other physical activities in their free times? (Please tick only **ONE BOX** for **EACH LINE**).

	Every week	Less than every week	Not at all	I don't know	I don't have
Father	☐	☐	☐	☐	☐
Mother	☐	☐	☐	☐	☐
Brother	☐	☐	☐	☐	☐
Sister	☐	☐	☐	☐	☐
Best friends	☐	☐	☐	☐	☐
A teacher I like	☐	☐	☐	☐	☐

19. Outside school hours which of these activities do you usually participate in for at least 20 minutes a week.

Walking	☐	Jumping rope	☐
Gymnastics	☐	Running/Jogging	☐
Volleyball	☐	Soccer	☐
Horseback Riding	☐	Skateboarding/Skating	☐
Hiking/Climbing	☐	Swimming	☐
Tennis	☐	Bicycling	☐
Baseball/Softball	☐	Dancing	☐
Basketball	☐	Videogames	☐
Surfing	☐	Watching television	☐
Football	☐	Other (specify) _____	☐
		None	☐

20. Outside school hours why do you participate in these activities? (please tick **ONE BOX** on **EACH LINE**)

	For transportation	To improve my health	For competition	To be with friends	None
Walking	☐	☐	☐	☐	☐
Gymnastics		☐	☐	☐	☐
Volleyball		☐	☐	☐	☐
Horseback Riding	☐	☐	☐	☐	☐
Hiking/Climbing	☐	☐	☐	☐	☐
Tennis		☐	☐	☐	☐
Baseball/Softball		☐	☐	☐	☐
Basketball		☐	☐	☐	☐
Football		☐	☐	☐	☐
Jumping rope		☐	☐	☐	☐
Running/Jogging	☐	☐	☐	☐	☐
Soccer		☐	☐	☐	☐
Skateboarding/Skating	☐	☐	☐	☐	☐
Swimming	☐	☐	☐	☐	☐
Bicycling	☐	☐	☐	☐	☐
Surfing		☐	☐	☐	☐
Dancing		☐	☐	☐	☐
Netball		☐	☐	☐	☐
Other (specify)	☐	☐	☐	☐	☐

21. How many hours a day do you usually watch TV or videos? (please tick **ONE BOX**)

Not at all	☐	2-3 hours	☐
Less than 1/2 hour	☐	4 hours	☐
1/2 hour - 1 hour	☐	More than 4 hours	☐

22. How many hours a week do you usually play video games? (please tick **ONE BOX** only)

Not at all	☐	4-6 hours	☐
Less than 1 hour	☐	7-9 hours	☐
1-3 hours	☐	10 hours	☐

23. Outside school hours when do you usually participate in these activities? (please tick only **ONE BOX** in **EACH LINE**).

	Only weekends	Only weekdays	Both	Never
Walking	☐	☐	☐	☐
Gymnastics	☐	☐	☐	☐
Volleyball	☐	☐	☐	☐
Horseback Riding	☐	☐	☐	☐
Hiking/Climbing	☐	☐	☐	☐
Tennis	☐	☐	☐	☐
Baseball/Softball	☐	☐	☐	☐
Basketball	☐	☐	☐	☐
Football	☐	☐	☐	☐
Jumping rope	☐	☐	☐	☐
Running/Jogging	☐	☐	☐	☐
Soccer	☐	☐	☐	☐
Skateboarding/Skating	☐	☐	☐	☐
Swimming	☐	☐	☐	☐
Bicycling	☐	☐	☐	☐
Surfing	☐	☐	☐	☐
Dancing	☐	☐	☐	☐
Videogames	☐	☐	☐	☐
Watching Television	☐	☐	☐	☐
Netball	☐	☐	☐	☐
Other (specify)	☐	☐	☐	☐

24. Inside school hours: What do you feel about your physical education lessons at school? (Please tick **ONE BOX** only).

I like them very much	☐	I dislike them	☐
I like them	☐	I dislike them very much	☐
I neither like nor dislike them	☐	I do not attend them	☐

25. How healthy do you think you are? (please tick **ONE BOX** only).

Very healthy	☐
Quite healthy	☐
Not very healthy	☐

26. Do you think your body is:

Much too thin	☐	A bit too fat	☐
A bit too thin	☐	Much too fat	☐
About the right size	☐	I don't think about it	☐

27. Do you think you are (please tick **ONE BOX** only)

Very good looking	☐	Not very good looking	☐
Quite good looking	☐	Not at all good looking	☐
About average	☐	I don't think about my looks	☐

28. How fit do you think you are ? (please tick **ONE BOX** only)

Very fit	☐	Average	☐
Fit	☐	Not very fit	☐

29. How much do you weigh? _____ kilograms.

30. How tall are you ? _____ cms.

31. Here is a list of reasons some children give for participating in sport. Please read each one and tick how important this is to you. (please tick **ONE BOX** on **EACH LINE**)

	Very important	Fairly important	Not important
To have fun	☐	☐	☐
To be good at sport	☐	☐	☐
To win	☐	☐	☐
To make new friends	☐	☐	☐
To improve my health	☐	☐	☐
To see my friends	☐	☐	☐
To get in good shape	☐	☐	☐
To look good	☐	☐	☐
To enjoy the feeling of using my body	☐	☐	☐
To be a sport star	☐	☐	☐
To please my parents	☐	☐	☐
To lose weight	☐	☐	☐

32. Here is a list of reasons why some children do **not** participate in some exercises **out side school**. Please read each one and tick how important this is to you. (Please tick **ONE BOX** on **EACH LINE**)

	Very important	Fairly important	Not important
(a) I do not attend sport because it is too expensive.	☐	☐	☐
(b) I do not attend sport because I have no transport.	☐	☐	☐
(c) I do not attend sport because I have no time.	☐	☐	☐
(d) I do not have access to the facilities needed for the exercise I want to participate in. Please write down the exercise _____	☐	☐	☐
(e) I do not go swimming because boys and girls should have separate times when in swimming pool.	☐	☐	☐

(f) OtherPlease Specify_____

APPENDIX E:

Heart Rate Monitor Information

Polar Sport Tester Heart Rate Monitor

Polar Vantage NV Heart Rate Monitor

Sample Heart Rate Curve

Sample Heart Rate Values

UNIVERSITY OF WOLLONGONG
Department of Public Health & Nutrition

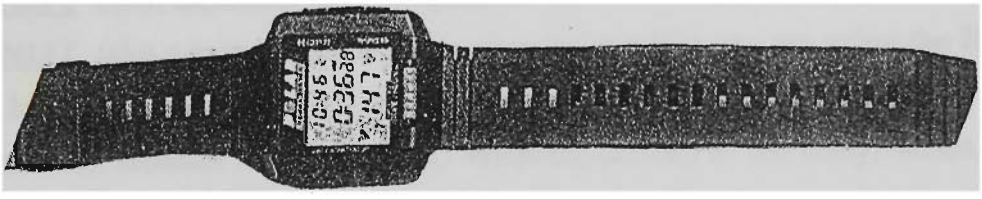
HEART RATE MONITOR INFORMATION

Dear Student,

Thank you for helping me with my research. By using a Heart Rate Monitor you will help me to find out more about levels of physical activity in young people.

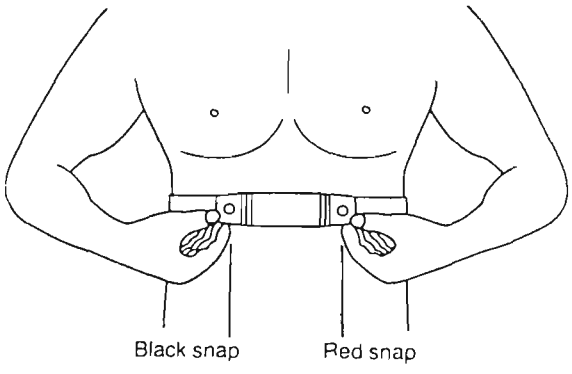
There are three parts to this Heart Rate Monitor as shown in the diagram:

1. A Wrist Monitor (worn like an ordinary watch)

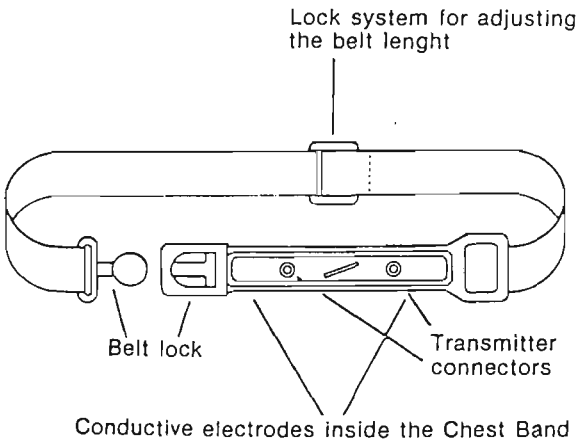


Note: The wrist monitor is covered because continuously looking at your heart rate may interrupt your activities.

2. A Sensor/Transmitter which is located in the middle of a chest band and should be centred on the chest below the pectoral muscle as shown below.



3. A Chest Band



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Please note that

- The watch has been set to measure your heart rate all the time in 12 hour blocks each day (8 AM to 8 PM).
- The watches will be changed each day because there is not enough memory in one watch to record your heart rate for one week.
- The researcher would be grateful if you would remove the watch every night at 8 PM and bring it to school the next morning

It will be appreciated if you

- **DO NOT** touch the watch
- **DO NOT** loosen the band
- **DO NOT** open the cover of the watch,
- **DO NOT** take a bath, shower and surf or swim while you are using the Heart Rate Monitor (8 AM to 8 PM). If you do these activities during this period, take off the wrist monitor and chest band. Write the activity in the diary. When you are dry again please put them back on.

Thank you again,

Fatemeh Oskouie

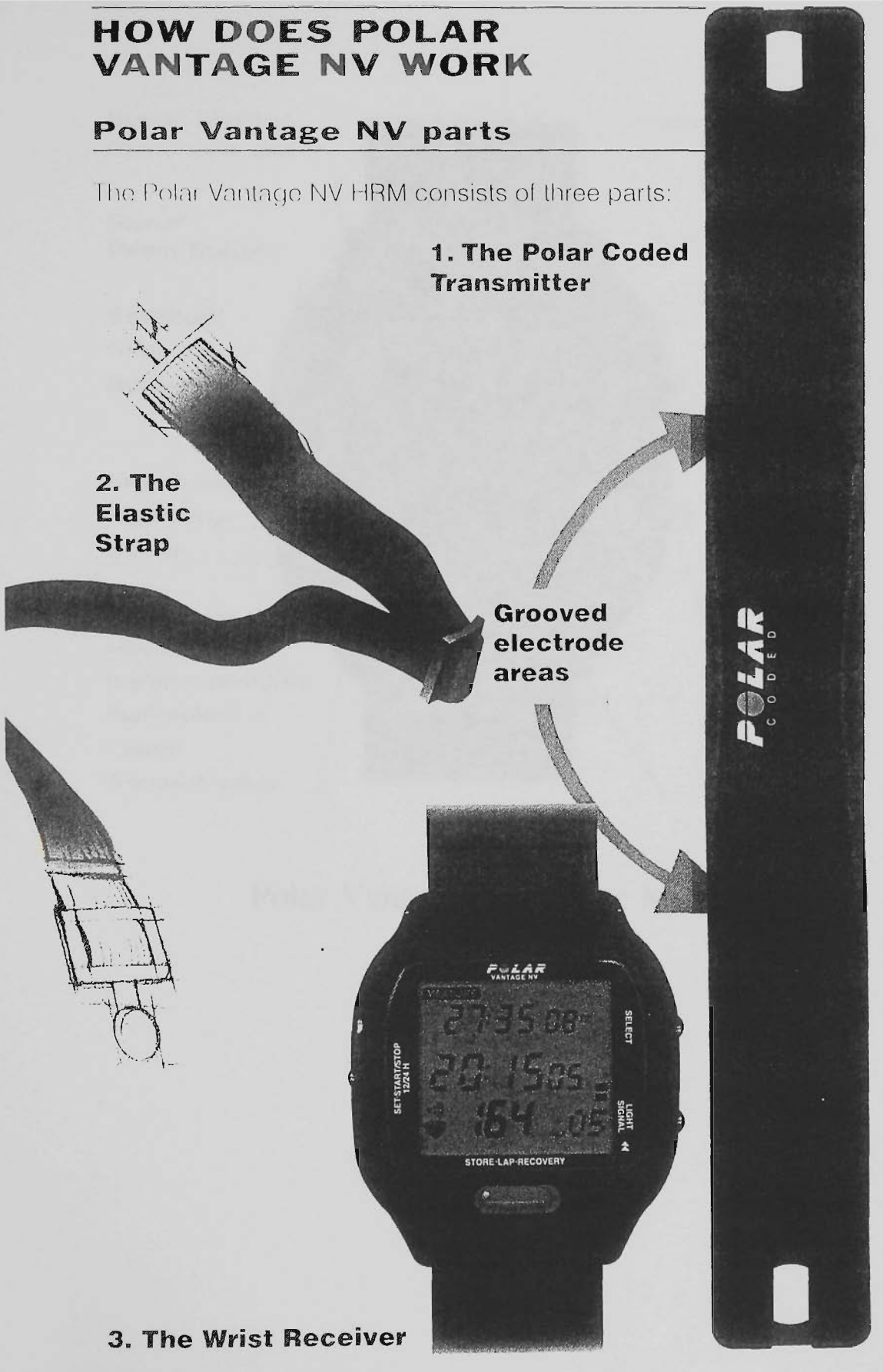
KÄYTTÖ 4000 ENG
11.91 PE

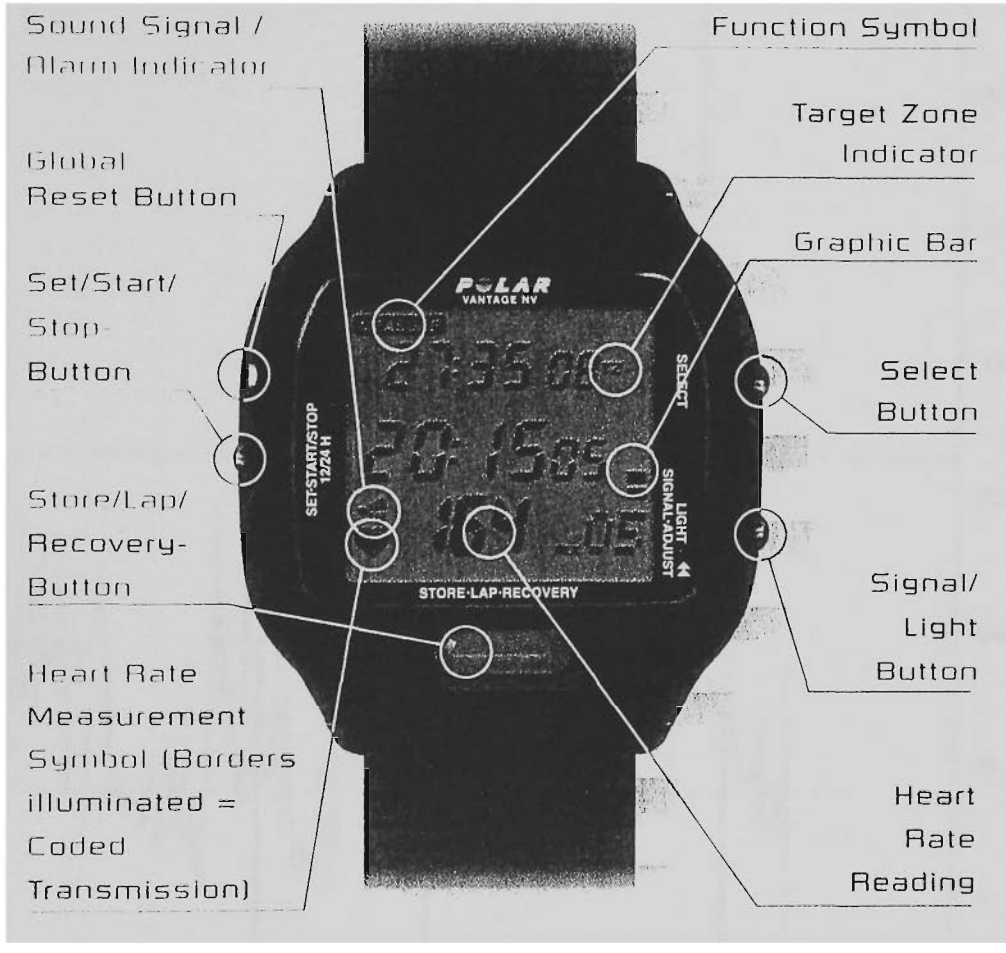
Polar Sport Tester Heart Rate Monitor

HOW DOES POLAR VANTAGE NV WORK

Polar Vantage NV parts

The Polar Vantage NV HRM consists of three parts:

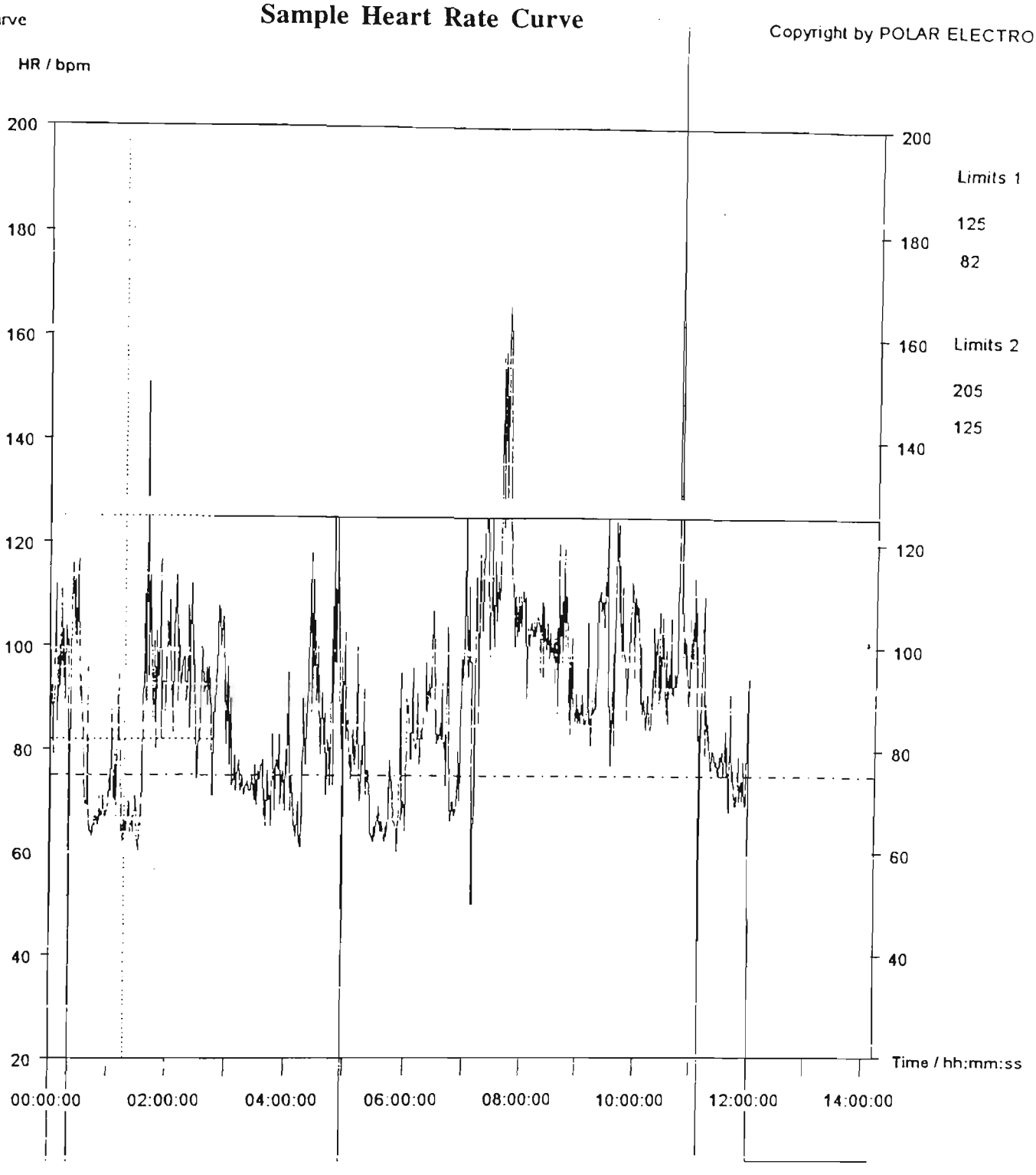




Polar Vantage Heart Rate Monitor

Curve

Sample Heart Rate Curve



HR: 68
Time: 01.17.00.0

Person		**Date**	25/08/1996	**Average**	75 bpm	**Recovery**	0
Exercise	1996/08/25 07:53:18 AM	**Time**	7:53:18 AM	Duration of exercise: 14:10:33.5			
Note							

Sample Heart Rate Values

Listing (1/2)

Person:
Exercise: 1996/08/25 07:53:18 AM
Date: 25/08/1996
Time: 7:53:18 AM

Final Time: 14:10:33.5 HR 0

Time Heart Rate Values

00:00	0	99	93	84	79	99	112	85	86	102	92	100
00:12	111	92	103	86	93	104	100	101	0	75	110	110
00:24	116	102	113	100	104	117	92	90	94	89	84	77
00:36	69	70	69	96	68	64	64	64	63	66	67	65
00:48	67	66	65	71	66	68	67	71	69	66	68	68
01:00	68	73	76	72	88	72	69	80	74	66	86	95
01:12	82	81	64	65	62	68	64	66	64	70	69	63
01:24	64	67	63	65	71	68	62	62	60	69	65	78
01:36	86	110	100	89	151	94	111	114	105	86	91	101
01:48	80	103	94	94	94	117	82	93	93	93	87	91
02:00	105	100	109	100	88	93	83	103	106	114	98	89
02:12	103	92	93	95	97	98	97	89	92	108	106	84
02:24	112	112	96	103	92	87	74	75	81	82	86	100
02:36	99	91	91	92	96	88	95	96	91	88	71	71
02:48	87	87	94	95	108	107	107	100	104	106	103	92
03:00	81	90	96	88	77	90	73	74	74	79	72	75
03:12	76	78	74	72	75	74	71	72	73	73	74	72
03:24	72	72	75	74	70	77	71	69	76	74	74	77
03:36	77	78	67	72	65	74	76	70	71	69	65	83
03:48	74	68	76	78	76	80	83	69	74	76	75	68
04:00	80	75	79	95	76	68	75	73	67	65	65	63
04:12	66	70	64	61	61	67	90	88	78	77	87	87
04:24	104	108	118	87	113	96	105	89	93	100	89	79
04:36	83	89	91	81	87	71	77	82	80	73	83	108
04:48	73	126	97	97	125	108	111	92	80	98	0	90
05:00	103	82	85	86	77	79	74	81	85	79	77	82
05:12	100	86	76	70	75	81	77	92	75	71	76	76
05:24	71	71	64	63	63	62	65	63	66	66	69	64
05:36	66	64	66	63	62	65	63	67	78	74	75	71
05:48	66	66	66	64	60	64	67	95	66	69	70	68
06:00	64	90	87	89	79	78	79	96	83	81	80	83
06:12	91	87	77	84	84	82	87	88	97	88	87	93
06:24	91	90	98	107	106	98	90	81	83	83	82	85
06:36	82	93	82	80	83	73	104	101	84	69	66	70
06:48	68	70	67	68	70	71	80	70	77	99	94	99
07:00	100	128	99	94	95	112	97	97	50	50	50	113
07:12	114	109	85	118	116	111	103	113	122	122	127	125
07:24	119	101	98	110	128	108	100	117	111	105	113	110
07:36	109	113	156	152	123	157	146	129	157	166	160	127
07:48	118	113	112	107	100	110	102	104	110	103	110	104
08:00	107	111	109	101	110	90	104	101	100	104	105	102
08:12	102	105	101	105	106	106	104	95	103	109	94	108
08:24	106	102	99	105	104	97	103	99	100	98	102	93
08:36	101	104	87	120	97	104	109	96	103	119	100	110
08:48	109	101	86	100	83	102	92	88	87	85	91	87
09:00	85	88	85	89	87	91	85	85	85	88	105	85
09:12	88	81	86	90	87	88	93	88	101	109	110	111
09:24	107	109	109	104	113	110	129	101	89	88	77	86
09:36	84	99	81	127	117	124	107	116	104	98	112	100
09:48	99	96	92	86	96	97	106	101	113	111	107	94
10:00	110	108	105	108	105	89	100	89	87	90	88	85
10:12	84	91	90	85	84	85	94	88	104	91	99	100
10:24	102	89	107	90	93	106	98	99	87	100	89	85
10:36	95	92	106	91	93	90	95	94	92	96	126	220
10:48	145	107	116	98	102	96	101	95	94	88	93	106
11:00	96	104	97	114	97	107	94	82	83	0	86	89
11:12	102	110	88	79	89	82	85	81	77	76	80	80
11:24	79	77	77	78	75	75	79	77	79	80	75	76
11:36	84	75	81	71	68	91	82	74	76	71	69	71
11:48	69	73	79	70	74	74	70	78	69	69	70	86
12:00	94	0	0	0	0	0	0	0	0	0	0	0

APPENDIX F:

Activity Diary

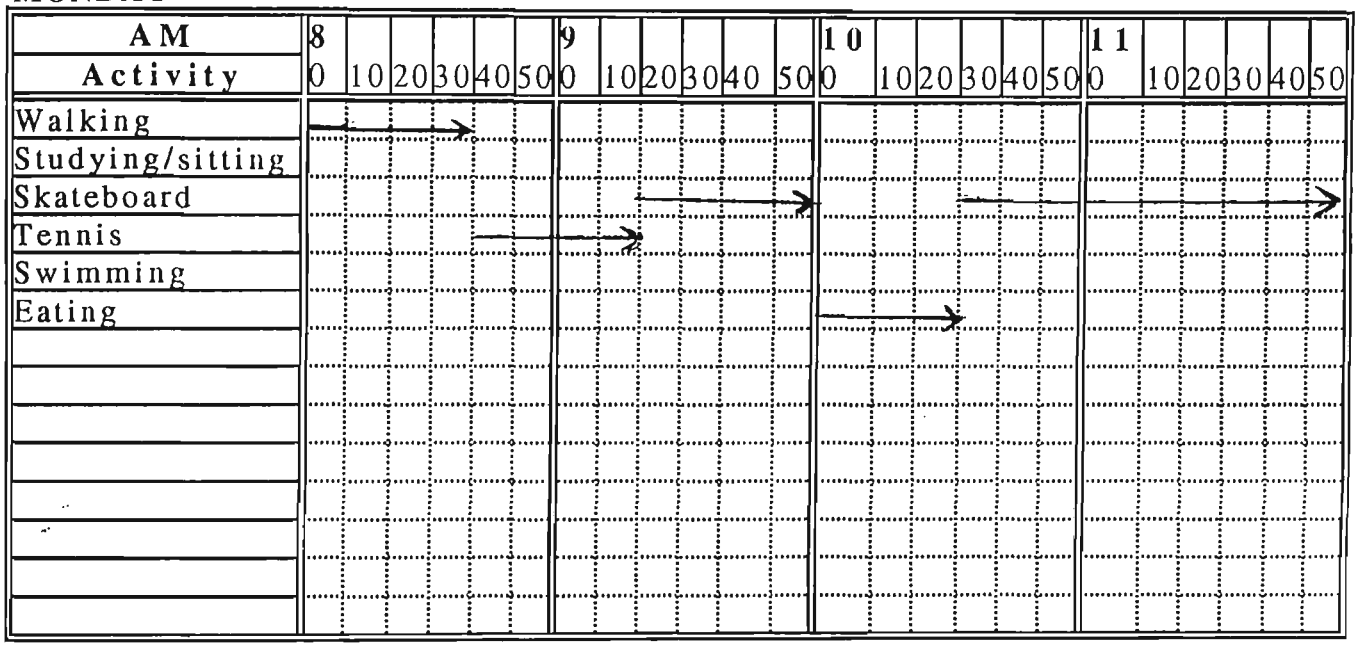
UNIVERSITY OF WOLLONGONG
Department of Public Health & Nutrition

PHYSICAL ACTIVITY DIARY INFORMATION FORM

Dear Student,

Please use the attached form to show your daily activities and exercises. Record your activity and show it's duration during the day by drawing a line in the relevant row. An example of filling the diary has been shown in the Table below:

MONDAY



Some examples of daily activities are as follows:

----- Bicycling
----- Tennis
----- Baseball
----- Basketball
----- Skating
----- Walking
----- Football
----- Watching television
----- Soccer
----- Jumping rope
----- Studying
----- Running
----- Volleyball
----- Jumping rope
----- Horseback Riding
----- Eating
----- Others

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MONDAY

AM	8						9						10						11					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

PM	12						1						2						3					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

PM	4						5						6						7					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

TUESDAY

AM	8						9						10						11					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

PM	12						1						2						3					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

PM	4						5						6						7					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

WEDNESDAY

AM	8						9						10						11					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

PM	12						1						2						3					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

PM	4						5						6						7					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

THURSDAY

AM	8						9						10						11					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

PM	12						1						2						3					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

PM	4						5						6						7					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

FRIDAY

AM	8						9						10						11					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

PM	12						1						2						3					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

PM	4						5						6						7					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

SATURDAY

AM	8						9						10						11					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

PM	12						1						2						3					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

PM	4						5						6						7					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

SUNDAY

AM	8						9						10						11					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

PM	12						1						2						3					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

PM	4						5						6						7					
Activity	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50	0	10	20	30	40	50
Walking																								
Studying/sitting																								
Skateboard																								
Tennis																								
Swimming																								
Eating																								

APPENDIX G:

Skinfold Height and Weight Assessment Data Sheet

Skinfold Sites

Skinfold Caliper

UNIVERSITY OF WOLLONGONG

DEPARTMENT OF PUBLIC HEALTH AND NUTRITION

Skinfolds, Height and Weight Assessment Data Sheet

Date ____/___/_1996_

Trial 1

Skinfold	mm
Biceps	
Triceps	
Subscapular	
Medical calf	

Height _____ cm

Weight _____ kg

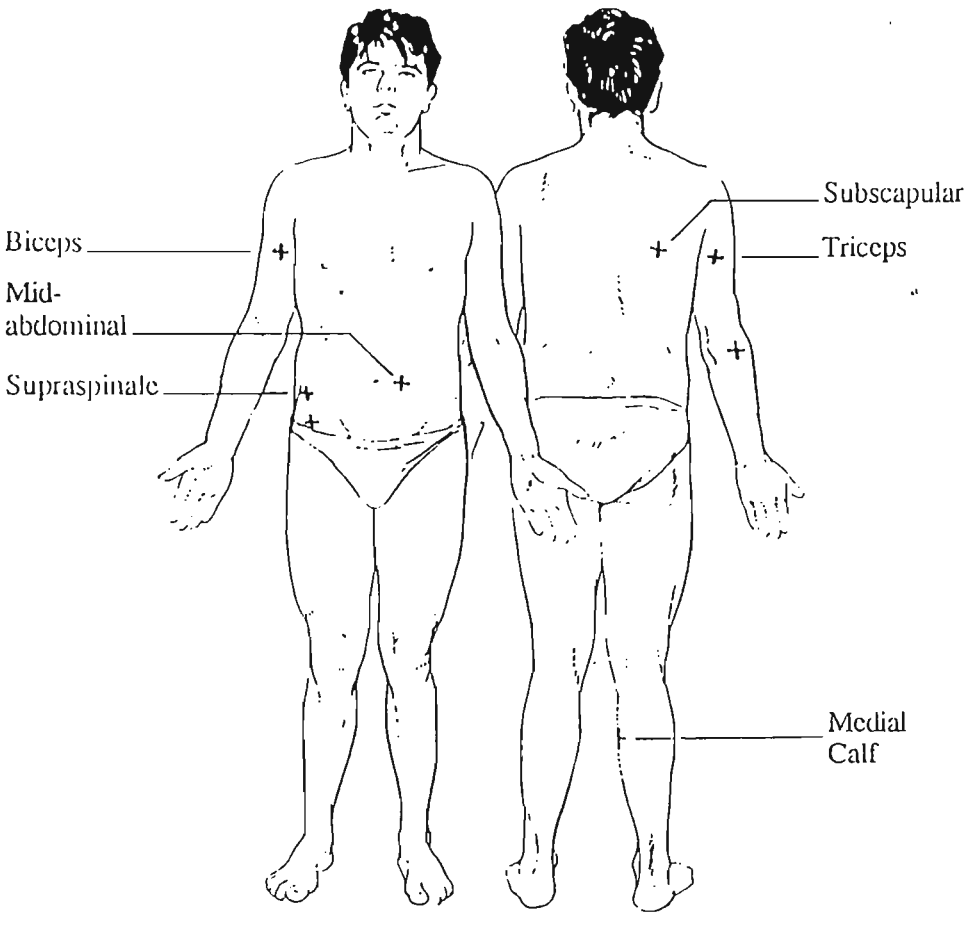
Trial 2

Skinfold	mm
Biceps	
Triceps	
Subscapular	
Medical calf	

Trial 3

Skinfold	mm
Biceps	
Triceps	
Subscapular	
Medical calf	

SKINFOLD SITES

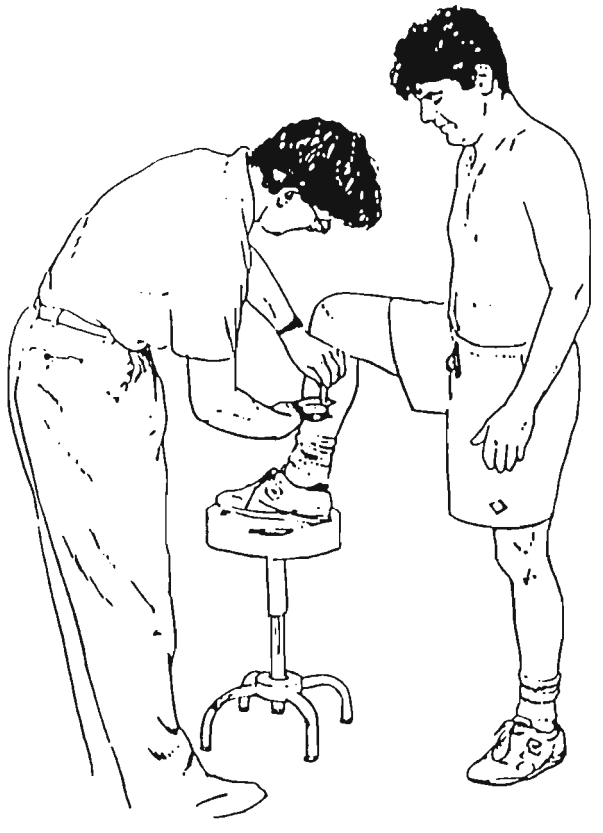


Biceps skinfold site

Triceps skinfold site

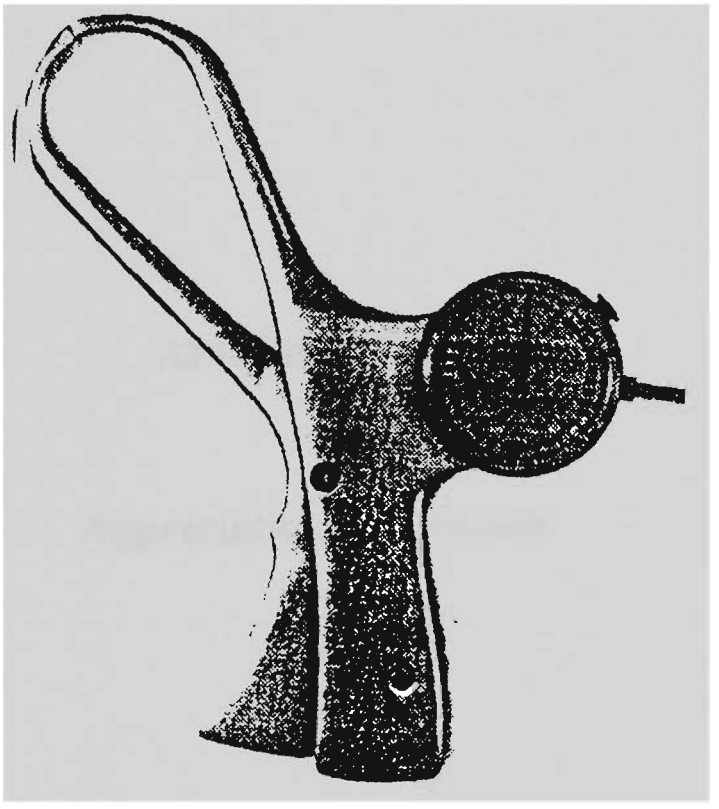
SKINFOLD SITES
(Continued)

Subscapular skinfold site



Medial calf skinfold site

Source: Gore & Edward (1992)



Holtain skinfold caliper

APPENDIX H:

Appreciation Certificate

Certificate of Appreciation

University of Wollongong
This is to certify that

was an enthusiastic participant in Health Research

F Oskouie

16/9/96

APPENDIX I:

Illawarra Youth Health Survey Questionnaire

Illawarra Region

ILLAWARRA YOUTH HEALTH SURVEY

OFFICE USE ONLY			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9

HOW TO COMPLETE THIS FORM

Most questions can be answered by filling in a box or writing your answer on the line provided.

Please read each question carefully.

* Use only a blue or black pen or 2B pencil.

* Do not use red pens.

* Completely fill in the box.

* Fully whiteout or erase any mistakes.

* Do not make stray marks on this form.

EXAMPLE QUESTION

QA. How often do you go to the cinemas?

If your answer is ONCE A WEEK, then you would fill in the box like this:

- ▢ Never
- ▢ Now and then
- ▢ Once a month
- ■ Once a week
- ▢ A few times a week

● ▢ ▢	RIGHT
✗ ✓ ▢	WRONG

YOUTH HEALTH SURVEY

1. Are you male or female? (Please fill one box).
   - ☐ Male
   - ☐ Female

2. In what month were you born? (Please fill one box).
   - ☐ Jan ☐ Apr ☐ Jul ☐ Oct
   - ☐ Feb ☐ May ☐ Aug ☐ Nov
   - ☐ Mar ☐ Jun ☐ Sep ☐ Dec

3. In what year were you born? (Please fill one box).
   - ☐ 1978 ☐ 1983
   - ☐ 1979 ☐ 1984
   - ☐ 1980 ☐ 1985
   - ☐ 1981 ☐ 1986
   - ☐ 1982 ☐ 1987

4. What class are you in at school? (Please fill one box).
   - ☐ Primary - Year 6
   - ☐ Secondary - Year 8
   - ☐ Secondary - Year 10

5. What suburb or town do you live in?

   _____

6. What language do you speak at home? (Please fill one box).
   - ☐ English
   - ☐ Other
   - ☐ English + other

   If you regularly speak a language other than English, please write which language on the line below.

   _____

7. What is your father's job? Please write down exactly what he does, for example, bank teller, postal worker, nurse or unemployed. If you don't know, or if your father is not living with you, write *don't know*.

   _____

8. What is your mother's job? Please write down exactly what she does, for example, business manager, teacher or unemployed. If you don't know, or if your mother is not living with you, write *don't know*.

   _____

9. What type of dwelling do you live in? (Please fill one box).
   - ☐ Separate house
   - ☐ Unit, flat, townhouse, semi-detached or terrace house
   - ☐ Other (eg caravan, mobile home)

10. Outside school hours: How many times a week do you usually exercise in your free time for at least 20 minutes so much that you get out of breath or sweat? (Please fill one box).
    - ☐ Every day
    - ☐ 4 - 6 times a week
    - ☐ 2 - 3 times a week
    - ☐ Once a week
    - ☐ Once a month
    - ☐ Less than once a month
    - ☐ Never

11. Outside school hours: How many hours a week do you usually exercise in your free time so much that you get out of breath or sweat? (Please fill one box).
    - ☐ None
    - ☐ About 1/2 hour
    - ☐ About 1 hour
    - ☐ About 2 - 3 hours
    - ☐ About 4 - 6 hours
    - ☐ 7 hours or more

12. Outside school hours: How many hours a week do you usually spend walking for recreation, exercise or to get to and from places? (Please fill one box).
    - ☐ None
    - ☐ About 1/2 hour
    - ☐ About 1 hour
    - ☐ About 2 - 3 hours
    - ☐ About 4 - 6 hours
    - ☐ 7 hours or more

13. On average, how many hours a day do you usually watch TV (including school days and weekends)? (Please fill one box).
    - ☐ Not at all
    - ☐ Less than half an hour a day
    - ☐ 1/2 - 1 hours
    - ☐ 2 - 3 hours
    - ☐ 4 hours
    - ☐ More than 4 hours

14. On average, how many hours a week do you usually watch videos (including school days and weekends)? (Please fill one box).
    - ☐ Not at all
    - ☐ Less than 1 hour a week
    - ☐ 1 - 3 hours
    - ☐ 4 - 6 hours
    - ☐ 7 - 9 hours
    - ☐ 10 hours or more

Don't forget to completely fill in the box, when giving your answers.

EXAMPLE QUESTION:

Q. Do you like going to the beach? ■ Yes ☐ No

15. On average, how many hours a week do you usually play video or computer games (including school days and weekends)? (Please fill one box).

- ☐ Not at all
- ☐ Less than 1 hour a week
- ☐ 1 - 3 hours
- ☐ 4 - 6 hours
- ☐ 7 - 9 hours
- ☐ 10 hours or more

16. Inside school hours: How do you feel about your physical education lessons at school?

- ☐ I like them very much
- ☐ I like them
- ☐ I neither like or dislike them
- ☐ I dislike them
- ☐ I do not attend them

17. Inside school hours: When you are outside between 11am and 3pm (daylight savings time, or between 10am and 2pm at other times) on a sunny day, how often do you: (Please fill one box for each line).

	Always	Usually	Sometimes	Occasionally	Never
Stay in the shade?.....	☐	☐	☐	☐	☐
Wear a broad-brimmed or legionnaires ..... hat (with flap over neck)?	☐	☐	☐	☐	☐
Wear wrap around-style sun glasses?	☐	☐	☐	☐	☐
Wear sunscreen?	☐	☐	☐	☐	☐
Cover your arms and legs with clothes?	☐	☐	☐	☐	☐

18. Outside school hours: When you are outside between 11am and 3pm (daylight savings time, or between 10am and 2pm at other times) on a sunny day, how often do you: (Please fill one box for each line).

	Always	Usually	Sometimes	Occasionally	Never
Stay in the shade?.....	☐	☐	☐	☐	☐
Wear a broad-brimmed or legionnaires ..... hat (with flap over neck)?	☐	☐	☐	☐	☐
Wear wrap around-style sun glasses?.....	☐	☐	☐	☐	☐
Wear sunscreen?.....	☐	☐	☐	☐	☐
Cover your arms and legs with clothes?	☐	☐	☐	☐	☐

19. How often do you control what food you eat to: (Please fill one box for each line).

	Never	Rarely	Sometimes	Often	Never
Put on weight?	☐	☐	☐	☐	☐
Lose weight?.....	☐	☐	☐	☐	☐
Other - Why?_____	☐	☐	☐	☐	☐

20. In the last week, how often did you eat or drink the following? (Please fill one box for each line).

	Every day	Almost every day	2-3 times per week	Once a week	Rarely or never
Bread	☐	☐	☐	☐	☐
Cereal	☐	☐	☐	☐	☐
Rice	☐	☐	☐	☐	☐
Pasta or noodles	☐	☐	☐	☐	☐
Fruit	☐	☐	☐	☐	☐
Fruit juice	☐	☐	☐	☐	☐
Vegetables	☐	☐	☐	☐	☐
Milk	☐	☐	☐	☐	☐
Cheese	☐	☐	☐	☐	☐
Yoghurt	☐	☐	☐	☐	☐
Ice-cream	☐	☐	☐	☐	☐
Meat eg sausages, chops	☐	☐	☐	☐	☐
Eggs	☐	☐	☐	☐	☐
Chicken	☐	☐	☐	☐	☐
Fish - fresh or tinned	☐	☐	☐	☐	☐
Cakes or biscuits	☐	☐	☐	☐	☐
Lollies or chocolates	☐	☐	☐	☐	☐
Chips or nuts	☐	☐	☐	☐	☐
Soft drink or cordial	☐	☐	☐	☐	☐
Tea of coffee	☐	☐	☐	☐	☐
Water	☐	☐	☐	☐	☐
Low fat dairy products	☐	☐	☐	☐	☐
Wholemeal or wholegrain foods eg low fat milk or yoghurt	☐	☐	☐	☐	☐
Fried food	☐	☐	☐	☐	☐
Vitamin pills	☐	☐	☐	☐	☐
Pain killer pills	☐	☐	☐	☐	☐

21. Last week, how often did you: (Please fill one box for each line).

	Every day	Almost every day	2-3 times per week	Once a week	Rarely or never
Eat breakfast?	☐	☐	☐	☐	☐
Eat lunch?	☐	☐	☐	☐	☐
Eat dinner?	☐	☐	☐	☐	☐
Eat between meal snacks?	☐	☐	☐	☐	☐
Take lunch to school?	☐	☐	☐	☐	☐
Buy lunch from a shop?	☐	☐	☐	☐	☐
Buy lunch from a school canteen?	☐	☐	☐	☐	☐

22. How often do you eat food from the following places? (Please fill one box for each line).

	Every day	Almost every day	2-3 times per week	Once a week	Once a month	Seldom or never
McDonalds	☐	☐	☐	☐	☐	☐
Hungry Jacks	☐	☐	☐	☐	☐	☐
KFC	☐	☐	☐	☐	☐	☐
Big Rooster	☐	☐	☐	☐	☐	☐
Pizza shop	☐	☐	☐	☐	☐	☐
Fish and chips shop	☐	☐	☐	☐	☐	☐
Other take away	☐	☐	☐	☐	☐	☐

23. How often do you use a seatbelt when you sit in a car? (Please fill one box).

- ☐ Always
- ☐ Often
- ☐ Sometimes
- ☐ Seldom/never
- ☐ Usually there is no seat belt where I sit

24. How often do you wear a helmet that's done up when you ride a bicycle? (Please fill one box).

- ☐ Always
- ☐ Often
- ☐ Sometimes
- ☐ Seldom/never (or don't have a helmet)
- ☐ Don't ride a bicycle

25. How healthy do you think you are? (Please fill one box).

- ☐ Very healthy
- ☐ Quite healthy
- ☐ Not very healthy

26. How do you feel about school at the present? (Please fill one box).

- ☐ I like it a lot
- ☐ I like it a bit
- ☐ I don't like it very much
- ☐ I don't like it at all

27. Please read each statement about your school carefully. Fill one box for each statement.

	Strongly Agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
In our school the students take part in making rules.	☐	☐	☐	☐	☐
The students are treated too severely/strictly in this school.	☐	☐	☐	☐	☐
The rules in this school are fair.	☐	☐	☐	☐	☐
Our school is a nice place to be.	☐	☐	☐	☐	☐
I feel I belong at this school.	☐	☐	☐	☐	☐
Our school is clean.	☐	☐	☐	☐	☐

28. Please fill one box for statements about the students in your class.

	Always	Often	Sometimes	Rarely	Never
The students in my class(es) enjoy being together.	☐	☐	☐	☐	☐
Most of the students in my class(es) are kind and helpful.	☐	☐	☐	☐	☐
Other students accept me as I am.	☐	☐	☐	☐	☐

29. Please fill one box for each statement about your teachers. If you have only one teacher, think of this person when you answer the questions.

	Strongly Agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
I am encouraged to express my own views in my class(es).	☐	☐	☐	☐	☐
Our teaches treat us fairly.	☐	☐	☐	☐	☐
When I need extra help, I can get it.	☐	☐	☐	☐	☐
My teachers are interested in me as a person.	☐	☐	☐	☐	☐

30. How many close friends do you have? (Please fill one box).

- ☐ None
- ☐ One
- ☐ Two or more

31. Do you feel confident in yourself?

- ☐ Always
- ☐ Often
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

32. Do you think your body is: (Please fill one box).

- ☐ Much too thin
- ☐ A bit too thin
- ☐ About the right size
- ☐ A bit too fat
- ☐ Much too fat
- ☐ I don't think about it

33. How easy is it for you to talk to the following people about things that really bother you?
(Please fill one box for each line).

	Very easy	Easy	Difficult	Very difficult	I don't have
Father	☐	☐	☐	☐	☐
Mother	☐	☐	☐	☐	☐
Other grown-ups	☐	☐	☐	☐	☐
Brothers	☐	☐	☐	☐	☐
Sisters	☐	☐	☐	☐	☐
Friends	☐	☐	☐	☐	☐
Teachers	☐	☐	☐	☐	☐
School counsellors	☐	☐	☐	☐	☐
Your doctor	☐	☐	☐	☐	☐
Other person	☐	☐	☐	☐	☐

34. During the last six months was there a time when you felt unhappy, sad or depressed? (Please fill one box).

- ☐ No (Please go to Question 35)
- ☐ Yes, at home and at school
- ☐ Yes, but only at home
- ☐ Yes, but only at school

When you were feeling like that, how bad was it?
(Please fill one box).

- ☐ Almost more than I can take
- ☐ Quite bad
- ☐ Worse than usual
- ☐ About usual

35. During the last six months was there a time when you felt under strain, stress or pressure? (Please fill one box).

- ☐ No (Please go to Question 36)
- ☐ Yes, at home and at school
- ☐ Yes, but only at home
- ☐ Yes, but only at school

When you were feeling like that, how bad was it?
(Please fill one box).

- ☐ Almost more than I can take
- ☐ Quite bad
- ☐ Worse than usual
- ☐ About usual

36. During the past year have you:
(Please fill one box for each line).

	Not at all	A little	Quite a lot	A lot
Felt too tired to do things?	☐	☐	☐	☐
Had trouble going to sleep or stay awake?	☐	☐	☐	☐
Felt unhappy, sad, or depressed?	☐	☐	☐	☐
Felt hopeless about the future?	☐	☐	☐	☐
Felt nervous or tense?	☐	☐	☐	☐
Worried too much about things?	☐	☐	☐	☐
Felt lonely?	☐	☐	☐	☐
Felt left out of things?	☐	☐	☐	☐
Found it hard to make new friends?	☐	☐	☐	☐

The next two questions are about bullying - we say a student is being bullied when another student or group of students say or do nasty and unpleasant things to him or her. It is also bullying when a student is teased repeatedly in a way he or she doesn't like. But it is not bullying when two students of the same strength quarrel or fight.

37. Have you been bullied in school this term?
(Please fill one box).

- ☐ I haven't been bullied in school this term
- ☐ Once or twice
- ☐ Sometimes
- ☐ About once a week
- ☐ Several times a week

38. How often have you taken part in bullying other students in school this term? (Please fill on box).

- ☐ I haven't bullied others in school this term
- ☐ Once or twice
- ☐ Sometimes
- ☐ About once a week
- ☐ Several times a week

39. Have you ever smoked tobacco (including cigarettes) even if it was a puff or two?

- ☐ Yes
- ☐ No

If NO, please go to Question 44 - skip the questions in the box below.

If YES, how old were you when you first smoked tobacco?

_____ years.

40. How often do you smoke tobacco at present? (Please fill one box).

- ☐ Every day
- ☐ At least once a week but not every day
- ☐ Less than once a week
- ☐ I don't smoke

41. How many cigarettes do you usually smoke in a week? (Please fill one box).

- ☐ I don't smoke now
- ☐ I smoke just a puff or two occasionally
- ☐ Less than 1 cigarettes per week
- ☐ 1 to 4 cigarettes per week
- ☐ 5 to 9 per week
- ☐ 10 to 19 per week
- ☐ 20 or more

42. How old were you when you began to smoke everyday?

I was _____ years old.

- ☐ I do not smoke every day

43. Where do you usually get your cigarettes from? (Please fill one box).

- ☐ Cigarette machine
- ☐ Petrol station
- ☐ Corner store
- ☐ Take away food store/milk bar
- ☐ Supermarket
- ☐ Club/pub
- ☐ Bottle shop
- ☐ Friends
- ☐ Brother or sister
- ☐ Parent
- ☐ Other (Please write it down):_____

44. In five years time, do you think you will smoke? (Please fill one box).

- ☐ Yes
- ☐ No
- ☐ Don't know

45. How easy do you think it would be for you to get cigarettes from each of the following? (Please fill one box for each line).

	Never tried	Very hard	Hard	Easy	Very easy
Cigarette machine	☐	☐	☐	☐	☐
Petrol station	☐	☐	☐	☐	☐
Corner store	☐	☐	☐	☐	☐
Milk bar/take-away ..	☐	☐	☐	☐	☐
Supermarket	☐	☐	☐	☐	☐
Club/pub	☐	☐	☐	☐	☐
Bottle shop	☐	☐	☐	☐	☐

46. How often do other people smoke inside your house? (Please fill one box).

- ☐ Every day
- ☐ At least once a week but not every day
- ☐ Less than once a week
- ☐ Never

47. Have you ever had even part of an alcoholic drink? (That means beer, wine, coolers, cider, or spirits like whisky).

- ☐ No
- ☐ Yes, just a few sips
- ☐ Yes, I have had fewer than 10 alcoholic drinks in my life
- ☐ Yes, I have had more than 10 alcoholic drinks in my life

If NO, please go to Question 54 on page 8 - skip the questions in the box below.

48. If YES, at present how often do you drink anything alcoholic? Try to include even those times when you only drink a small amount. (Please fill one box for each line).

	Every day	Every week	Every month	Less than once a month	Never
Beer	☐	☐	☐	☐	☐
Wine/coolers ...	☐	☐	☐	☐	☐
Spirits	☐	☐	☐	☐	☐
Cider	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

49. Have you ever had so much alcohol that you were really drunk? (Please fill one box).

- ☐ No, never
- ☐ Yes, once
- ☐ Yes, 2 - 3 times
- ☐ Yes, 4 - 10 times
- ☐ Yes, more than 10 times

50. On a day when you have had a whole drink of beer, wine, coolers, cider or spirits, how many whole drinks would you usually have? (Please fill one box).

- ☐ I don't drink alcohol
- ☐ A sip now and then
- ☐ Two drinks or less
- ☐ 3 - 4 drinks
- ☐ 5 - 6 drinks
- ☐ 7 drinks or more

51. Think back over the last two weeks. How many times have you had five or more alcoholic drinks in a row? (Please fill one box).

- ☐ None
- ☐ Once
- ☐ Twice
- ☐ 3 - 6 times
- ☐ 7 - 9 times
- ☐ 10 or more times

52. Where do you usually get your alcohol from? (Please fill one box).

- ☐ I don't drink alcohol
- ☐ Buy it from a pub, bottle shop
- ☐ Get it/buy it from other people
- ☐ Friends give it to me
- ☐ Get it from home
- ☐ Other way
  Please write it down:_____

53. Has anyone ever refused to sell you alcohol because you were under age? (Please fill one box).

- ☐ No, I have never tried to buy alcohol
- ☐ No, I have never been refused service
- ☐ Yes, I have been refused service once or twice
- ☐ Yes, I have been refused service frequently

54. How likely is it that someone like you would be refused service if you tried to buy alcohol? (Please fill one box).

- ☐ Very likely
- ☐ Fairly likely
- ☐ Fairly unlikely
- ☐ Very unlikely

Many young people get injured at places such as the street, at home, playing sports, or during a fight with others. The next questions ask about accidents or injuries that might have happened to you during the last year.

55. During the last 12 months, were you injured and had to be treated by a doctor or a nurse?

- ☐ Yes
- ☐ No

If NO, you do not need to answer any more questions - thank you for completing this questionnaire.....

If YES, how many times? Number of times:_____

Now we would like you to think about THE ONE most serious injury or accident that you had during the past 12 months.

56. Did this ONE injury need medical teatment such as the placement of a cast, stitches, surgery or stay in a hospital overnight?

- ☐ Yes
- ☐ No

57. Did this ONE injury cause you to miss at least one full day of school or other usual activities?

- ☐ Yes
- ☐ No

58. Which of the following conditions best describes the main result of this ONE injury?

- ☐ Broken or dislocated bone
- ☐ Sprain, strain or pulled a muscle
- ☐ Cuts or punctured wounds
- ☐ Concussion or other head or neck injury
- ☐ Bruises or internal bleeding
- ☐ Burn
- ☐ Poisoning
- ☐ Another type of injury
  (please specify):_____

59. Which of the following places best describes where this ONE injury occurred?

- ☐ In your home or garden
- ☐ In someone else's home
- ☐ At school
- ☐ At a sport facility
- ☐ In the street/road near your home
- ☐ In the street/road not near your home
- ☐ In a park or recreational place
- ☐ On a farm
- ☐ At work
- ☐ In the surf
- ☐ In the snow
- ☐ In some other place:_____

60. Which of the following best describes what you were doing when you got injured?

- ☐ Riding a bicycle
- ☐ Roller skating or using a skateboard
- ☐ Riding in a car or other vehicle
- ☐ Got hit by a car or other vehicle
- ☐ Got a sport injury during training or playing
- ☐ Playing in the playground at school during free time
- ☐ Accidentally tripped over or fell down
- ☐ Accidentally got struck/hit or cut by an object
- ☐ During a fight with another person
- ☐ Fell off something
- ☐ Surfing
- ☐ Skiing
- ☐ Some type of other event
  (please specify):_____

Thank you for completing the questionnaire.

The ILLAWARRA REGION 1996