THE EFFECT OF ACCUMULATIVE PHYSICAL ACTIVITY ON THE FITNESS AND HEALTH STATUS OF RURAL SCHOOL CHILDREN

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A thesis submitted in partial fulfilment of the requirements for the degree of Master of Arts (Sport, Recreation and Exercise Science) in the Department of Sport, Recreation and Exercise Science, University of the Western Cape.

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Phillip Jacobus Wildschutt

KEYWORDS

Physical activity

Body composition

Blood pressure

School children

Fitness

Obesity

Hypertension

Anthropometry

i iii iii opoiii eti j

Caledon/Overberg



Maximal oxygen uptake (VO_{2max})

ABSTRACT

THE EFFECT OF ACCUMULATIVE PHYSICAL ACTIVITY ON THE FITNESS AND HEALTH STATUS OF RURAL SCHOOL CHILDREN

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Numerous studies focusing on cardiovascular disease (CVD) risk factors such as obesity, hypertension, smoking, diabetes mellitus, elevated serum lipids, inactivity and lack of physical fitness prevalent in children highlight the importance of the early diagnosis and prevention of conditions that are associated in adulthood with CVD (Toselli, Graziani, Taraborelli, Grispan, Tarsitani, Grupioni, 1997).

The purpose of this comparative and correlational cross-sectional study was to assess the impact of accumulative physical activity on the fitness profile, blood pressure and body composition in 14 – 16 year old school children in the Western Cape of South Africa. The sample comprised of 162 learners (72 males and 90 females) selected from rural schools in the Caledon/Overberg region of the Western Cape. Demographic and physical activity participation data were obtained through standardised questionnaires. Body composition was determined by standard anthropometric methods as described in Norton and Olds (1996). Blood pressure was measured using a Dina map vital signs monitor, with learners sitting after at least 5 minutes rest. The maximal 20 m shuttle run test, described by Leger and Lambert (1982), was carried-out to predict maximal aerobic power. Fitness components such as strength, flexibility, power and cardiovascular endurance were assessed using standardised fitness tests. Data were analysed using Moonstats and SAS. Descriptive statistics were used in order to characterise and describe the sample. Analysis of variance (ANOVA) and T-tests were used to test differences between age groups and gender. Multiple regression analysis was performed to assess the influence of independent variables to the variance in dependent variables. The level of significance was set at P<0.05.

Written permission was obtained from the Western Cape Education Department and school principals to conduct the research in the schools under their jurisdiction and informed written consent was obtained from the subjects and their parents.

The results indicate that more than 50% of rural school children in the Caledon/Overberg region of the Western Cape engaged in sufficient health enhancing physical activity. With regard to body composition, none of the boys were either overweight or obese, while 11.1% and 3.3% of the girls were overweight and obese, respectively. An analysis of the data showed an inverse relationship between body mass, BMI, skinfold thickness and physical activity. Using the FITNESSGRAM standards, most of the boys (52.4%) but not the girls (29.9%) had acceptable levels of cardiovascular fitness. Boys performed better than the girls in all fitness tests, but flexibility. No significant correlation was found between blood pressure and physical activity, while $VO_{2 \text{ max}}$ was found to be significantly associated with physical activity (p<0.01). A Pearson's correlation coefficients analysis found significant and negative associations between BMI, skinfolds, and $VO_{2 \text{ max}}$. In conclusion, the results from this study demonstrate the positive impact of habitual physical activity on the body composition, cardiovascular fitness, but not the hypertensive state of rural school children.

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DECLARATION

I declare that "The Effect of Accumulative Physical Activity on the Fitness and Health Status of Rural School Children" is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by means of complete references.

Phillip Jacobus Wildschutt		November 2005
Signed:		
Witnesses:	UNIVERSITY of the WESTERN CAPE	
Prof. A.L. Travill	WESTERN CAPE	Dr. G. Jordaan

DEDICATION

I dedicate this thesis to my parents, Susan and Frederick, for the sacrifices they have made to provide their children with the precious gift of education. This is your reward for believing in me. May God bless you.



ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to Prof. Travill and Dr. Jordaan for supervising my thesis. Thank you for the guidance, support, and trust which enabled me to complete my thesis. I would like to thank the Western Cape Education Department for granting me permission to do the research in the selected schools. To the principals and staff of Teslaarsdal Primary and Swartberg Secondary, I wish to express my appreciation for their cooperation during the conducting of my research at the schools. A special word of thanks to Wilfred Habelgaarn and Pieter Giliomee for their assistance in the administration of the physical activity questionnaires. I sincerely thank the learners of Caledon for their willingness to participate in the study. I would also like to thank the Statistics Department at the University of the Witwatersrand for their assistance with the data-analysis.

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I would like to extend my gratitude to all relatives, sisters and friends for their encouragement and support rendered. Finally, I wish to thank my wife, Geralda, and son, Curtly, for their encouragement, support, love and understanding during the completion

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CHAPTER ONE

INTRODUCTION

1.1 **Background**

The world's health is undergoing an unprecedented transition on several fronts, including epidemiological, nutritional and demographic. The result is a broad shift in disease burden. A report from the World Health Organization (WHO) (2001) predicts that the majority of deaths by broad cause (59%) are from non-communicable diseases (NCDs) (Figure 1).

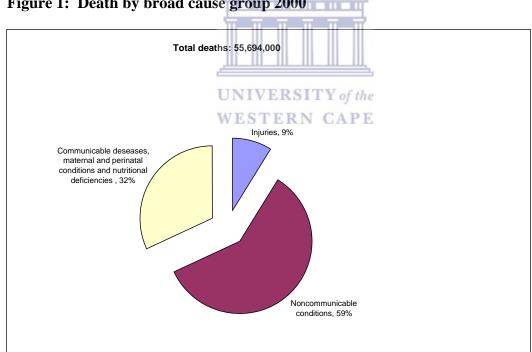


Figure 1: Death by broad cause group 2000

Source: WHO, World Health report, 2001

The report further states that in the European, American and Western Pacific Regions, NCDs are in an overwhelming majority. The South - East Asia and Eastern Mediterranean Regions are in transition, with NCDs now a more significant public health problem than infectious diseases.

The WHO reports that the African region is also in transition, with communicable diseases still predominant in most countries in the region, but warns that the incidences of NCDs are increasing (WHO, 2003a: 7).

Data contained in the World Health Report (2002) show that high blood pressure is a major contributing factor to all deaths in the world. Of the ten leading risk factors, six relate to nutrition, diet and physical activity. The report suggests that progress in these two areas, combined with reductions in tobacco and alcohol use, will have enormous impact on the prevention of NCDs and will lead to major health gains that are cost-effective (WHO, 2003a: 7).

The health transition in Africa

The World Health Organization report of 2003, highlights that while communicable diseases, food shortages and undernutrition are still being encountered in many countries in the African Region. Like the rest of the world, these countries are also affected by epidemiological, nutritional and demographic transition.

NCDs, especially CVDs, are increasing rapidly throughout the region and were estimated to have caused 22% of all deaths in 2001. They now constitute the major health problem in some countries (e.g., Algeria, Mauritius and Seychelles) and are as important as communicable diseases in others (e.g., Côte d'Ivoire, Nigeria). In Harare, prevalence in women of the risk factor obesity (BMI=30 kg/m2) is now higher than that of HIV infection (WHO, 2003a: 11)

These figures point to the significant role of undernutrition, which should not be overlooked when addressing the challenges of overnutrition, the report states. In many countries, both forms of malnutrition co-exist. Balanced diets are essential for improving population health. However, a surprisingly high prevalence of overweight is found in African countries, especially among women. Childhood obesity is also a growing problem across the world, with physical inactivity a major factor (WHO, 2003a: 8).

The World Health Organisation in 2005 estimates that physical inactivity causes almost 2 million deaths worldwide annually. Globally it is estimated to cause about 10-16% of all cases of breast cancer, colon cancer, and diabetes, and about 22% of all ischemic heart disease incidents. These estimates are similar in men and women (WHO, 2005: 1).

Over the past 50 years, a variety of populations have been studied for possible relations among physical activity, body composition, physiological fitness, and cardiovascular health. The unique and fundamental contributions of epidemiology have been recognized as a means to understand the causes of cardiovascular diseases, and as procedures to prevent and control them (Berlin and Colditz, 1990; Powell, Thompson, Caspersen and Kendrick, 1987). This lead to the realisation that physical activity protects against the development of CHD, stroke, hypertension and obesity (Lee, Sesso and Paffenbarger, 2001; Bouchard, Shephard and Stephens, 1994).

Furthermore, physical exercise improves functional capacity; enhances mood, thought, and psychological behaviour; and delays the infirmities and disabilities of old age (Morris, 1994).

Physical activity is interrelated with energy expenditure which may cause elevation of metabolic rate and influence other physical fitness and health attributes of the body (Armstrong and Welshman, 1997). The Centres for Disease Control and the American College of Sports Medicine recommended that children and adults gradually build to 30 minutes of activity of moderate intensity on most, preferably all days of the week (Pate, Pratt, Blair, Haskell, Macera, Bouchard et al., 1995). Activities of moderate intensity burn 4-7 kilocalories per minute (kcal/min) and have a metabolic equivalent (MET) value of 3.0 - 6.0. Examples of moderate physical activities are level walking at 2.5 – 4 mph, cycling at 5.5- 9.7 mph, swimming at 1ft/s and most racket sports (Wilmore and Costill, 1994: 523).

The global estimate for the prevalence of physical activity among adults is 17% according to the World Health Report (WHR) of 2002. The report further states that estimates for prevalence of some, but insufficient activity (<2.5 hours per week of moderate activity) range from 31% to 51%, with a global average of 41% across the sub-

regions (WHO, 2005: 1).

The majority of South Africans studied in various regional cross-sectional surveys fail to meet recommended minimum physical activity standards (Lambert, Bohlmann, and Kolbe-Alexander et al. 2001).

Specific physical activity guidelines for children were recently developed by the National Association for Sport and Physical Activity (NASPE). These guidelines suggest that:

- (1) Elementary school aged children should accumulate at least 30 to 60 minutes of age and developmentally appropriate physical activity from a variety of physical activities on all, or most days of the week;
- (2) An accumulation of more than 60 minutes, and up to several hours per day, of age and developmentally appropriate physical activity is encouraged for elementary school aged children;
- (3) Some of the child's activity each day should be in periods lasting 10 to 15 minutes or more and include moderate to vigorous activity. This activity will typically be intermittent in nature involving alternating moderate to vigorous activity with brief periods of rest and recovery (Corbin and Pangrazi, 1998).

Worldwide, childhood obesity has reached epidemic proportions with 155 million schoolaged children being either obese or overweight (Noakes, 2004). The Youth Risk Behaviour Survey of 2002 revealed that 17% of adolescents in South Africa are overweight and 4% are obese. With regard to physical activity, 29% had no physical education classes in schools and 25% watched TV for over 3 hours per day (Department of Health, 2002: 12). Physical activity helps to prevent and treat obesity non-pharmacologically, by increasing the amount of energy expended, and increasing the resting metabolic rate (Wilmore & Costill, 1994).

Hypertension is now recognized to be a disease of lifestyle, in part the result of poor diet (over-nutrition and salt), obesity and lack of physical activity (Opie, 1995: 37).

Research studies (Nielsen and Andersen, 2003; Al-Hazaar et al., 1994; Hagberg, 1990; Cooper, Pollock, Martin, White, Linnerud and Jackson, 1976; Cooper, Pollock, Martin, White, Linnerud and Jackson, 1976; Montoye, Metzner, Keller, Johnson and Epstein, 1972; Montoye, Metzner, Keller, Johnson and Epstein, 1972) which investigated the relationship between inactivity and hypertension found that more active and fit subjects exhibited lower systolic and diastolic blood pressures. These findings suggest that active people and fit people are at a reduced risk of developing hypertension.

Modern forms of transport prevent young people from walking or cycling to school. In South Africa security concerns have fuelled the trend to transport children to and from school by 'Mom's taxi' or bus (Rössner, 2004). However, walking distances to school is part of the daily physical activity patterns of most children in the Overberg/Caledon region of the Western Cape. A substantial number of them walk between 5 km – 6 km to and from school. The Western Cape Education Department only provides transport for children traveling 10km and more to the nearest school.

The normal everyday activities in which children participate, including travelling to and from school, can contribute to their daily quantum of physical activity, which in turn, should lead to healthier lives (Biddle, Cavill and Sallis, 1998).

1.2 Aim of the Study

The purpose of this comparative and correlational cross-sectional study is to assess the impact of accumulative physical activity on the fitness status, blood pressure and body composition of 14 - 16 year old school children in the Caledon/Overberg region of the Western Cape.

1.2.1 Objectives

- a) To ascertain the physical activity levels, anthropometric characteristics, blood pressure and cardio-vascular fitness of rural school children in the Overberg/Caledon region of the Western Cape.
- b) To determine the relationship between physical activity, body composition, physical fitness and blood pressure of rural school children by gender and age.

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1.3 Hypothesis

- 1. Accumulative physical activity, such as walking to and from school can contribute to children's daily requirement of physical activity, which in turn, should enhance their health and fitness.
- 2. The prevalence of obesity, hypertension and lack of fitness is lower in rural children with high levels of un-organised daily physical activity patterns.
- 3. Gender and age strongly influence the relationship between physical activity, body composition, physical fitness and blood pressure of rural school children.

1.4 Limitations / Assumptions

The sample for this study was not representative of all rural school children in the Overberg region of the Western Cape, since only children of mix heritage from two schools in the region participated in the study. Race-based population groups were defined by Apartheid. Africans were those whose ancestry is from the African continent; whites were those with European ancestry; the mixed-ancestry group (a uniquely defined South-African group) was of mixed heritage, including aboriginal (Koi, San), Malay, European, and African; and Indian/Asian defines those descendants from East Asia, primarily the Indian subcontinent. (Puoane et al., 2002). Only selected fitness components and health risks factors were assessed in this study.

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1.5 Abbreviations

DBP: Diastolic Blood Pressure

SBP Systolic Blood Pressure

BMI: Body Mass Index

CHD: Chronic Heart Disease

CDC: Center for Disease Control and Prevention

CVD: Cardiovascular Disease

ERASS: The Exercise Recreation And Sport Survey

HEPA: Health Enhancing Physical Activity

kcal/min: kilocalories per minute

mmHg: millimetres of mercury

MVHEPA: Moderate to Vigorous Health Enhancing Physical Activity

NASPE: National Association for Sport and Physical Activity

NCSH: National Center for Health Statistics

NCDs: Non-communicable Diseases

NHANES: United States National Health and Nutritional Examination Survey III

PA: Physical Activity

YRBS: South African Youth Risk Behaviour Survey

CDC: United States Center for Disease Control

USDHHS: United States Department of Health and Human Services

VO_{2 max}: Maximal Oxygen Uptake

WHO: World Health Organization

20SRT: 20m shuttle run test

1.6 Definition of Terms

Rural School children: School children from the Caledon/Overberg region aged 14-16 years.

Physical activity: This is any bodily movement produced by skeletal muscles that results in energy expenditure and is positively correlated with physical fitness (Centre for Disease Control and Prevention, 2002).

Body composition: Body composition can be defined as a ratio of fat-free mass and is expressed as percentage body fat (%BF) (Lee, 1995).

Body mass index: Body mass index (BMI) is calculated as weight (kg) divided by height² (m²) and expressed as an SD score relative to contemporary reference data (Cole; Freeman; Preece, 1995).

Physical fitness: Physical fitness is defined as a set of attributes that allow the body to respond or adapt to the demands of stress or physical activity (Caspersen and Merrit, 1995).

High blood pressure: High blood pressure is also called hypertension. Hypertension is a chronically elevated arterial blood pressure sometimes arbitrarily defined as any resting pressure greater than 140/90 millimetres of mercury (Lamb, 1984).

20m shuttle run test: This test involves continuous running between two lines 20m apart in time to recorded beeps. The time between recorded beeps decrease each minute (level) with an initial running velocity of 8.5 km/hr, which increases by 0.5 km/hr each minute (Leger and Lambert, 1982).

Health Enhancing Physical Activity: This is usually an activity that results in energy expenditure of at least three metabolic equivalents (3 METs), which represents the ratio of work metabolic rate to a standard resting metabolic of 1 MET obtained during quiet sitting (Wilmore and Costill, 1994: 523).



CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The current consensus is that physical activity and physical fitness are reciprocally related and that they exert independent effects on health. This implies that people need to be physically active even if they have reasonable levels of fitness. Individuals with low levels of fitness can also obtain health benefits by remaining physically active. Some of the factors influencing fitness are out of a person's control (e.g. genetics and rate of maturation), therefore the emphasis should be placed on being physically active (Corbin, 2001). This review will focus on selected health risk factors such as fitness, body composition, obesity, and hypertension and their relation to physical activity.

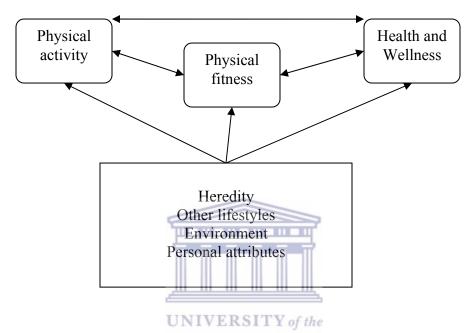
2.2 The Relationship between Physical Activity, Physical Fitness and Health

The relationship between physical activity and physical fitness is a complex one. Welk and Blair (2001: 11) explain the difference:

Many people assume that physical activity and physical fitness are directly related but they actually represent very different things. Physical activity is a behavior while physical fitness is a trait or characteristic. While physical activity will contribute to physical fitness the relationships are not as strong as many would expect. The relationship between physical activity and obesity is also not as high as would be expected (especially among children). Even if a relationship is present, it is not clear that it is a "causal" factor. Physical inactivity can lead to obesity but it is equally plausible that obesity leads to inactivity.

The model presented below is useful in understanding the relationships between physical activity, physical fitness and health (Corbin, 2001).

Figure 2 : The complex relationship among physical activity, physical fitness, health and other factors



(Adapted from Bouchard et al., 1990) TERN CAPE

2.3 Habitual Physical Activity (PA) Patterns among Adolescents

In developing countries especially Africa, activity patterns for adolescents in rural areas are different from those in urban areas. The common activities for rural adolescents include walking long distances to fetch firewood and water for home use (Emiola, Talabi, and Ogunsakin, 2002; Bénéfice and Cames, 1999) and working in the field in order to earn a living (Bénéfice and Cames, 1999). Many adolescents are involved in heavy and demanding physical activities, which could at times lead to injury and negative health

consequences (Garnier and Bénéfice, 2001). This concern was also expressed by the World Health Organisation (1998), noting that the hard physical labour of females from developing countries throughout their lives is likely to impact negatively on their musculoskeletal development.

In most countries of the African Region, physical education and sport in schools are under threat due to competing academic priorities, lack of facilities, financial constraints and lack of parental support. There is also little emphasis on physical activity in the workplace and at the community level, again owing to economic pressures and lack of facilities. For individuals, long working hours, commuting, competing leisure time activities and cultural factors are further obstacles to regular physical exercise (WHO, 2003a: 16).

Black South African children aged 5-12 years were found to engage in a variety of PA with distinct gender differences. Boys preferred football and karate and girls enjoyed skipping rope, watering gardens, Molentse (making a circle with pantihose and jumping in and out of it), football, and netball (Peltzer, Phaswana, and Promtussananon, 2002). Physical Activity preference is influenced by personal motivation and cultural factors. For boys the reasons for enjoying PA were to get stronger and healthier bodies and to protect themselves, while for girls the most important reasons were to develop strong and healthy bodies and be happy with doing the physical activity (Peltzer et al., 2002).

Phillips (2001: 35) found that Strand high school children in the Western Cape, South Africa boys were participating mostly in rugby, soccer, athletics and girls preferred netball, walking, dancing, running, and swimming.

Girls generally prefer more sedentary activities than boys (Peltzer et al., 2002; Bénéfice, Garnier and Ndiaye, 2001), a trend that continues into adulthood (Biddle et al., 1998). Studies and reviews on the PA patterns of the general population reveal lower levels of PA among the older adolescents and particularly female adolescents (Van Mechelen, Twisk, Post, Snel, and Kemper, 2000; Allison, Dwyer, and Makin, 1999; Michaud, Narring, Cauddery and Cavadini, 1999; Dietz, 1996).

2.3.1 Television Viewing



As modernization gradually increases in developing countries, people become more sedentary. This is partly due to less physical labour, with adolescents resorting to more sedentary activities such as video and television viewing, playing cards and computer games (Rimmer, 2000).

Television viewing is a major contributor to the inactive lifestyle of adolescents (Dietz, 1996). The 1ST South African National Youth Risk Behaviour Survey (2002) revealed that 25% of high school learners (Grade 8-11) spent more than 3 hours per week watching television and 29% had no physical education classes.

A study done among urban and rural adolescents in Norway found that weekly time spent on physical activity was 9 hours. Time spent watching television or on the computer was almost double (16 hours) for the whole group, without significant geographical or gender differences (Sjolie and Thuen, 2002). This large amount of weekly time spent on a television/computer is similar to findings from studies among adolescents in Russia (Levin, Ainsworth, Kwok, Eddy, and Popkin, 1999) and the US (Lindquist, Reynolds, and Goran, 1999; Andersen, Crespo, Bartlett, Cheskin, and Pratt, 1998; Myers, Strikmiller, Webber, and Berenson, 1996). The large amounts of time spent on a television/computer may seem unfortunate since the amount of time spent watching television has been shown to be related to low back pain and obesity in adolescents and children (Andersen et al., 1998; Balague, Nordin, Skovron, Dutoit, Yee, and Waldburger, 1994).

2.3.2 Sports Participation

Sport is the most popular PA among adolescents from developed countries and has therefore been selected as the main marker for PA levels in most studies (Prista and Marques, 2000). However there is a high drop-out rate during adolescence (Sallis, Zakarian, Hovell, and Hoffstetter, 1996). Heath, Pratt, Warren, and Kann (1994) note that participation in sport does not appear to contribute to the development of life long habitual activity patterns.

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2.3.3 Walking to School

Active commuting to school by means of walking is one of the most common PA among rural school children in developing countries such as Nigeria (Emiola et al., 2002), South Africa (Naidu and Khumalo, 2005), and the Philippines (Tudor-Locke, Ainsworth, Adair, and Popkin, 2003). Although walking to school is a potential source of continuous moderate activity, it has been largely ignored in surveys of PA (Tudor-Locke, Ainsworth, and Popkin, 2001). A National Household Travel Survey, conducted by Statistics South Africa in 2003, has found that over 560000 children in South Africa spend more than 2 hours a day walking to and from school. It further revealed that 76% of school children and students in urban areas walk to classes or lectures as opposed to 91% of those in rural areas (Naidu and Khumalo, 2005).

The trend in developed countries such as Norway seems to be different with more urban children walking or cycling to school than rural children (Sjolie and Thuen, 2002). In fact, various Norwegian studies have found a lower level of physical performance, measured as muscle strength, aerobic capacity and joint mobility, in rural adolescents compared with those living in urban areas (Sjolie, 2000; Ellingsen, 1999; Andersen, Seliger, Rytenfrantz, and Nesset, 1980; Solstad, 1973). One of the factors explaining these differences seems to be the extent to which the adolescents walk or cycle to school and regular activities. In a large Norwegian study, children who walked or cycled between 2 and 4 km to school had better aerobic capacity than those walking shorter distances or those using a school bus (Solstad, 1973).

One of the reasons given for the increase in physical inactivity among children in Britain is increasing use of motorized transport. In Britain, a National Travel Survey 1999/2001 Update (Department for Transport, 2002) found that the percentage of trips by children in Britain that are by car increased from 35% in 1985/86 to 52% in 1999/2001, while the percentage of trips by children that were walked declined from 47% to 36% over the same period. Mackett, Lucas, Paskins, and Turbin (2003: 3) found that older children in Britain generally use more calories travelling to school than younger children, with children who walk using rather more calories than those who travel by car or bus.

Different living environments such as rural versus urban areas, and the lifestyles in such areas, can be considered natural experiments for the influence of the environment on physical activity. The large differences in spatial characteristics, and opportunities for recreational activities in such areas, may create substantial differences in the level of physical activity (Sjolie and Thuen, 2002).

2.4 Epidemiological Studies Done in Developed and Developing Countries Around the World

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2.4.1 The Relationship Between PA and Coronary Heart Disease

Noakes and Lambert (1995: 87) are of the opinion that most of our understanding of the relationship between physical activity and CHD has been influenced by five researchers (i.e. Jeremy Morris, Ralph Paffenbarger, David Siscovick, Ken Cooper and Steven Blair).

These researchers and their colleagues concluded separately that people who engage in regular physical activity are less likely to suffer from CHD.

As early as 1953, Morris and his associates found that conductors on the London transport system had a 30% lower incidence of CHD than the sedentary bus drivers. Similar findings were reported for postmen when compared to less active postal clerks (Noakes and Lambert, 1995: 87)

Among British civil servants in sedentary occupations and who were similar in respect of their coronary risk factors, Morris et al. (1973) found a relationship between the level of PA and the rate of heart attack. The heart attack rate in the vigorously active group was found to be one-third of that in the less active group (Noakes and Lambert,1995: 87).

In the early 1950's, armed with a 40 year history of his subjects, Paffenbarger studied Longshoremen, and Harvard graduates. Both study populations were vigorously active in their occupations (Longshoremen) or leisure time (Harvard Graduates). Among Longshoremen, those who performed heavy manual labour had a far lower risk of fatal heart attack than did the less active. As in the studies of Morris and his colleagues, the risk was reduced even in Longshoremen who had other coronary risk factors. Protection increased with increasing level of workday energy expenditure, so that the risk of fatal heart attack was reduced by 50% for weekly energy expenditure of 39900 kJ (9500 kcal) (Noakes and Lambert, 1995: 88).

In the Harvard Graduate study, Paffenbager, Hyde, Yung, and Wing (1984), found that men who reported climbing 50 or more steps each working day had a 20% lower risk of first heart attack than men who climbed less. He further found that men who walked five blocks daily were at 21% lower risk of heart attack than those who walked less. Those who reported vigorous sporting activity in leisure time had a 27% lower risk than those who did not exercise vigorously (Paffenbarger et al., 1984). When total leisure time was calculated, it was found that risk of first heart attack fell with increasing leisure time activity and was 39% lower in those expending more than 8400 kJ of energy in leisure time physical activity each week.

Siscovick and his colleagues collected data on all persons dying suddenly during a twelve-month period in Seattle, Washington. After excluding from their analysis all, but persons who were absolutely healthy right up to the moment they suddenly died, a group of 145 sudden deaths remained. They found that those persons who exercised vigorously on a regular basis had a two-thirds lower risk of sudden death than those who did not exercise. According to Noakes and Lambert (1995), the studies of Siscovick and his colleagues confirm the findings that sudden death is reduced in regularly active persons.

In 1989 Blair and his colleagues reported that people who were judged to be physically fit on the basis of their treadmill running performance at the initial screening test had lower mortality from all causes of death, than did those who were judged to be unfit (Noakes and Lambert, 1995: 87).

In summary these studies show that physical activity significantly reduces the risk of heart attack. However, since these studies were conducted among adults, the findings and benefits cannot be generalised to children and adolescents. Bar-Or (1995: 1) cautions: "children are not miniature adults. Their responses to activity are quite different from those of adults". The author further noted that prospective studies that have tracked activity patterns from childhood to adulthood are lacking. Therefore no reliable evidence exist to proof or disproof that an active child will become an active adult who, in turn, has a lower risk of disease than an inactive adult.

2.4.2 PA Levels among Children and Adolescents

A number of studies and surveys were done to determine the PA levels of children and adolescents. Selected studies and surveys using different methodologies will now be reviewed.

2.4.2.1 PA Levels in the United States of America

In the United States, Britain, and most other developed nations less than half of the adults are regularly active (Caspersen and Merritt, 1995; Stephens and Caspersen, 1994; Health Education Authority, 1992). An estimated third of deaths from coronary heart disease in the United States (about 160 000 deaths per year) are attributable to insufficient physical activity (Powell and Blair, 1994).

Data from the Youth Risk Behavior Surveillance – United States 2003, revealed that 63% of high school students participate in sufficient vigorous physical activity, and 25% participate in sufficient moderate physical activity. It further showed that participation in physical activity declines as children get older and that 67% of high school students met the national recommendations for both vigorous and moderate physical activity in 2003 (Grunbaum, Kann, Kinchen, Ross, Hawkins, and Lowry, et al., 2004)

Regarding participation in physical education classes, over half (56%) of U.S. high school students (71% of 9th graders but only 40% of 12th graders) were enrolled in a physical education class in 2003. The percentage of high school students who attended physical education classes daily decreased from 42% in 1991 to 25% in 1995, and has remained stable at that level until 2003 (28%) (Grunbaum et al., 2004).

The data also revealed that, in 2003, 38% of 9th graders but only 18% of 12th graders attended a daily physical education class. Among the 56% of students who are enrolled in a physical education class, 80% exercised or played sports for 20 minutes or more during an average class (Grunbaum et al., 2004).

2.4.2.2 PA Levels in Canada and Northern Ireland

Surveys done in Canada revealed that 74% adolescent boys and 67% adolescent girls participated in vigorous aerobic activity at a frequency of three or more days per week. When compared to the USA or England, Canadian adolescents are more vigorously active, regardless of methodological differences in the studies (Pate, Long and Heath, 1994).

Riddoch, Savage, Murphy, Crann, and Boreham (1991) conducted the Northern Ireland Survey among school children aged 11-16 years, using the 7-Day Physical Activity Recall Questionnaire. Results from the survey showed that younger children were more active than older children, and that, at all ages, boys were more active than girls.

2.4.2.3 PA Levels in Australia UNIVERSITY of the

Instruments used in population surveys in Australia measured physical activity during the past 7 days or past two weeks, and the past 12 months (Merom and Bauman, 2003).

National Australian physical activity surveys, which used similar sampling methods and interviewing techniques (Merom and Bauman, 2003; Armstrong and Welshman, 2000) estimated "sedentariness" among Australians to be between 14.6% and 15.8%, while 31.3% - 45% of Australians are "sufficiently active".

The Exercise Recreation And Sport Survey (ERASS), 2002 found that walking accounted for about 59% of Health Enhancing Physical Activity (HEPA) days in Australia for both males and females and for people aged over 30 years. For those aged 60 years and over walking accounted for more than three quarters of their HEPA days. This may reinforce the notion that walking is a very important component of overall health related PA promotion, and is especially so as it does not vary across age groups, so has accessibility and equity dimensions (Merom and Bauman, 2003).

Besides walking, males and females are different in what constitutes most of their HEPA days. For males greater proportions of HEPA days were due to jogging and football while for females it was swimming and gym activities (Merom and Bauman, 2003).

2.4.2.4 PA Levels in Nigeria

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Bénéfice et al. (2001) reviewed some physical activity studies done among Nigerian students at higher educational institutions and found them to be good attempts, since most of the studies describing the PA patterns among adolescents have been done in developed countries. Although not representative, the studies reveal the problem of physical inactivity among adolescents and students in tertiary institutions in Nigeria (Bénéfice et al., 2001).

Emiola et al. (2002) assessed the effect of different levels of regular PA on the physical fitness and health status of Kwara State of Nigeria primary school children aged 6-11

years. A validated Children's Activity Rating Scale (CARS) developed by the authors was used to obtain information about the children's PA levels. The findings of the study revealed a lack of regular organized physical education programmes in almost all of the schools used in the study. It further indicated that PA can be used to improve the body composition and physical fitness of children (Emiola et al., 2002).

2.4.2.5 PA Levels in Senegal

Most studies (Bénéfice et al., 2001; Garnier and Bénéfice, 2001; Bénéfice and Cames, 1999) on PA patterns done in Senegal were conducted among girls in rural areas, and were longitudinal (3years) in nature. As with the studies in Nigeria, sample sizes were relatively small. However, the in-dept statistical analysis of the data revealed many useful components of the studies. The instruments of measurements were direct observation and self-administered questionnaires. Garnier and Bénéfice (2001) observed that Senegalese girls had much higher levels of PA compared to American and British girls.

2.4.2.6 PA Levels in Rwanda

A cross-sectional study using a 24-hour Total Activity Record was used to assess the PA patterns of urban adolescents in Rwanda for seven days (Tumusiime, 2005). The study sample (n=1771) was randomly selected from six urban schools in Rwanda. Results from the study revealed that the adolescents spent more time in sedentary activities.

It further showed that boys spent more time in non-sedentary activities than girls (6.2 hours/day versus 5.0 hours/day) and that sedentary behaviour increased with increasing age for both genders.

2.4.2.7 PA Levels in South Africa

Cross-sectional studies in South Africa found that more than 40% of historically and socio-politically disadvantaged persons living in urban communities do not participate in any leisure or occupational physical activity (Levitt, Katzenellenbogen, Bradshaw, Hoffman and Bonnici, 1993). Lambert et al. (2001) further noted that the majority of South Africans studied in various regional cross-sectional surveys reported low-to-moderate levels of participation in PA, and do not meet minimum PA recommendations as prescribed by the United States Center for Disease Control (Pate et al., 1995).

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A cross-sectional study (Phillips, 2001), using the One-Year Physical Activity Recall Questionnaire, among urban high school learners in the Stand area of the Western Cape, South Africa found most of the learners (64.8%) were insufficiently active. The learners engaged in recreational PA for 1-3 days per week, falling short of the recommended 30min of moderate PA on all or most days of the week (Pate et al., 1995).

Frantz (2004) assessed the daily habitual physical activity patterns of urban learners in the four high schools in the Belhar community of the Western Cape, South Africa through a 24-hour recall over a period of 7 consecutive days. Results from the study showed that about 32% of the high school learners (n=951) were physically inactive. In most of the components for health-related fitness, the author found that more than 50% of the inactive learners were not able to meet the norms for various health-related fitness tests. In addition, 23% of the physically inactive learners were overweight and 15% showed signs of hypertension.

Engelbrecht, Pienaar, and Coetzee (2002) investigated possible relationships between PA and physical fitness of girls (13-15years) in the North West Province in South Africa. They classified most of the subjects as low active (74.5%) and found a relatively low level of aerobic fitness among the girls in the study.

An editorial review from the Birth to Twenty study noted that insufficient physical activity is not limited to adults. Unpublished data from the study suggest that more than 0% of young people in South Africa (in grades 4-5) do not regularly engage in vigorous physical activity. It was further revealed that physical activity is less common among girls than boys and among those with lower income and less education (Birth to Twenty, 2002).

2.5 Physical Activity Recommendations for Children and Adolescents

As recently as the 1940s, physical activity was considered to be a cause of heart attacks, and heart attack patients were advised to stay in bed. Initially, vigorous activity was advocated as the means of staying healthy. Since the 1970s, however, research has

shown that moderate-intensity physical activity is also beneficial for health, and the accumulation of moderate activity for 30 minutes on most, or preferably all, days of the week is recommended as an effective Cardiovascular disease (CVD) prevention measure (Report of a Joint FAO/WHO Expert Consultation, op. cit.) (WHO, 2003a: 10).

Experts from all over the world developed an activity consensus statement for Adolescents. The consensus statement for adolescents (ages 11 to 21) contains two basic Guidelines (Corbin and Pangrazi, 2001: 43).

Guideline 1: All adolescents should be physically active daily, or nearly every day [30 to 60 minutes], as part of play, games, sports, work, transportation, recreation, physical education, or planned exercise, in the context of family, school, and community activities.

Guideline 2: Adolescents should engage in three or more sessions per week of activities that last 20 minutes or more and require moderate to vigorous levels of exertion.

In contrast to preadolescent children, the consensus is that adolescents should participate in some continuous and vigorous activity. Meeting Guideline 1 should be a priority. Participation in 30 to 60 minutes of daily activity is a reasonable, even minimal, goal for sedentary youth. Beyond this, guideline 2 is a desirable goal. The consensus statement includes brisk walking, jogging, stair climbing, basketball, racquet sports, soccer, dance, swimming laps, skating, strength (resistance training), lawn mowing, and cycling as some examples of activities that meet Guideline 2.

Biddle et al. (1998) acknowledge that neither the minimal nor the optimal amount of physical activity for children can be defined precisely. Notwithstanding this difficulty, they make the following recommendations (Mackett et al., 2003: 1-2).

- All young people should participate in physical activity of at least moderate intensity for one hour per day;
- Young people who currently do little activity should participate in physical activity of at least moderate intensity for at least half an hour per day.

They further note that moderate intensity activities for children may include brisk walking, cycling, swimming, most sports or dance, and that such activities may be carried out as part of transportation, physical activity, games, sport, recreation, work or structured exercise, and for younger children, as part of active play.

The Council for Physical Education for Children (COPEC) of the National Association for Sport and Physical Activity (NASPE) recently developed physical activity guidelines for children. These guidelines are commonly referred to as the NASPE Physical Activity Guidelines for Children. The five major guidelines are summarized below (Corbin and Pangrazi, 1998).

The British Health Authority recently published similar guidelines for children. This group offered a similar recommendation suggesting that children should be involved in sixty minutes of moderate physical activity each day (Health Education Authority, 1998).

NASPE Physical Activity Guidelines for Children

- Elementary school aged children should accumulate at least 30 to 60 minutes of age and developmentally appropriate physical activity from a variety of physical activities on all, or most days of the week.
- An accumulation of more than 60 minutes, and up to several hours per day, of age and developmentally appropriate physical activity is encouraged for elementary school aged children.
- -Some of the child's activity each day should be in periods lasting 10 to 15 minutes or more and include moderate to vigorous activity. This activity will typically be intermittent in nature involving alternating moderate to vigorous activity with brief periods of rest and recovery.
- Extended periods of inactivity are inappropriate for children
 (Corbin and Pangrazi, 2001: 41).

2.6 Specific Health Benefits Associated with Physical Activity

Appropriate regular physical activity is a major component in preventing the global burden of chronic disease. A report on physical activity by the World Health Organization in 2005 states that regular physical activity reduces the risk of heart disease, stroke, breast, and colon cancers. These benefits are mediated through a number of mechanisms. In general, the report suggest, physical activity improves glucose metabolism, reduces body fat and lower blood pressure; these are the main ways in which it is thought to reduce the risk of cardiovascular disease (CVD) and diabetes. It can also manage and minimize the effects on these diseases. The report further states that physical activity may also reduce the risk of colon cancer by its effects on prostaglandins, reduced intestinal transit time, and higher antioxidant levels (WHO, 2005: 1).

In 1996, The Surgeon General of the United States issued a report called "Physical Activity and Health" that summarized the current consensus regarding the health benefits of physical activity (U.S. Department of Health and Human Services, 1996). General conclusions from the report are listed below (Welk and Blair, 2001: 12).

General Conclusions from the Surgeon General's Report on Physical Activity and Health

- People of all ages, both male and female, benefit from regular physical activity.
- Significant health benefits can be obtained by including a moderate amount of physical activity (e.g., 30 minutes of brisk walking or raking leaves, 15 minutes of running, or 45 minutes of playing volleyball) on most, if not all, days of the week.
- Through a modest increase in daily activity, most Americans can improve their health and quality of life.
- Additional health benefits can be gained through greater amounts of physical activity.
- People who can maintain a regular regimen of activity that is of longer duration or of more vigorous intensity are likely to derive greater health benefits.
- Physical activity reduces the risk of premature mortality in general, and of coronary heart disease, hypertension, colon cancer, and diabetes mellitus in particular.
- Physical activity also improves mental health and is important for the health of muscles, bones and joints.
- Research on understanding and promoting physical activity is at an early stage, but some interventions to promote physical activity through schools, worksites, and health care settings have been evaluated and found to be successful.

Biddle et al. (1998) argue that there are three main rationales for young

people to take part in regular physical activity:

- To optimise physical fitness, current health and well-being, and growth and development;
- To develop active lifestyles that can be maintained throughout adult life;
- To reduce the risk of chronic diseases of adulthood (Mackett et al., 2003: 1).

They further suggest that the normal everyday activities in which children participate, including travelling to and from school, can contribute to their daily quantum of physical activity, which in turn, should lead to healthier lives.

Bar-Or (1995) cautions that, although the beneficial effects to health of enhanced physical activity (PA) during adult years are numerous, much less evidence is available regarding the effects of an active lifestyle during childhood and adolescence on adult health. The author postulates that the main reason for the paucity of information on the possible carryover of benefits from childhood to adulthood is the lack of longitudinal studies that have followed the same individuals over many years.

One of the few large-scale longitudinal studies in the world is the Birth to Twenty study. Birth to 20, launched in 1990, is the largest and longest running study of child health and development in Africa, and was started due to rising concerns about the implications of the rapid rate of urbanization on the health and wellbeing of South African children. Made up of 3273 families, the study is now in its 15th year of operation, and will run until the children reach the age of 20years (Birth to Twenty, 2002).

In agreement with the current consensus regarding the health benefits of physical activity (USDHHS, 1996), an editorial release from the Birth to Twenty study states:

regular physical activity substantially reduces the risk of dying of coronary heart disease, as well as decreases the risk for colon cancer, diabetes, and high blood pressure. It also helps to control weight; contributes to healthy bones, muscles, and joints; reduces falls among the elderly; helps to relieve the pain of arthritis; reduces symptoms of anxiety and depression; and is associated with fewer hospitalisations, doctor visits, and medications (Birth to Twenty, 2002: 1).

The editorial release further suggest that 'loading' sports, such as netball, hockey, soccer, rugby, have excellent benefits for bone mineral density in later life. This, in turn, reduces the risk of developing osteoporosis in later life. (That is not to say that 'non-loading' sport, such as swimming and cycling, aren't beneficial - they are great for keeping toned and fit) (Birth to Twenty, 2002).

These findings were echoed by the WHO in 2003 stating:

Physical activity has measurable biological effects, affecting cholesterol levels, insulin sensitivity and vascular reactivity. Moreover, these effects are dose-dependant – the more exercise the greater the health benefits. However, considerable health benefits can be gained with only small increases in moderate physical activity, e.g., regular walking (WHO, 2003: 10).

2.7 Techniques to Assess Physical Activity in Children and Adolescents

A number of different techniques are available for assessing physical activity including heart rate monitors, activity monitors, pedometers, direct observation techniques and various self report instruments (See Table 1 below) (Welk and Wood, 2000).

Table. 1: Comparison of Different Types of Physical Activity Assessments

Type of activity	Advantages	Disadvantages
measure		
Heart rate monitor	- Accurate indicator of	- High cost
	physical activity	- Time-intensive to download
	- Good educational	- Difficult to assess large
	potential to teach about	numbers of children
	the cardiovascular system	- Relevant only to aerobic
		activity
		- Other factors affect hear rate
		(e.g. Illness, anxiety etc.
Activity monitor	- Accurate indicator of	- High cost
	physical activity	- Time intensive to download
	- Good educational	- Difficult to assess large
	potential to teach about	numbers of children
	"accumulating" activity	Ti .
	over the whole day	
Pedometer	- Easy to use	- Records "quantity" of movement
		the but not "quality" (e.g. intensity of
	WESTERN CA	movement)
Direct observation	- Provide quantitative and	- Requires trained observers
	qualitative information	- Can only track several students
	about physical activity	at a time
		- Is very time consuming
Self -report	- Low cost	- Potential problem with validity
	- Easy to administer to	and reliability
	large groups	- The respondent must have the
	- Good educational	cognitive ability to self-report
	potential for use in	activity for a segmented day or
	curriculum	across days

Adapted from Welk and Wood (2000)

2.7.1 Self-report Instruments

Self-report instruments are the most commonly used format to collect information about physical activity. Depending on their scope, they can provide detailed or general information about physical activity (Sallis, 1991). A consideration in large scale studies is the need to apply methodology that is simple, low cost, robust and time-efficient so that large samples can be surveyed (Welk and Morrow, 2001: 58).

An advantage of self-reports is that they are inexpensive, easy to use and can be administered to large groups in a cost-effective manner. A limitation of self-reports is that they usually require some form of recall and can be quite subjective, limiting their use for population-based assessment of PA and energy expenditure. However, the tendency for people to report socially desirable responses can be problematic but this may be less of an issue with children (Welk and Morrow, 2001: 58).

Self-report measures vary considerably in the time frame and format used for the assessment. Some measures are designed to provide a general assessment of a child's normal level of physical activity. They often rely on a recall of activity completed over a representative period such as one week. A limitation of this format is that it assumes that the recent week is representative of the child's activity in other weeks (Welk and Morrow, 2001: 58).

In some countries, [e.g. the Canadian PA instrument, the Australian ERASS, or the Minnesota PA questionnaire], the assessments of 12 month recalled leisure time activity are accepted PA measurements used for surveillance. An advantage of these instruments is that it provides useful information about long-term habits, usually missing in surveys that measure the past 7 days or past two weeks physical activity (Merom and Bauman, 2003: 31).

Another class of self-report measures utilizes detailed logs or activity records collected or recalled over several days. An advantage of this approach is that children have an easier time recalling specific activities from a previous day than generalizing over a longer period of time. Another advantage is that these instruments can provide considerable details regarding the type, intensity and duration of activity. A disadvantage of these instruments is that the results may not generalize to a child's typical activity level (Welk and Morrow, 2001: 58).

2.8 Fitness

Health related fitness include components such as cardiovascular endurance, muscular strength, body composition and flexibility (Malina, 1994). Exercise prescription for the improvement of cardiovascular endurance involves four basic factors, i.e. type/mode of exercise; frequency of participation; duration of each exercise bout; and intensity of the exercise bout (Wilmore and Costill, 1994: 518). For most healthy young or middle-aged adults improvement in maximal oxygen uptake (VO_{2 max}) can be expected if (1) exercise

intensity is at least that required to bring the heart rate to about 150 beats per minute, (2) the duration of each exercise bout at this intensity is at least 30 minutes, and (3) the frequency of training is at least three times per week (Lamb, 1984: 195).

2.8.1 Physical Activity and Cardiovascular Fitness

The measuring of maximal aerobic capacity (VO_{2 max}) of children is important to determine the fitness and health status of a population and also to measure the effect of intervention programmes. Maximum aerobic capacity increases up to the age of 12 years, where after a plateau is reached and thereafter a decline (Rowland, 1990). Prista, Maia, and Marques, (1997) suggest that habitual activities of light to moderate intensity have an important influence on endurance. Fat percentage has a significant influence on VO_{2 max}. Rowland, Vanderburgh, and Cunningham (1997) report that low levels of physical fitness are caused by inactivity with an increase in fat percentage as a result.

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The aerobic fitness of 13-15 year old girls in the North-West Province of South Africa was reported as low for both high and low fat percentage groups (Engelbrecht et al., 2002). The European Paediatric Work Physiology group noted low mass related VO2max, in the absence of other illnesses, as a health risk (Armstrong and Mc Manus, 1996). Emiola et al. (2002) assessed the effect of activity level on the health and fitness of Nigerian primary school children and found that children with higher activity levels have better bone formation and are less prone to common illnesses than children with lower activity levels. This is in line with similar observations by Bar-Or (1987) and Armstrong and Welsman (1997).

Current Physical activity recommendations encourage adults to accumulate at least 30 minutes of moderate physical activity on most, preferably all, days of the week. Data from the Behavioural Risk Factor Surveillance System reveals that among Americans only 21.1% of men and 19.6% of women meet the recommendation (Simpson, Serdula, Galuska et al., 2003). A similar trend was found among South Africans (Lambert et al., 2001).

Biddle et al. (1998) state that moderate intensity activities for children may include brisk walking, cycling, swimming, most sports or dance, and that such activities may be carried out as part of transportation, physical activity, games, sport, recreation, work or structured exercise, and for younger children, as part of active play. Hence, the normal everyday activities in which children participate, including travelling to and from school, can contribute to their daily quantum of physical activity, which in turn, should lead to healthier lives.

2.8.2 Factors that Influence Physical Fitness in Children and Adolescents

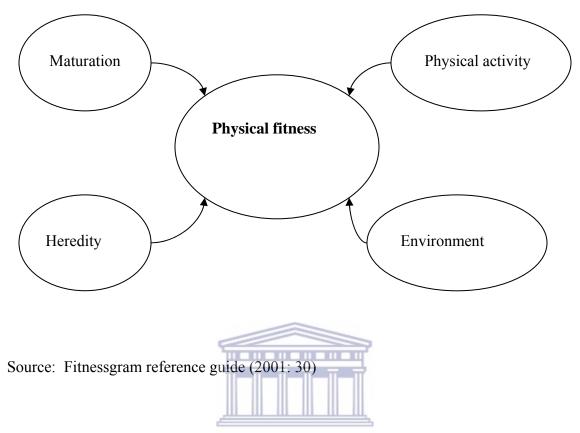
There are a variety of factors that influence levels of physical fitness and many are outside of a person's control (Welk and Blair, 2001). These factors include maturation, physical activity, heredity and the environment (see Figure 3).

Among children, heredity and maturation (age) have more influence on the fitness than does physical activity. As children become adults, maturation and age become less important factors (Pangrazi and Corbin, 2001: 30). Also healthy lifestyles begin to

become more important in influencing health and health risk factors as a person grows older. A report of the Surgeon General states that inactivity contributes significantly to a variety of hypokinetic conditions among adults while these conditions are not prevalent in youth (USDHHS, 1996).

Even an active child can score poorly on a fitness test if he or she does not have a hereditary predisposition to do well on a specific fitness test and/or if he or she is younger than his or her class mates or is a late maturer (Armstrong and Welsman, 2000; Pangrazi and Corbin, 1990). Likewise, a child who is inactive can perform better than many other children if he or she has a strong hereditary predisposition to do well and is older or more mature than other children in the group (Pangrazi and Corbin, 2001: 30). Other lifestyle factors such as nutrition and socioeconomic status (Travill, 2000) also play a role, as do factors such as environment and medical care. Some students are simply more motivated to do well on these types of tests than are their classmates (Pangrazi and Corbin, 2001: 30).

Figure 3: Factors influencing physical fitness



2.8.3 The Influence of Physical Activity on Physical Fitness

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Payne and Morrow (1993) reviewed 28 studies examining training and aerobic performance in children and concluded that improvement is small to moderate in prepubescent children. They state that:

the relatively small-to-moderate increase in pre- to post-aerobic improvement and the weak relationship between type of training program and effect size lead to questions concerning traditional practices when dealing with children and their fitness. Are we expecting too much from traditional physical education or fitness programs? Have award structures, designed to motivate children within these programs or test batteries, been appropriately designed when children appear to elicit only small improvements in aerobic capacity? Clearly, curriculum planners, teachers, fitness directors, exercise physiologists, and physicians need to consider carefully the ramifications of these findings (Payne and Morrow, 1993: 312).

If there is improvement in running performance in young children, Bar-Or (1983) postulates that it may occur because they become more efficient mechanically or improve in anaerobic metabolism. Another theory is that young children are active enough to make intergroup differences negligible (Corbin and Pangrazi, 1992).

Katzmarzyk, Malina, Song, and Bouchard (1998) evaluated the relationship between indicators of physical activity and health-related fitness in Quebec youth 9-18 years. The authors concluded that there is a significant relationship between activity and health-related physical fitness, but a large part of the variability (80-90%) in fitness is not accounted for by physical activity.



2.9 Body Composition and Obesity Resilient of the

According to the National Institute on Health, obesity in children has become an epidemic in the United States. The number of children who are overweight has doubled in the last two to three decades with one child in five being overweight. The increase is in both children and adolescents, and in all age, race and gender groups (Torgan, 2002).

The interest in body composition has grown over the last decade because childhood obesity is associated with diseases such as hypertension, type 2 diabetes, respiratory ailments, orthopaedic problems, trouble sleeping, and depression (Styne, 2001). Lohman (1987) postulates that children with high % body fat (BF) tend to die sooner than a person of average weight, especially those who are obese at a younger age.

Body composition can be defined as a ratio of fat-free mass and is expressed as percentage body fat (%BF) (Lee, 1995). Percentage body fat is regarded as high when exceeding 25% for pubertal boys, 30% for pre-pubertal children or 35% for pubertal girls (Mantsena, Monyeki and Toriola, 2002).

Data from a number of studies reviewed by Goran (2001) provide strong evidence that higher levels of body fat during childhood can predict overweight later in life. Over nutrition was found to be prevalent among adult South Africans, particularly urban women (Puoane, Steyn, Bradshaw, Laubsher, Fourie, Lambert and Mbananga, 2002). However, Ellisras rural children were found to be predominantly ectomorphic with a low existence of obesity either in terms of overweight or overfatness (Monyeki, Van Lenthe, and Steyn, 1999).

According to the findings of the Youth Risk Behavior Survey of 2002, 17% of South African adolescents are over-weight while 4% are obese (Department of Health, 2002: 2).

2.9.1 Physical Activity and Obesity

The obesity epidemic prevalent in the Western world has been found to be fundamentally linked to a contemporary increase in energy intake and decrease in energy expenditure (physical activity), specifically during childhood (Shearer, Lauren, Baxter-Jones, Adams, Mirwald and Bailey, 2004). In 10 - 15 year old males in the North-West province of South Africa, it was found that the measures of obesity increased with a decrease in physical activity and that rural subjects are less obese than the semi-urban and urban

subjects, independent of their level of physical activity (Underhay, De Ridder, Van Rooyen, and Kruger, 2002).

The first South African Youth Risk Behaviour Survey conducted by the Medical Research Counsel, found that with regards to physical activity, 29% of high school children had no physical education classes in schools and 25% watched TV for over 3 hours per day (Department of Health, 2002: 12).

2.10 Hypertension

Blood pressure (BP) refers to the arterial pressure as measured in the brachial artery of the arm. High blood pressure (hypertension) is a chronically elevated arterial blood pressure sometimes arbitrarily defined as any resting pressure greater than 140/90 millimetres of mercury (mmHg). It is responsible for 10-15 % of all deaths in people over 50 years of age (Lamb, 1984: 380).

According to the NIH (1987) report, if a BP is greater than or equal to the 90th percentile but there is no end-organ damage or hypertensive crisis, then several closely timed measurements are made. Only after repeated measurements are greater than or equal to the 90th percentile, should a child be considered as having high normal BP or hypertension.

Population studies (Steyn, Rossouw, Jooste et al., 1993; Steyn, Jooste, Fourie et al., 1986; Seedat, 1983) in South Africa revealed that the Indian population has the lowest

incidence of hypertension (about 14%), while the urbanized Zulus have the highest incidence (25%). However, in rural Zulus, the incidence of hypertension is between 2% and 8% (Seedat, Hackland and Mpontshana, 1981), suggesting that urbanization may considerably increase the risk of hypertension.

The stepwise regression analysis of Nigerian school children revealed that the strong determinants of blood pressure levels were body mass, BMI, and triceps skinfolds (Balogun, Obajuluwa, Abereole, Olaogun, Oyeyemi, and Balogun, 1990). In other studies of children, the partial correlation coefficient identified body mass as the most important determinant of systolic and diastolic blood pressure (Guerra, Ribeiro, Costa, Duarte, and Mota, 2002). These findings are in agreement with other data suggesting that obese people are more likely to be hypertensive than their lean counterparts showing a positive relation of body mass and fat distribution with blood pressure (Schieken, 1995). Age may also be a factor, independent of height and body mass, affecting blood pressure level in childhood (Lauer, Burns, and Clarke, 1985). Heavier and/or taller children tend to have higher blood pressure levels in comparison to lighter and/or shorter children of the same age (Anderson, and Haraldsdottir, 1995).

Among all known childhood predictors of adult blood pressure levels, the level of blood pressure in childhood is by far the strongest (Gillman, Cook, Rosner, Evans, Keough, Taylor, and Hennekens, 1993; Berenson, Srinivasan, Webber, Nicklas, Hunter, Johnson, Arbeit, Dalferes, Wattigney, and Lawrence, 1991; Lauer, and Clarke, 1989). Thus, the potential to prevent adult hypertension starting in childhood depends on knowledge of the

determinants of childhood blood pressure and aspects of its short- and long-term variability (Gillman and Ellison, 1993).

2.10.1 Physical Activity and Hypertension

The studies (Cooper, Pollock, Martin, White, Linnerud, and Jackson, 1976; Montoye, Metzner, Keller, Johnson, and Epstein, 1972) that investigated the relationship between inactivity and hypertension found that the more active and fit subjects, exhibited lower systolic and diastolic blood pressures. Fagard, M'Muyamba, Staessen, Vanhees, and Amery (1985) concluded that BP reduction with chronic exercise averaged 9 mm systolic and 7 mm diastolic. These relatively small differences indicate that exercise alone cannot replace pharmacological interventions in hypertensive individuals. In individuals with high normal blood pressure, however, exercise may reduce pressures into the normal range.

2.11 Conclusion

A number of studies have documented links between physical activity and physical fitness and cardiovascular disease risk factors (mainly cholesterol) in children (Katzmarzyk, Malina, and Bouchard, 1999; Raitakari, Taimela, Porkka, Temala, Valimaki, and Akerblom, 1997). Because both physical activity and fatness have been found to track over the lifespan (Van Mechelen, Twisk, Post, and Kemper, 2000) it is important that children establish positive lifestyle habits and healthy levels of fitness at an early age. While there is significant health benefits associated with physical activity

for children (Bar-Or, 1995), the relationships would likely be contingent on continued involvement over time.

South African studies (Underhay, De Ridder, Van Rooyen, and Kruger, 2002; Sparling, Noaks, Steyn, Jooste, Bourne, and Bardenhorst, 1994; Levitt, et al., 1993; Noakes, Benade, Jooste, and Van Zyl, 1986; Walker, Walker, and Mngomozulu, 1982) on exercise, physical activity and the prevention of chronic disease are limited and no data exist which describe the relationship between participation in physical activity and cardiovascular disease risk factors of rural school children in the Overberg/Caledon region of the Western Cape.



CHAPTER THREE

METHODOLOGY

3.1 Study Design

A comparative and correlational cross-sectional study design was used in this study.

All surveys tests and measurements were conducted by the researcher between March

and May 2005 and included the following:

- A 12-month Physical Activity (PA) prevalence survey
- Anthropometric measurements
- Fitness tests
- Blood pressure measurements

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3.2 Research Setting

3.2.1 Study Population

The study population was school children aged 14 - 16 years of both sexes from a secondary and primary school in the Caledon/Overberg region of the Western Cape. These traditionally coloured (mixed heritage) state-funded schools were selected because it is attended by a substantial number of children walking long distances to and from school.

Caledon, an agricultural town on the slopes of the Klein Swartberg 110km east of Cape Town on the N2, is surrounded by farmlands of wheat, barley, canola and onions. The town owes its location to the presence of the hot water springs, which were used by the local Khoi-Khoi long before Ferdinand Appel was granted grazing rights at the springs in 1708. The population of Caledon consists of approximately 12000 people (Caledon Tourism, 2005).

3.2.2 Sample Size and Sampling Procedure

A sample of 162 (72 boys and 90 girls) subjects, representing school children, were randomly selected from the study population. The names of all 14-16 year old children from the participating schools were obtained from the school registers. The boys and girls were then separated and listed alphabetically. From these lists, 72 boys and 90 girls were randomly selected using the moon stats random number generator computer programme.

Permission to conduct the research at the selected schools was obtained from the Western Cape Education Department and the School Governing Bodies (Appendix 1). Informed written consent was obtained from the subjects and their parents/guardians using standardised consent forms. To ensure proper understanding of the content, all forms were translated into Afrikaans, which is the mother tongue of all the participants (Appendix 2). The research was approved by the Higher Degrees Committee of the University of the Western Cape.

3.3 Data Collection

3.3.1 Physical Activity

3.3.1.1 "Exercise, Recreation and Sport Survey" (ERASS)

The "Exercise, Recreation and Sport Survey" (ERASS), developed by Merom and Bauman (2003), was adapted and used as a self administered questionnaire to obtain an estimate of the prevalence of habitual and sufficient participation in health enhancing physical activities (HEPA) and the prevalence of sedentariness (Appendix 3). HEPA, relevant to Southern Africans, particularly those common among rural children were added to the Australian version (Merom and Bauman, 2003) of the ERASS. The additional activities included carrying heavy bags, and making/chopping and carrying fire wood.

A second set of questions were included which focused specifically on active commuting to and from school, and sedentary behaviour such as time spent watching TV and/or playing computer/video games. There were also demographic questions asked, which related to gender, age, and residential address etc. (Appendix 4).

Merom and Bauman (2003) recently used the ERASS to successfully collect information, from Australians aged 15 years and older, on participation in any type of PA done for exercise, recreation or sport purposes, recalled during the previous 12 months. They concluded that the ERASS provides useful health-related information about PA and

that it may be more useful than previously thought for PA surveillance purposes, as long as it is consistent in its measurement over time (Merom and Bauman, 2003: 4).

3.3.1.2 Health Enhancing Physical Activity (HEPA) Measures

The conceptual definition of PA in this survey was activity undertaken for the purpose of 'exercise, recreation or sport' as understood by the respondent (Merom and Bauman, 2003). The common dimensions of measures of HEPA are intensity, frequency and duration. To obtain health benefits, a minimum of at least moderate intensity activity is required. This is usually an activity that results in energy expenditure of at least three metabolic equivalents (3 METs), which represents the ratio of work metabolic rate to a standard resting metabolic of 1 MET obtained during quiet sitting (Wilmore and Costill, 1994: 523).

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The ERASS questionnaire allows one to derive estimates of health related PA (HEPA) based only on intensity and frequency. Using the energy expenditure compendium of Ainsworth et al. (1993), each of the activity types is assigned to either recreation and light physical activities (RLPA), which are activities that require less than 3.5 METs, or to moderate-vigorous physical activities (MVPA), which are activities that require at least 3.5 METs or more. Since the same type of MVPA could be undertaken both at a moderate or at a vigorous intensity (e.g. walking, cycling, swimming) and respondents were not asked to indicate the level of intensity (e.g. asked about participating in activities that resulted in increased heart rate or sweating, a commonly used indicator to

assess levels of intensities), one cannot assess vigorous intensity alone. Therefore only one level of HEPA is assumed, which is at least moderate, though vigorous types of activities could have been included (e.g. running, aerobics, etc.) within the broad MVPA category. Since there is no evidence for direct health benefits of Recreational and Light Physical Activities (RLPA), it is excluded from being classified as HEPA (Merom and Bauman, 2003: 10). The activity types that were classified as MVPA and under RLPA categories are listed in Appendix 3.

3.3.1.3 Physical Activity Classification

Respondents were classified into three groups (i.e., Sedentary, Active, and Sufficiently active) based on their level of physical activity.

A. Sufficiently active – respondents who did any type of Health Enhancing Physical Activity (HEPA)[≥ 3.5 METs] including walking more than 3km to and from school, for at least 5 days a week during the past year. The number of times each respondent participated in either walking and/or any moderate-vigorous physical activities (MVPA), in the last 12 months was summarised and divided by 52 weeks. Participation in RLPA was not included.

B. Active – respondents who did any type of HEPA [\geq 3.5 METs] at least 1 day per week and walk less than 3 km to and from school.

C. Sedentary - respondents who did less than 0.5 days a week of any HEPA, even if they participated in RLPA, and they did not do any moderate-intensity activity or walking at least 2 km to and from school during the past year, were defined as 'sedentary' individuals.

3.3.2 Anthropometry

All subjects underwent a series of anthropometric measurements, including body weight, standing height, and skinfold thickness (subscapular and triceps), in accordance with the standard procedures of the International Society for the Advancement of Kinanthropometry (ISAK) (Norton and Olds, 1996). Descriptions of the measurements technique and equipment used are included in Appendix 5. Body mass index (BMI) was computed as weight (kg) / height (m)². Cut-off points for body mass index in children, recommended by Cole, Bellizi, Flegal, and Dietz (2000) were used to determine the prevalence of overweight (25 kg/m² by the age of 18 years) and obesity (30 kg/m² by the age of 18 years). Skinfold thickness measurements used to estimate %BF in population studies has recently been validated by Wong, Stuff, Butte, Smith, and Ellis (2000) and Lohman, Caballero, Himes, Hunsberger, Reid, Stewart, and Skipper, (1999).

3.3.3 Blood Pressure (BP)

Blood pressure was measured using an automatic blood pressure monitor (Microlife BP 3BT0-A) with an appropriate cuff, covering two-thirds of the upper arm. The researcher

performed the procedure while the subject was in a sitting position with the arm at the level of the heart and after a 5-minute rest.

Selection of the correct BP cuff has been the subject of an intense, apparently unresolved, debate (Arafat and Mattoo, 1999). The most widely known recommendations on cuff selection for BP in children are from the Task Force on Blood Pressure Control in Children and its update by the National High Blood Pressure Education Program Working Group on Hypertension Control in Children and Adolescents (National High Blood Pressure Education Program Working Group on Hypertension Control in Children and Adolescents, 1996). According to the 1987 report, the BP cuff bladder should be wide enough to cover three quarters of the upper arm length from the acromion to the olectanon (National Heart, Lung, and Blood Institute Report of the Second Task Force on Blood Pressure Control in Children, 1987). In its update in 1996, the working group recommended that the width of the cuff bladder should equal 40% of the mid-upper arm circumference (National High Blood Pressure Education Program Working Group on Hypertension Control in Children and Adolescents, 1996).

Several automated devices use the oscillometric principle of measuring blood pressure. The most widely used of these devices are those manufactured under the name Dinamap. A Dinamap device measures blood pressure by first inflating the cuff rapidly above systolic pressure and then deflating the cuff in a stepwise fashion. When blood starts flowing through the artery, oscillations are detected by the surrounding cuff. The point of maximal oscillations corresponds to mean arterial pressure. Systolic (SBP) and diastolic

(DBP) pressures are calculated as functions of the mean and are calibrated to be equivalent to corresponding intra-aortic pressures (Ramsey, 1991).

The automatic BP device requires relatively little training, involving attention only to subject and environmental factors, application of the appropriate cuff, and correct use of the machine controls. Because there is no observer, bias caused by digit preference or knowledge of previous readings is eliminated. It is relatively easy to use with small children because there is no need for auscultation (Gillman and Cook, 1995).

3.3.3.1 Hypertension Cut-off Points

The participant was considered to have "suspected" hypertension when his/her SBP or DBP level for his/her age-sex-height group was above the 90th and below the 95th percentile value recommended by the updated 1987 Task Force Report of the National Heart Lung and Blood Institute of America. Similarly, the participant was considered to have "definite" hypertension when his/her SBP or DBP level for his/her age-sex-height group was above the 95thpercentile value as recommended by the updated Task Force Report (National High Blood Pressure Education Program Working Group on hypertension control in children and adolescents, 1996).

3.3.4 Fitness

The following fitness components were included for evaluation. See Appendix 6 for a detailed description of each test.

3.3.4.1 Cardiovascular Endurance

Cardiovascular endurance is defined as the ability of the circulatory and respiratory systems of the body to supply energy and especially oxygen to the muscles and for the muscles to use this energy to sustain prolonged exercise (Corbin and Lindsey, 1997: 54). Maximal oxygen uptake (VO_{2 max}) is a standard measure of cardiovascular endurance/cardiorespiratory fitness and describes maximal aerobic capacity adjusted for body size and composition (Gallagher, Savage, Murray, Smith, Young, Robson, Neville, Cran, Strain, and Boreham, 2002).

The maximal 20 m shuttle run test, described by Leger and Lambert (1982), was carried-out to predict maximal oxygen uptake (VO_{2 max}). The 20m shuttle run test (20SRT) was validated in laboratory conditions and showed moderate correlation with VO_{2 max} (r=0.72, p \leq 0.01), assessed by treadmill (Barnett, Chan, and Bruce, 1993). Laboratory tests are not practical for large groups and population studies because of the cost and operational implications. Therefore, field testing is still one of the most common methods in large studies (Guerra et al., 2002).

3.3.4.2 Flexibility

Flexibility is defined as the range of motion, available at a joint or a group of joints (Corbin and Lindsey, 1997: 78). The 'sit and reach' test which measures the flexibility of the lower back and hamstrings was used as a measure of flexibility.

Logical validity is accepted for this test. Johnson and Nelson (1986: 208) recorded reliability coefficients of .97 when the best score of three trials was recorded from separate measurements and correlated.

3.3.4.3 Grip Strength

Strength may be defined as the amount of muscular force that can be exerted against movable and immovable objects in one single maximal effort (Corbin and Lindsey, 1997: 99). Hand grip strength was used as a measure of strength and was tested by means of the hand grip dynamometer. Logical validity is accepted for this test.

3.3.4.4 Leg Power

Power is defined as the ability to release maximum force in the fastest possible time (Johnson and Nelson, 1986: 206). The standing long jump was used as a measure of power. Face validity is often claimed for this test.

3.3.5 Nutritional Anthropometry

Undernutrition, characterised by poor anthropometric status, is often a consequence of inadequate diet and frequent infection, and leads to calorie, protein, vitamin and mineral deficiency. In particular, stunting is a consequence of chronic poor nutrition, while wasting is a reflection of an acute poor nutritional condition (WHO, 2002).

For undernutrition analysis, measures of height-for-age, weight-for-age, and weight-for-height were calculated and expressed as numbers of standard deviations away from the mean (Z-scores) as modelled in the United States National Health and Nutritional Examination Survey III (NHANES) samples using the SAS (Frisancho, 1990). Z-score values of less than –2 for weight-for-age, height-for-age and weight-for-height were used as thresholds to determine the prevalence of underweight, stunting and wasting respectively (Gibson, 1990).

For overnutrition analysis, body mass index (BMI) was calculated for each subject, and the age-dependent BMI cut-off points recommended by Cole for overweight (25 kg/m² by the age of 18 years) and obesity (30 kg/m² by the age of 18 years) were used to determine whether a child was overweight or overweight and obese (Cole et al., 2000).

3.4 Data Analysis

Data was analysed using the SAS Version 9.1 (SAS Institute; Cary, NC) statistical package from the University of the Witwatersrand. Descriptive statistics (mean and standard deviation) were used in order to characterise and describe the sample. Analysis of variance (ANOVA) was used to test differences between age groups and T-tests for significance of gender differences. Pearson's product moment correlation coefficients were performed to determine possible associations between fitness, blood pressure and physical activity (PA). Multiple regression analysis was performed to assess the influence of independent variables to the variance in dependent variables. The level of significance for all tests was set at P<0.05.

3.5 Ethical and Legal Considerations UNIVERSITY of the

Written permission to conduct the research in the selected schools was obtained from the Western Cape Education Department and the School Governing Body. Participation in the research project was voluntary with written parental consent and individual records were kept strictly confidential. Individual results were only made available to the participating subjects. Subjects were allowed to withdraw from the study or tests at any stage.

Skinfold, blood pressure and anthropometric measurements were done privately with each subject. Testing protocols were explained before any testing would commence.

Every effort was made to minimize the occurrence of any and all discomforts during testing. No injuries were reported during testing. The work of others is acknowledged and written permission was obtained to use their material.



CHAPTER FOUR

RESULTS

4.1 Sample and Sample Size

The sample n=162 consisted of 72 boys and 90 girls. The mean (SD) age of the subjects was 15.1 ± 0.7 , ranging from 14 to 16 years. Table 4.1 presents the number of subjects by age and gender.

Table 4.1 Number of subjects by age and gender

Age	Gender Boys	Girls	All
14	16	21	37
15	23	UNTVERSITY of the	62
16	33	WESTERN CAPE	63
Total	72	90	162

4.2 Physical Activity

4.2.1 Introduction

The overall response rate to the ERASS - questionnaire was 98.14% (n=159) for rural school children aged 14 – 16 years. Only 3 girls did not complete the questionnaire. Of all the respondents, 45.28% (n=72) were boys, while 54.71% (n=87) were girls. Table 4.2 presents the data on sports participation, commuting mode, and hours spent watching television (TV) and/or playing computerized games. Most of the respondents

(55.3) participated in sports over the previous 12 months. A higher proportion of boys (66.7%) than girls (45.0%) participated in sports. The habitual mode of commuting to and from school for most of the respondents was walking (76.7%), while 23.3% commuted by bus or taxi.

Respondents were asked to indicate the number of hours per day they spent in front of the computer and/or television (TV). Overall, 22.4% spent more than 3 hours per day watching TV and/or playing computer games, while 30.9% spent between 30-60 minutes per day in front of the TV and/or computer.

Table 4.2 Descriptive statistics of respondents by gender

Variables	N		Percentage (%)
	UN	Boys n=72 ESTERN C	Girls n=87	All n=159
Sports participation:	88	66.7	45.0	55.3
Commuting mode to school:				
Bus/Taxi	37	22.2	24.1	23.27
Walking	122	77.8	75.9	76.72
TV/computer games:				
0.5-1 hours/day	47	30.6	30.5	30.92
1-2 hours/day	43	30.0	26.8	28.28
2- 3 hours/day	28	20.0	17.1	18.42
>3 hours/day	43	18.6	25.6	22.36

4.2.2 The 12-month Prevalence of any Physical Activity (PA)

Table 4.3 describes the prevalence of participation in any physical activity done for recreation exercise or sport purposes in the past 12 months, after grouping activity types into three main categories. The 12-month prevalence of recreational and light activities (RLPA) was 28.93% and moderate and vigorous PA (MVPA) 55.35%. Of all the children walking to and from school, 42.77% walked more than 2 km.

Table 4.3 The prevalence of 12-months participation in various types of physical activity based on ERASS (n=159)

Variable	N Percentage (%)				
	ŢI-II-II	All	Boys	Girls	
RLPA	46	28.93	25.0	32.18	
Walking (≥ 2 km)	68 WESTE	RSITY of the 42.77 RN CAPE	44.44	41.37	
MVPA	88	55.35	66.66	45.97	

Gender differences in the prevalence of these categories of physical activity were examined for walking, MVPA and recreational activities. Higher proportions of boys (66.7%) than girls (46%) participated in MVPA other than walking and more boys (44.4%) than girls (41.4%) participated in walking more than 2 km to and from school. Recreational and light activities were more prevalent among girls (32.2%) than boys (25%).

4.2.3 Walking

Walking to and from school was the most prevalent physical activity reported by the respondents. The respondents reported a daily value which ranged from 5 – 60 minutes. Table 4.4 presents the distances the rural children walk to and from school by gender. More respondents reported walking less than 2 km (57.2%) to and from school compared to those walking more than 2 km (42.7%). Higher proportions of girls (32.1%) than boys (25.2%) walk less than 2 km and more than 3 km (17.0% vs. 14.5%) to and from school.

Table 4.4 Prevalence of walking to and from school by distance

		Distar	2 -3 km	> 3km
Boys	n=72	25.2% 25.2%	RSITY of the 5.7% RN CAPE	14.5%
Girls	n=87	32.1%	5.7%	17.0%
All	n=159	57.2%	11.3%	31.4%

4.2.4 Prevalent Activities other than Walking

In the year prior to the study, rural school children took part in physical activities for exercise, recreation or sport other than walking reflected in Table 4.4 and Figure 1.1.

The most prevalent activities, besides walking, were athletics (21.4%) and rugby (21.4%). The second most prevalent activity was carrying heavy shopping bags (14.5%). Netball was the third most prevalent activity (13.8%).

Table 4.6 and Figures 1.2 – 1.3 present the gender differences in prevalent activities other than walking. The physical activities most prevalent in boys were rugby (54.8%), athletics (26.4%), cycling (13.9%), and working out in the gym (13.9%), while netball (25.3%), carrying heavy shopping bags (18.4%), and athletics (17.2%) were most prevalent in girls. Gender specific physical activities such as rugby and gymnastics were prevalent among boys, while girls engaged in netball, table tennis and dance.



Table 4.5 Participation in PA for exercise, recreation or sport other than walking, by activity type

walking, by ac		0/
Type of activity (n=159)	N	%
Athletics	34	21.38
Rugby	34	21.38
Carrying heavy shopping bags	23	14.46
Netball	22	13.83
Swimming	18	11.32
Gym/aerobics	18	11.32
Cycling/biking	15	9.43
Wood chopping/carrying	13	8.17
Jogging/running	12	7.54
Cricket	10	6.28
Volley ball	UNIVE.	RSITY of the 5.66 ERN CAPE
Orienteering/hiking	8	5.03
Soccer	8	5.03
Tennis	7	4.40
Roller skating	7	4.40
Golf	7	4.40
Basket ball	5	3.14
Table tennis	2	1.25
Gymnastics	1	0.62
Dance	1	0.62

Table 4.6 Participation in PA for exercise, recreation or sport other than walking, by activity type and gender

Type of activity	Boys	s (n=72)	Girls	s (n=87)
	N	%	N	%
Athletics	19	26.38	15	17.24
Rugby	33	45.83		
Carrying heavy shopping bags	7	9.72	16	18.39
Netball			22	25.28
Swimming	9	12.50	9	10.34
Gym/aerobics	10	13.88	8	9.19
Cycling/biking	10	13.88	5	5.74
Wood chopping/carrying	6	8.33	7	8.04
Jogging/running	8	11.11	4	4.59
Cricket	8	11.11	2	2.29
Volley ball		R694Y of the	4	4.59
Orienteering/hiking	WESTI	ER ₅ N ₅ CAPE	4	4.59
Soccer	7	9.72	1	1.14
Tennis	2	2.77	5	5.74
Roller skating	4	5.55	3	3.44
Golf	4	5.55	3	3.44
Basket ball	1	1.38	4	4.59
Table tennis			2	2.29
Gymnastics	1	1.38		
Dance			1	1.14

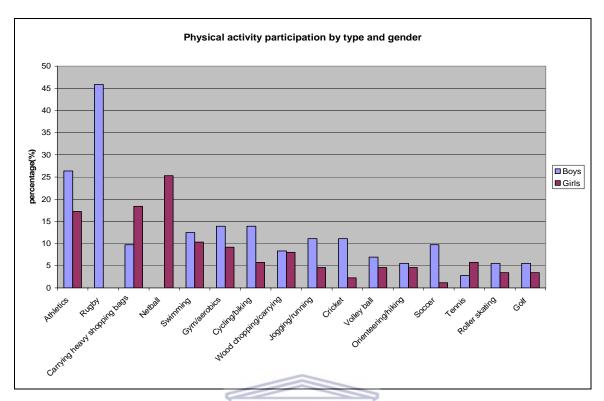


Figure 1.1 Physical activity prevalence of boys and girls aged 14-16 years



Respondents were classified into 3 groups (i.e., Sedentary, Active, and Sufficiently Active) based on their level of physical activity (Table 4.7).

A. **Sufficiently active** – percentage of respondents who did any type of Health Enhancing Physical Activity (HEPA)[≥ 3.5 METs] including walking more than 3 km to and from school, for at least 5 days a week during the past year. The number of times each respondent participated in either walking and/ or any moderate-vigorous physical activities (MVPA), in the last 12 months was summarised and divided by 52 weeks. Participation in RLPA was not included.

B. Active – percentage of respondents who did any type of HEPA [\geq 3.5 METs] at least 1 day per week and walk less than 3 km to and from school.

C. **Sedentary** - the percentage of respondents who reported less than 0.5 days a week of any HEPA, even if they participated in RLPA, and they did not do any moderate intensity activity or walking at least 2 km to and from school during the past year, were defined as 'sedentary' individuals.

Table 4.7 Classification according to physical activity levels of rural children

		Percentage (%)			
Classification		ĪĪĪĪ			YRBS	S (2002)
		All	Boys	Girls	_Nat_	WC_
Sedentary	n=46	28.93	RSITY of the 25.0 RN CAPE	32.18	37.5	41.7
Active	n=79	49.69	44.4	54.02	33.5	32.1
Sufficiently active	n=34	21.38	30.55	13.79	44.6	40.0

This classification indicated that 28% of respondents participated in only recreational and low intensity physical activities, while 21.4% of respondents engaged in sufficient health enhancing physical activities. Most of the respondents (49.69%) were classified as active. More girls (32.18%) than boys (25.0%) were classified as "sedentary", while more boys (30.55%) than girls (13.79%) were classified as "sufficiently active".

4.3 Anthropometric and Blood Pressure Characteristics

Anthropometric and blood pressure characteristics for boys and girls aged 14-16 years are presented in Table 4.8. For the total sample (n=162), significant gender differences were recorded for height, BMI, indices of fat distribution, and systolic blood pressure.

No significant gender differences were found for weight at all ages. The weight of both sexes increased consistently from age 14 years to 16 years (Table 4.9). The boys were significantly taller than the girls from ages 14-16 years, and the mean height for both sexes increased consistently during these ages.

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Table 4.8 Descriptive statistics of rural boys and girls aged 14-16 years

VARIABLES	BOYS	GIRLS	TOTAL
	N = 72	n = 90	n = 162
Age (yrs)	15.2 (0.80)	15.1 (0.75)	15.1 (0.77)
Weight (kg)	50.5 (7.56)	51.5 (10.63)	51.1 (9.38)
Height (cm)	165.1 (0.08)*	158.6 (0.06)*	162.0 (0.08)
BMI (kg/m²)	18.48 (1.91)*	20.42 (3.78)*	19.56 (3.23)
Triceps SF (mm)	6.92 (1.90)*	13.94 (4.53)*	10.82 (5.02)
Subscapular SF (mm)		13.20 (4.57)*	10.22 (4.91)
Sum of skinfolds (mm)	13.40 (3.57)*	27.14 (9.04)*	21.04 (9.88)
BP (mmHg):	n = 50	n = 65	n = 115
Systolic BP	126.1 (13.05)*	120.4 (11.95)*	122.8 (12.71)
Diastolic BP	74.4 (10.42)	71.3 (8.57)	72.7 (9.52)

Results are presented as means (standard deviations).

^{*} Indicates a significant difference between boys and girls (p<0.05)

Body mass index were consistently higher for girls than boys and reached a significant level at ages 15-16 years. Consistent with weight and height, BMI gradually increased with age.

The girls had significantly greater skinfolds than the boys at all ages. Skinfolds gradually increase with age among girls but decrease with age among boys (Table 4.10).

Boys recorded consistently higher values for both systolic- and diastolic blood pressure than girls, except for diastolic blood pressure at age 14 years, where girls recorded a slightly higher mean value than boys. Only systolic blood pressure at age 15 years showed a significant gender difference (Table 4.11). Mean systolic blood pressure gradually increased with age among both sexes, whereas diastolic blood pressure increased for boys but decreased for girls at all ages (Table 4.11).

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Pearson's correlation coefficients of blood pressure with selected CVD risk factors are presented in Table 4.13. Body mass index, gender, weight and grip strength were found to be significantly correlated with systolic blood pressure, whereas only $VO_{2\,max}$ was found to be significantly correlated with diastolic blood pressure.

Table 4.9 Mean (SD) weight (kg), height (cm) and body-mass index (BMI) of rural school children aged 14-16 years

Age			Weight	Height	BMI
(Years)	Boys	Girls	(kg)	(cm)	(kg/m^2)
	N	N	Boys Girls	Boys Girls	Boys Girls
14	17	21	47.0 47.8	160.5 156.8 *	18.1 19.4
			(7.25) (9.23)	(0.07) (0.05)	(1.96) (3.45)
15	27	44	51.8 51.3	165.9 158.60 *	18.8 20.4 *
			(7.84) (8.32)	(0.09) (0.07)	(2.14) (3.18)
16	36	31	53.3 54.5	166.8 159.3 *	19.1 21.4 *
			(13.34)(13.31) _{SITY} WESTERN C	(0.07) (0.06) CAPE	(3.61) (4.84)

^{*} Indicates a significant difference between boys and girls for the same age (p<0.05)

Table 4.10 Mean Skinfolds [SF] (mm) of rural school children aged 14 -16 years

Age			Tricep	OS		Subsc	apular		Sum o	of SF
(Years)	Boys	Girls	(mm)			(mm)			(mm)	
	N	N	Boys	Girls		Boys	Girls		Boys	Girls
14	17	21	7.9	12.3	*	7.1	11.4	*	14.9	23.7 *
			(2.71)	(3.95)		(2.41)	(3.39)		(5.08)	(7.14)
15	27	44	6.7	14.1	*	6.5	13.2	*	13.2	27.3 *
			(1.96)	(3.85)	<u></u>	(1.90)	(3.84)		(3.80)	(7.68)
16	36	31	6.6	14.9	*	6.2	14.4	*	12.8	29.3 *
				(5.45)	SITY		(5.76)		(2.16)	(11.18)
				ESTE		-				

Standard deviations are given in brackets.

^{*} Indicates a significant difference between boys and girls for the same age (p<0.05)

Table 4.11 Mean systolic and diastolic blood pressure (BP) measurements of rural school children aged 14-16 years

Age			Systolic Blo	Systolic Blood Pressure		Blood Pressure	
(Years)	Boys	Girls	(mm	hHg)	(mmHg)		
	N	N	Boys	Girls	Boys	Girls	
14	12	13	123.4	120.0	72.2	73.5	
			(13.00)	(10.38)	(9.64)	(7.62)	
15	16	25	127.4	117.9 *	74.3	70.4	
			(14.51)	(10.42)	(9.35)	(8.74)	
16	21	27	126.7 _{NIVE}	R 122.8 _{V of the}	76.4	71.1	
			(12.30) STI	ER(13.78)	(11.72)	(8.95)	

Standard deviations are given in brackets

^{*} Indicates a significant difference between boys and girls for the same age (p<0.05)

Table 4.12 T-test analysis for significant differences in weight, height, BMI, and blood pressure between boys and girls

Variable	Age	T-Score	p-value	
Weight	14	_	_	
	15	-	_	
	16	-	-	
Height	14	-2.08	0.045*	
	15	-2.96	0.006*	
	16	-4.45	0.000*	
BMI	14		-	
	15	2.59	0.012*	
	16	3.20	0.003*	
Sum of skinfolds	14	UNIVERSITY of the 4.17 WESTERN CAPE	0.000*	
	15	9.65	0.000*	
	16	7.96	0.000*	
Systolic BP	14	-	-	
	15	-2.45	0.019*	
	16	-	-	
Diastolic BP	14	-	-	
	15	-	-	
	16	-	-	

^{*} P < 0.05

⁻ Difference not significant

Table 4.13 Pearson's correlation coefficients of Blood pressure with selected CVD risk factors

Sy	stolic BP	Diastolic	BP
r	p-value	r	p-value
0.13	0.166	0.03	0.768
0.22	0.016*	0.16	0.080
0.26	0.005**	0.01	0.894
0.17	0.065	0.11	0.237
0.21	0.02*	0.08	0.399
			0.095
0.19	0.069	0.21	0.045*
0.19	0.110	0.09	0.423
-0.08	0.526	-0.05	0.680
0.36	0.001**	0.21	0.068
	0.13 0.22 0.26 0.17 0.21 -0.04 0.19 0.19 -0.08	0.13 0.166 0.22 0.016* 0.26 0.005** 0.17 0.065 0.21 0.02* UNIVERSITY of the control of the	0.13 0.166 0.03 0.22 0.016* 0.16 0.26 0.005** 0.01 0.17 0.065 0.11 0.21 0.02* 0.08 UNIVERSITY of the Company

^{*} Indicates a significant correlation (p<0.05)

^{**} Indicates a significant correlation (<0.01)

4.3.1 Nutritional Status

The nutritional status of rural school children aged 14-16 years is presented in Table 4.14. The overall average for being underweight, as indicated by weight-for-age, was 9.3%. Significantly more boys (15.3%) than girls (4.4%) were underweight. Overall, 4.3% of children were found to be stunted as indicated by height-for-age. Significantly more boys (6.9%) than girls (2.2%) were stunted. For the total sample, 6.2% of learners were overweight while 1.9% were overweight and obese. Overweight (11.1%) and obesity (3.3%) were only recorded among the girls. None of the boys were found to be either overweight or obese.

Table 4.14 Nutritional status of rural school children aged 14-16 years compared to National (Nat) and Western Cape (WC) reference data (YRBS, 2002)

Variable	,	All	Boys	Girls	YRBS	S (2002)
		(n=162) VER	(n=72) of the	(n=90)	WC	Nat
		% WESTE	R ₀ CAPE	%	%	
Underweigh	t (z-score < -2)					
Weight-for-a	ge	9.3	15.3	4.4	6.0	9.0
Stunting	(z-score < -2)					
Height-for-ag	ge	4.3	6.9	2.2	9.5	11.4
Wasting	(z-score < -2)					
Weight-for-h	eight	-	-	-	3.0	4.0
Overweight						
BMI (kg/m²)	>25	6.2	0.0	11.1	21.5	17.2
Obesity						
BMI (kg/m²)	>30	1.9	0.0	3.3	7.1	4.0

4.3.2 Hypertension

The prevalence of hypertension among rural school children aged 14-16 years is presented in Table 4.15. For the total sample, 38.3% children were hypertensive as indicated by systolic and/or diastolic blood pressure exceeding the 95th percentile for age and height. Significantly more boys (48.0%) than girls (30.8%) were found to be hypertensive.

The overall average for systolic blood pressure greater than the 95th percentile for age and height, was 31.3%. Significantly more boys (40.0%) than girls (24.6%) recorded systolic blood pressure readings greater than the 95th percentile for age and height.

Overall, 14.8% of children recorded diastolic blood pressure measurements greater than the 95th percentile for age and height. Significantly more boys (24.0%) than girls (7.7%) displayed diastolic blood pressure readings greater than the 95th percentile for age and height.

Blood pressure centiles for boys and girls aged 14-16 are presented in Table 4.16. The results of this study show that boys and girls and girls are within the normal range (50^{th} - 90^{th} centile) in both systolic and diastolic blood pressure, except for boys 14-15 years old. The boys aged 14-15 years fall in the 50^{th} – 90^{th} centile (normal range) in diastolic blood pressure, but the 90^{th} – 95^{th} centile (high normal range) in systolic blood pressure.

 Table 4.15
 Hypertension prevalence in rural school children aged 14-16 years

Variable	All	Boys	Girls
	(n=115)	(n=50)	(n=65)
	%	%	%
Systolic BP > 95 th percentile	31.3	40.0	24.6
Diastolic BP > 95 th percentile	14.8	24.0	7.7
Systolic- and/or Diastolic BP	38.3	48.0	30.8
(> 95 th percentile)			

Table 4.16 Blood pressure percentiles for boys and girls by age and height

Gender	Age	Centiles Systolic BP UNIVERSITY of the	Diastolic BP
Boys	14	\geq 90th - \leq 95th	≥ 50th - ≤90th
Girls	14	≥ 50th - ≤ 90th	≥ 50th - ≤ 90th
Boys	15	≥ 90th - ≤ 95th	≥ 50th - ≤ 90th
Girls	15	≥ 50th - ≤ 90th	≥ 50th - ≤ 90th
Boys	16	≥ 50th - ≤ 90th	\geq 50th - \leq 90th
Girls	16	≥ 50th - ≤ 90th	≥ 50th - ≤ 90th

4.4 Fitness

The mean (+SD) fitness characteristics for the total sample are presented in Table 4.17. Significant gender differences were recorded for all fitness tests. Boys had greater maximal aerobic power, leg power, and grip strength than girls, while girls had greater range of motion (flexibility) than boys. When the fitness results were analysed by age group, only grip strength showed a significant gender difference for age group 14 years.

Table 4.17 Fitness characteristics of rural boys and girls aged 14-16 years

Performance	Boys		Girls		Total	
Variables						
	Mean	SD	Mean	SD	Mean	SD
$ m VO_{2max}$	41.2	(10.89)*	30.7	(9.15)*	35.4	(11.23)
(ml/kg ⁻¹ /min ⁻¹)	W	ESTERN C	APE			
Sit and reach (cm)	36.81	(7.74)*	40.89	(7.73)*	38.79	(7.95)
Grip strength (kg): L	24.6	(9.29)*	14.7	(4.78)*	19.8	(8.90)
R	26.0	(8.90)*	15.9	(5.22)*	21.09	(8.89)
Standing long-jump (m)	1.56	(0.31)*	1.22	(0.22)*	1.38	(0.31)
		1 11				

Results are presented as means (standard deviations)

^{*} Indicates a significant difference between boys and girls (p<0.05)

Mean flexibility scores for boys and girls, as measured by sit-and-reach, are presented in Table 4.18. Girls consistently recorded higher mean values than boys for flexibility. However, none of these gender differences were significant. For both sexes, the flexibility showed a plateau from age 15-16 years.

Mean explosive strength scores for boys and girls, as measured by standing long jump, are presented in Table 4.18. Although the boys consistently recorded higher values for standing long jump than the girls, these gender differences were only significant for ages 15 and 16 years. Explosive strength, for both sexes, increased from age 14 to 15 years, after which a plateau was observed from age 15-16 years.

Mean grip strength scores for boys and girls, as measured by the hand grip dynamometer, are presented in Table 4.19. The boys consistently recorded higher scores for grip strength than girls. The gender differences were significant for all ages. Grip strength increased with age for both sexes.

Mean maximal aerobic power ($VO_{2\,max}$) scores for boys and girls, as measured by the 20 m shuttle run test, are presented in Table 4.19. Although the mean $VO_{2\,max}$ scores were consistently higher for boys than girls, the gender differences were only significant for ages 15 and 16 years. Maximal aerobic power consistently increase with age (14-16) years) for boys, while for girls, $VO_{2\,max}$ gradually decreased with age.

Pearson's correlation coefficients of cardiovascular fitness ($VO_{2 max}$) with selected CVD risk factors are presented in Table 4.21. Cardiovascular fitness showed significant positive correlations with height, diastolic blood pressure, leg power and grip strength, but a significant negative correlation with weight and body mass index, and skinfolds.

Table 4.18 Fitness characteristics of rural boys and girls aged 14-16 years

Age	Sit and reach (cm)		Sit and reach (cm) Standing long jum				
	Boys		Girls	Boys		Girls	
	Mean	SD	Mean SD	Mean	SD	Mean	SD
14	35.0	8.41	42.4 10.81		0.24	1.14	0.23
15	39.1	3.36	UNIVERSITY 39.8/E6.18ERN C	-	0.31	1.25	0.24*
16	37.1	8.72	40.6 6.56	1.67	0.28	1.23	0.20*

^{*} Indicates a significant difference between boys and girls for the same age (p<0.05)

 Table 4.19
 Fitness characteristics of rural boys and girls aged 14-16 years

Age	Grip strength		ı (kg)	(kg) VO _{2 ma}		O _{2 max} (ml/kg ⁻¹ /min ⁻¹)		
	Boys		Girls		Boys		Girls	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
14	20.9	7.06	12.9	6.56*	36.4	7.90	32.9	8.09
15	26.1	12.18	13.73	4.47*	39.2	11.03	31.7	10.41*
16	27.8	7.58	16.8	4.71*	45.2	11.07	27.83	7.73*
			UN	VIVERSITY	of the			

^{*} Indicates a significant difference between boys and girls for the same age (p<0.05)

Table 4.20 T-test analysis for significant differences in $VO_{2\,max}$, sit and reach, grip strength, and standing long jump between boys and girls

Variable	Age	T-Score	P-value
$VO_{2 max}$	14	NS	NS
	15	-2.34	0.024*
	16	-6.79	0.000*
Sit and reach	14	NS	NS
	15	NS	NS
	16	NS	NS
Grip strength	14	-2.69	0.014*
	15	-3.07	0.011*
	16	UNI5/44RSITY of the	0.000*
		WESTERN CAPE	
Standing long jump	14	NS	NS
	15	-3.61	0.002*
	16	-5.49	0.000*

^{*} P < 0.05

NS - Difference not significant

Table 4.21 Pearson's correlation coefficients of Cardiovascular fitness (VO $_{2\,max}$) with selected CVD risk factors

Variables	VO2max		
	r	p-value	level
Weight	-0.23	0.005	<0.01**
Height	0.17	0.041	<0.05*
Body mass index	-0.37	0.000	<0.01**
Sum of skinfolds (Tri & Sub)	-0.63	0.000	<0.01**
Systolic blood pressure	0.19	0.069	< 0.05
Diastolic blood pressure	UNIVERSITY of the WESTER 0.21 CAPE	0.045	<0.05*
Leg power	0.33	0.003	<0.01**
Flexibility	-0.07	0.539	< 0.05
Grip strength	0.35	0.001	<0.01**

^{*} Indicates a significant correlation (p<0.05)

^{**} Indicates a significant correlation (<0.01)

4.5 Physical Activity, Health and Fitness

Table 4.22 presents the means (SD) of the anthropometric and blood pressure variables in the three physical activity (PA) levels of boys and girls aged 14-16 years.

The "sufficiently active" groups recorded the lowest mean scores for weight, BMI and skinfolds among both sexes. For the boys, significant differences (p<0.05) were observed in the triceps skinfolds, subscapular skinfolds, and sum of skinfolds of the different activity levels (Table 4.22). The difference between the lowest and highest activity levels among the boys were 1.68mm, 1.39mm, and 3.07mm for triceps, subscapular, and sum of skinfolds, respectively. The "active" group was the tallest among the boys, while the "sufficiently active" group was the tallest among the girls.

Systolic blood pressure was highest in the "active" and sedentary groups for boys and girls respectively, while for both sexes, diastolic blood pressure was highest for the "sufficiently active" group. No significant differences were observed in the mean weight, height, body mass index, and blood pressures of the three PA levels.

Table 4.22 Mean and SD of selected body composition and blood pressure variables of 14-16 year old children classified as sedentary, active, and sufficiently active

Variables		Activity levels				
		Sedentary	Active	Suff. Active		
	Gender	Mean SD	Mean SD	Mean SD		
Age	Boys	15.11 ±0.76	15.28 ±0.77	15.27 ±0.88		
(Yrs)	Girls	15.07 ± 0.72	15.11 ± 0.76	15.0 ± 0.85		
Weight	Boys	50.9 ± 6.59	51.9±7.63	48.6±8.12	1.25	0.293
(kg)	Girls	52.9 ± 12.22	51.3 ± 9.40	50.4 ± 11.80	0.14	0.870
Height	Boys	164.6±0.08	166.6±0.08	163.3±0.10	1.07	0.349
(cm)	Girls	157.4 ±0.05	158.7±0.06	159.3±0.06	0.60	0.552
BMI	Boys	18.6 ± 2.06	18.7 ± 2.02	18.1 ± 1.62	0.62	0.54
(kg/m^2)	Girls	21.4 ±4.57	20.3±3.33	19.8 ± 3.91	0.49	0.616
Triceps SF	Boys	8.0±2.70VER	6.7±1.57 the	6.3±1.13	4.59*	0.013
(mm)	Girls	14.9±5.06	13.7±4.17 E	13.0±5.06	0.68	0.429
Subscapular	Boys	7.4±2.20	6.3±1.47	6.0±1.41	3.76*	0.028
SF (mm)	Girls	14.4±5.45	12.9±4.07	12.0±4.45	1.39	0.255
Sum of SF	Boys	15.4±4.85	13.0±2.99	12.3±2.46	4.35*	0.017
(mm)	Girls	29.2±10.48	26.6±8.16	25.0±9.50	1.12	0.33
BP Systolic	Boys	120.6 ± 9.91	128.8 ±13.28	126.9 ±14.29	1.59	0.215
(mmHg)	Girls	123.3 ±16.40	119.2 ±10.35	118.5±4.59	0.78	0.463
BP Diastolic	Boys	73.9 ± 9.28	74.6±11.09	75.2 ± 10.75	0.06	0.941
(mmHg)	Girls	73.4 ± 5.53	70.0±9.94	74.5±7.48	1.39	0.257

^{*} Indicates a significant difference between physical activity groups (p<0.05)

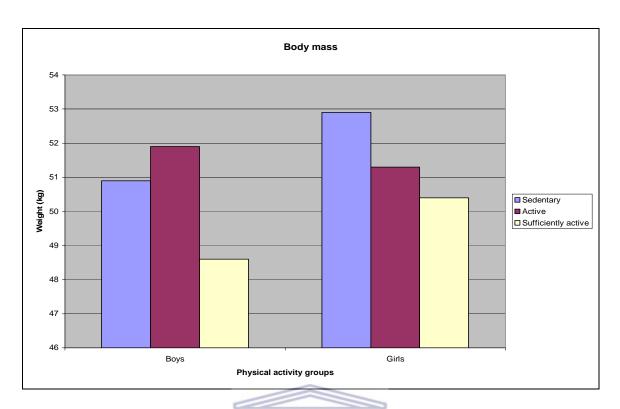


Figure 1.2 Mean body mass of 14-16 year old children classified as sedentary, active, and sufficiently active

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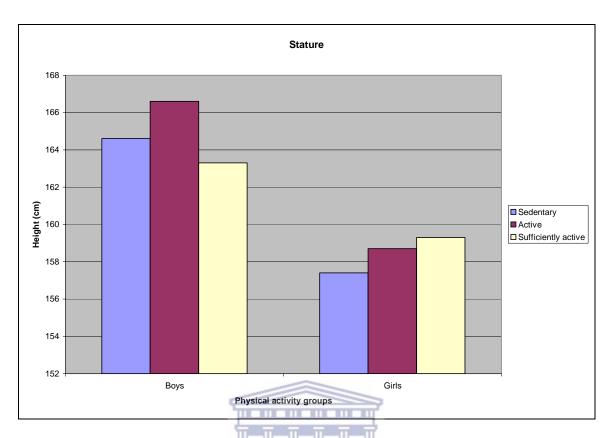


Figure 1.3 Mean stature of 14-16 year old children classified as sedentary, active, and sufficiently active

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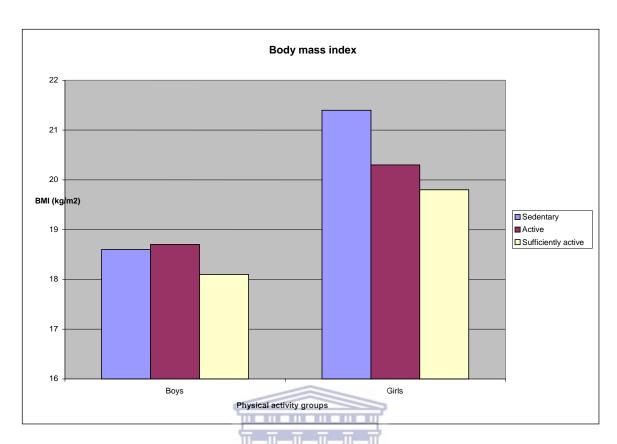


Figure 1.4 Mean body mass index of 14-16 year old children classified as sedentary, active, and sufficiently active

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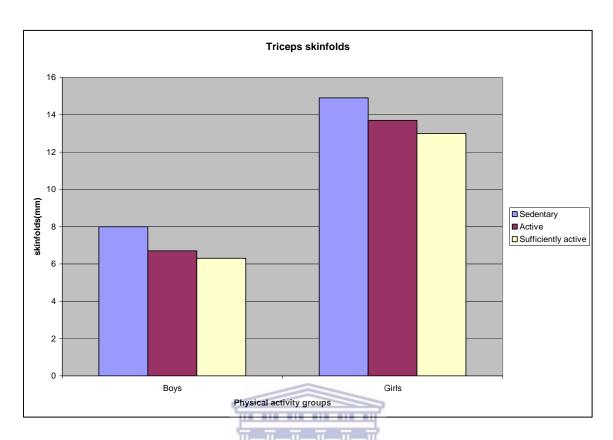


Figure 1.5 Mean triceps skinfolds of 14-16 year old children classified as sedentary, active, and sufficiently active

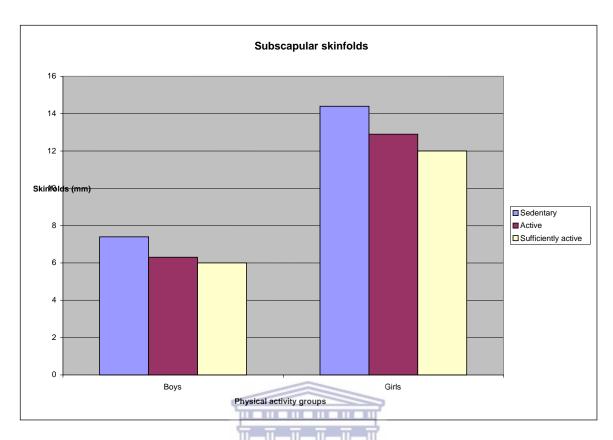


Figure 1.6 Mean subscapular skinfolds of 14-16 year old children classified as sedentary, active, and sufficiently active

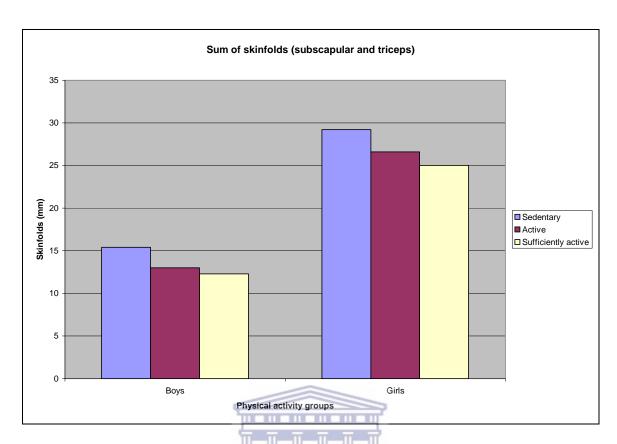


Figure 1.7 Mean sum of skinfolds of 14-16 year old children classified as sedentary, active, and sufficiently active

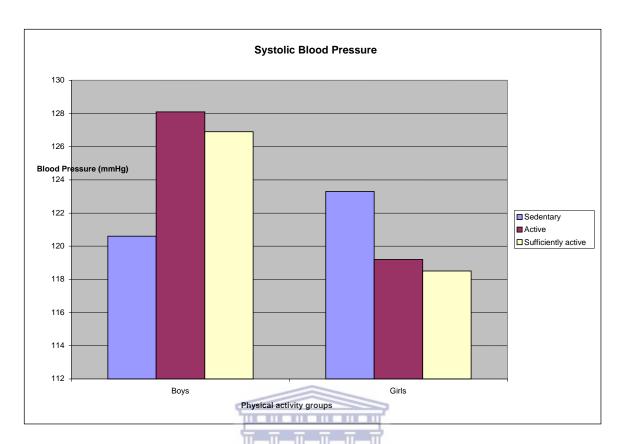


Figure 1.8 Mean systolic blood pressure of 14-16 year old children classified as sedentary, active, and sufficiently active

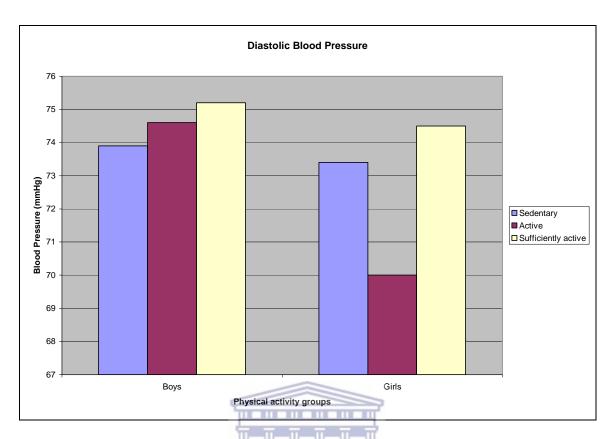


Figure 1.9 Mean diastolic blood pressure of 14-16 year old children classified as sedentary, active, and sufficiently active

Table 4.23 presents the Means (SD) of selected physical fitness variables of 14-16 year old children classified as sedentary, active, and sufficiently active. The "sedentary" and "active" group recorded the lowest mean scores for handgrip strength among boys and girls, respectively.

For standing long jump, the "sedentary" group recorded the highest mean score among the boys, while the "sufficiently active" group recorded the highest mean score among the girls. Mean flexibility scores were highest for the "sufficiently active" and "active" group among girls and boys, respectively.

Mean $VO_{2\ max}$ scores were lowest for the sedentary group and highest for the "Sufficiently active" group among both sexes. From all the fitness variables, only $VO_{2\ max}$ showed a significant difference (p<0.05) with the higher activity levels, recording higher mean scores (Table 4.23). The differences between mean VO_{2max} scores of the lowest and highest activity levels were 13.07 ml/kg/min and 8.88ml/kg/min for boys and girls, respectively.

Table 4.23: Mean and SD of selected physical fitness variables of 14-16 year old children classified as sedentary, active, and sufficiently active

Variables		Activi		F	P	
		Sedentary	Active	Suff. Active		
	Gender	Mean SD	Mean SD	Mean SD		
Handgrip	Boys	23.16 +6.99	27.63 +9.48	23.87 +9.24	0.04	0.362
(kg)	Girls	15.35 +5.50 UNIVER	14.64 +5.63 SITY of the	22.11 +11.50	0.32	0.731
S Long-jump	Boys	160.0 +0.23	157.2 +0.32	152.3 +0.35	0.17	0.846
(cm)	Girls	118.3 +0.22	120.3 +0.18	137.1 +0.41	0.28	0.754
Sit-and-reach	Boys	34.86 +6.99	38.93 +5.82	35.6 +9.53	0.97	0.39
(cm)	Girls	39.5 +7.66	39.89 +7.93	43.0 +5.48	0.73	0.692
VO _{2 max}	Boys	33.11 +6.98	42.54 +11.94	46.18 +9.09	7.67*	0.0011
(ml/kg/min)	Girls	27.26 +9.36	31.89 +7.33	36.14 +8.34	5.28*	0.0072

^{*} Indicates a significant difference between physical activity groups (p<0.05)

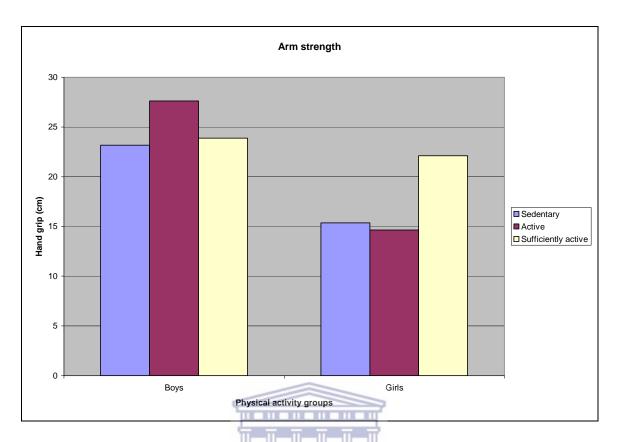


Figure 1.10 Mean grip strength of 14-16 year old children classified as sedentary, active, and sufficiently active

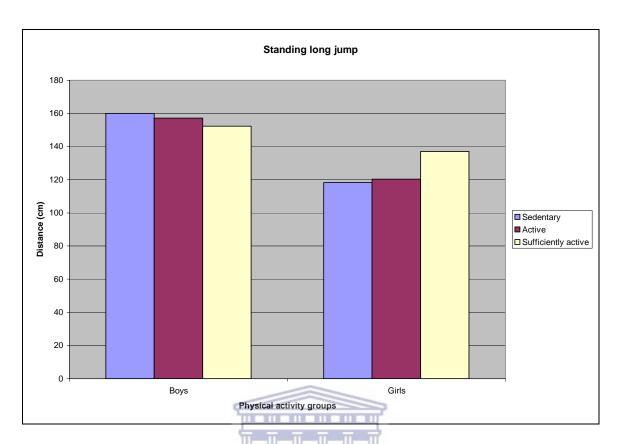


Figure 1.11 Mean leg power of 14-16 year old children classified as sedentary, active, and sufficiently active

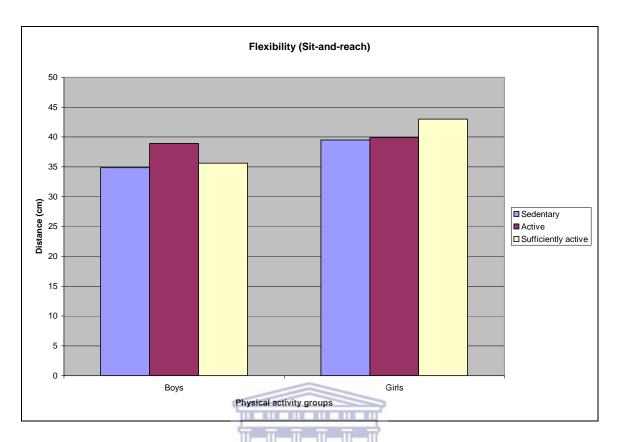


Figure 1.12 Mean flexibility of 14-16 year old children classified as sedentary, active, and sufficiently active

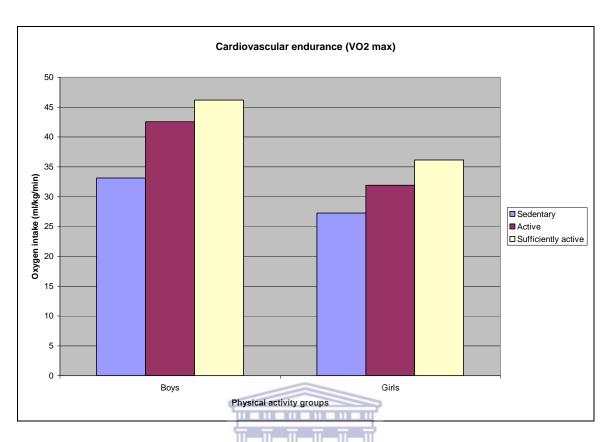


Figure 1.13 Mean cardiovascular endurance of 14-16 year old children classified as sedentary, active, and sufficiently active

Table 4.24 Pearson's correlation coefficients of physical activity with selected CVD risk factors

Variables				
	Gender	р-ч	value level	
Weight	All	-0.08	0.307	<0.05
	Boys	-0.11	0.380	
	Girls	-0.06	0.597	
Height	All	0.08	0.316	< 0.05
	Boys	-0.07	0.553	
	Girls	0.11	0.295	
Body mass index	All	-0.15	0.068	< 0.05
	Boys	-0.11	0.372	
	Girls	0.11	0.324	
Sum of skinfolds	All	-0.24	0.002	<0.01**
(Triceps and Subscapular)	Boys	-0.31	0.007	<0.01**
	Girls	-0.16	0.141	
Systolic blood pressure	All	0.05	0.566	< 0.05
	Boys	0.12	0.403	
	Girls	-0.15	0.250	
Diastolic blood pressure	All	0.03	0.728	< 0.05
	Boys	0.05 ER S.05	0.746	
	Girls	0.06	0.662	
VO _{2 max}	All	0.43	0.000	<0.01**
	Boys	0.43	0.000	<0.01**
	Girls	0.35	0.002	<0.01**
Leg power	All	0.13	0.250	< 0.05
	Boys	-0.10	0.566	
	Girls	0.12	0.453	
Flexibility	All	-1.01	0.912	< 0.05
	Boys	-0.02	0.900	
	Girls	0.15	0.392	
Grip strength	All	0.15	0.184	< 0.05
-	Boys	-0.03	0.869	
	Girls	0.02	0.908	

^{*} Indicates a significant correlation (p<0.05)

^{**} Indicates a significant correlation (<0.01)

4.6 Relationships between Physical Activity and Cardiovascular Disease (CVD) Risk Factors

Relationships between physical activity and selected cardiovascular risk factors are presented in Table 4.24. A significant correlation was found between physical activity (PA) and cardiovascular endurance (VO_{2 max}) for boys (r=0.43; p<0.01) and girls (r=0.35; p<0.01). The relationship between PA and sum of skinfolds yielded negative correlations. However, only the correlation for boys reached a significant level (r=0.31; p<0.01). No other significant correlations were found.

Table 4.25 Hypertension prevalence by Physical Activity group

Variable	Activity Groups						
	Sedentary	Active	Sufficiently active				
	0/0	%	%				
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Systolic- and/or Diastolic BP	43.3	37.7	42.9				
(> 95 th percentile)							

4.7 Stepwise Regression Analysis

4.7.1 Contribution of CVD Risk Factors to Cardiorespiratory Fitness (VO_{2 max})

Values of stepwise regression analysis between cardiorespiratory fitness ($VO_{2 max}$) and other cardiovascular disease (CVD) risk factors are presented in Tables 4.26 – 4.27. For boys, six variables (sum of skinfolds, BMI, flexibility, age, diastolic blood pressure, and weight) entered the fitted regression model and contributed to 61.7% of the total variance of $VO_{2 max}$. Sum of skinfolds, age, diastolic and systolic blood pressure explained 40.6% of the total variance of $VO_{2 max}$ in girls.

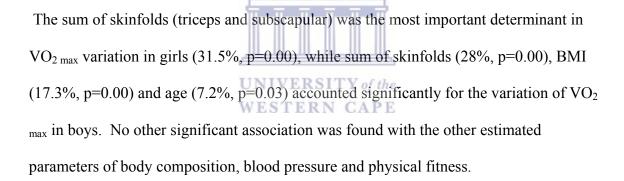


Table 4.26 Stepwise regression analysis between anthropometric characteristics, physical fitness, blood pressure and $VO_{2\,max}$ for boys aged 14-16 years

Step	Vari abl e Entered	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
Boys						
1	sum of skinfolds	0. 2800	0. 2800	13. 0899	12. 06	0. 0015*
2	BMI	0. 1725	0. 4526	5.0032	9. 46	0. 0045*
3	Flexibility	0.0655	0. 5180	3. 1768	3. 94	0. 0567
4	Age	0.0724	0.5904	0. 9429	4. 95	0. 0343*
5	dĭastolic BP	0. 0163	0.6067	1. 9921	1. 12	0. 3000
6	Weight	0. 0102	0. 6169	3. 3937	0. 69	0. 4122
	5					

^{*} Significant contribution to VO2max (p< 0.05)

Table 4.27 Stepwise regression analysis between anthropometric characteristics, physical fitness, blood pressure, and $VO_{2\,max}$ for girls aged 14-16 years

Step	Vari abl e Entered	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
Girls						
1	Sum of skinfolds	0. 3146	0. 3146	-2. 6920	13.77	0. 0008*
2	Age	0.0380	0. 3526	-2.0934	1. 70	0. 2026
2 3	Dĭastolic BP	0. 0221	0.3747	-0. 9111	0. 99	0. 3279
4	Systolic BP	0. 0312	0. 4059	-0.0622	1. 42	0. 2443

^{*} Significant contribution to VO2max (p< 0.05)

4.7.2 Contribution of CVD Risk Factors to Blood Pressure

Values of stepwise regression analysis between systolic blood pressure and other cardiovascular disease (CVD) risk factors are presented in Tables 4.28-4.29. Weight, $VO_{2 \text{ max}}$, height, and BMI accounted for 24.9% of the total variation in systolic blood pressure in boys. However, only weight (12.6%, p=0.04) showed a significant influence.

Body mass index, flexibility, $VO_{2 \text{ max}}$, and grip strength accounted for 38.7% of the total variation of systolic blood pressure in girls. Of the four variables entered, BMI played the most important role (30.6%, p=0.00).

Table 4.28 Stepwise regression analysis between anthropometric characteristics, physical fitness, $VO_{2\,max}$, and Systolic blood pressure for boys aged 14-16 years

Step	Vari abl e Entered	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
Boys						
1 2 3 4	wei ght VO _{2 max} hei ght BMI	0. 1261 0. 0581 0. 0187 0. 0465	0. 1261 0. 1841 0. 2028 0. 2494	-1. 8101 -1. 6165 -0. 1978 0. 3541	4. 47 2. 13 0. 68 1. 74	0. 0426* 0. 1544 0. 4164 0. 1983

^{*} Significant contribution to systolic BP (p< 0.05)

Table 4.29 Stepwise regression analysis between anthropometric characteristics, physical fitness, $VO_{2\,max}$, and Systolic blood pressure for girls aged 14-16 years

Step	Vari abl e Entered	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
Girls						
1 2 3 4	BMI Flexibility VO _{2 max} Grip strength	0. 3057 0. 0374 0. 0318 0. 0116	0. 3057 0. 3431 0. 3749 0. 3865	-2. 0447 -1. 4419 -0. 6319 0. 9350	13. 21 1. 65 1. 43 0. 51	0. 0010* 0. 2091 0. 2425 0. 4813

^{*} Significant contribution to systolic BP (p< 0.05)

Values of stepwise regression analysis between diastolic blood pressure and other Cardiovascular disease (CVD) risk factors are presented in Tables 4.30 - 4.31. For boys, BMI, age, sum of skinfolds, and $VO_{2\ max}$ entered the fitted regression model and accounted for 21.6% of the total variation of diastolic blood pressure. However, none of the variables entered played a significant role.

Standing long jump, sum of skinfolds, height, and flexibility explained 37.2% of the variation of diastolic blood pressure in girls. Sum of skinfolds (14.2%, p=0.03) and height (10.6%) p=0.04) were important determinants in diastolic blood pressure variation in girls. No other significant association was found with the other estimated parameters of body composition, blood pressure and physical fitness.

Table 4.30 Stepwise regression analysis between anthropometric characteristics, physical fitness, $VO_{2 \text{ max}}$, and Diastolic blood pressure for boys aged 14-16 years

Step	Vari abl e Entered	Parti al R-Square	Model R-Square	C(p)	F Value	Pr > F
Boys						
1	BMI	0. 1099	0. 1099	-2. 5833	3. 83	0. 0595
2	Age	0. 0369	0. 1468	-1. 6789	1. 30	0. 2636
3	Sum of skinfolds	0. 0272	0. 1740	-0. 4854	0. 95	0. 3368
4	VO _{2 max}	0. 0421	0. 2161	0. 2651	1. 50	0. 2303

^{*} Significant contribution to diastolic BP (p< 0.05)

Table 4.31 Stepwise regression analysis between anthropometric characteristics, physical fitness, $VO_{2\,max}$, and Diastolic blood pressure for girls aged 14-16 years

Step	Vari abl e Entered	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
Girls						
1 2 3 4	Standing long jump Sum of skinfolds Height Flexibility	0. 0864 0. 1421 0. 1063 0. 0373	0. 0864 0. 2284 0. 3347 0. 3721	9. 6719 5. 8142 3. 4308 3. 8911	2. 84 5. 34 4. 47 1. 61	0. 1025 0. 0282* 0. 0434* 0. 2159

^{*} Significant contribution to diastolic BP (p< 0.05)



CHAPTER FIVE

DISCUSSION

The purpose of this cross-sectional study was to assess the impact of accumulative physical activity on the fitness status, blood pressure and body composition of 14 – 16 year old rural school children in the Caledon/Overberg region of the Western Cape. To realize the objectives of the study, 162 children (72 boys and 90 girls) were surveyed on their habitual physical activity patterns. Thereafter they were measured on selected anthropometric variables and tested on selected fitness variables. Blood pressure (systolic and diastolic) was also measured.

5.1 Physical Activity (PA)



Physical inactivity has become a major public health problem, contributing to the chronic, non-communicable disease epidemic. Physical activity is necessary to maintain good emotional and physical health as well as to prevent disease. Individual behaviours which feature recommended levels of physical activity, especially if practised from childhood, can improve self-esteem and reduce the risk of obesity. Obesity is closely associated with diabetes and certain types of cancer, anxiety, stress, high blood pressure and elevated cholesterol, which contribute to heart disease and stroke (Centers for Disease Control and Prevention, 2000; Sallis, 2000; Scully, Kremer, Meade, Graham, and Dudgeon, 1998).

Results from the PA questionnaire showed that most (55.35%) of the rural school children in Caledon, participated in sufficient levels of health enhancing physical activity (HEPA). However, almost 1 out of 3 (28.93%) children engaged in only relatively light PA, which is insufficient with no proven heath benefits. Phillips (2001), using a similar One-Year Physical Activity Recall protocol, found much higher levels (64.8%) of insufficient physical activity among children from an urban community in the Western Cape.

Health enhancing PA was more prevalent among boys, while no or relatively light PA was more prevalent among girls. This gender pattern is consistent with the literature suggesting that girls, generally, prefer more sedentary activities than boys (Peltzer et al., 2002; Benefice, Garnier and Ndiaye, 2001), and that this trend continues into adulthood (Biddle et al., 1998). Physical activity and age were not statistically significant. When compared with the results of the South African Youth Risk Behaviour Survey (YRBS) (Department of Health, 2002), rural school children in Caledon (28. 9%) had a lower prevalence of insufficient PA than the National mean for all (37.5%) and/or "coloured" (45.6%) high school children. The gender trends were also similar, with more girls than boys engaging in insufficient PA. It is however important to note that the YRBS (Department of Health, 2002) used a 7-day recall, while a one-year recall questionnaire was used in this study.

The low prevalence of insufficient physical activity among the rural children in this study is encouraging. However, any number of sedentary children should be a public health concern, since the numbers are unlikely to decrease with age, especially for girls (Van Mechelen et al., 2000; Allison et al., 1999; Dietz, 1996), and the associated health risks are well documented. Minimising the risk of morbidity or premature mortality associated with CVD in adulthood, should begin in childhood or adolescence (Boreham et al., 2004).

A National Household Travel Survey, conducted by Statistics South Africa in 2003, has found that over 560 000 children in South Africa spend more than 2 hours a day walking to and from school. It further revealed that 76% of school children and students in urban areas walk to classes or lectures as opposed to 91% of those in rural areas (Naidu and Khumalo, 2005).

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In agreement with these findings, results from this study revealed that walking was the most common form of commuting to and from school. Almost 4 out of 5 (76.72%) children walked to and from school, while a minority (23.27%) made use of motorized transport. Walking distances varied, with most children (57.2%) walking less than 2 km. However, a significant number of children (31.4%) walked more than 3 km to and from school, 5 days per week. Walking to school was also found to be the most typical commuting behaviour for Filipino youth (46.8% and 36.6% of boys and girls, respectively) (Tudor-Locke et al., 2003). Active commuting to school by means of

walking is one of the most common physical activities among rural school children in developing countries (Tudor-Locke et al., 2003; Emiola et al., 2002).

Besides walking and athletics, boys and girls are different in what constitutes most of their HEPA days. For Boys, greater proportions of HEPA days were due to rugby, cycling and gym activities, while for females, it was netball and carrying heavy shopping bags. Peltzer et al. (2002) found distinct gender differences regarding PA choices among African children and postulates that physical activity preference is influenced by personal motivation and cultural factors.

Rugby and netball emerged as the most popular sports among boys and girls respectively. This was not surprising as these are the most common sporting activities in the Caledon/ Overberg region. Rugby's popularity is partly motivated by sporting legends such as Errol Tobias (first Springbok of colour), Gary Boshoff (former SARU- captain) and Ashwin Willemse (current Springbok), all from Caledon. Heath et al. (1994), however, postulates that participation in sport does not appear to contribute to the development of lifelong habitual activity patterns.

Almost 1 out of 4 (22.36%) children watched TV or played video games for more than 3 hours per day. This sedentary behaviour was more prevalent among girls (25.6%) than boys (18.6%). Differences among age groups were insignificant. These results are comparable with the National prevalence (25.2%), but notably lower than that among "coloured" (29.6%) learners (Department of Health, 2002). Television viewing is a

major contributor to the inactive lifestyle of adolescents (Dietz, 1996) and the amount of time spent watching television has been shown to be related to low back pain and obesity in adolescents and children (Andersen et al., 1998; Balague et al., 1994).

Sedentary lifestyle is both a matter of individual choice and a function of an environment that promotes inactivity (Department of Health, 2002). The outcomes of this study reflect the choices made by the learners relating to their participation in physical activity, as well as the environmental factors which may influence these choices.

5.2 Anthropometric Characteristics

Body composition of rural school children in this study varied with age and gender and agreed with other South African studies (Engelbrecht et al., 2002; Travill, 2000; Hennenberg and Louw, 1998). As expected, girls had, generally, significantly higher values for fat mass and BMI than the boys, whilst the boys had higher mean values of fatfree mass and stature. This is likely to be explained by the maturational process. Literature suggest that, at the beginning of puberty, maturation is associated with gender differences in muscle and fat mass, as well as with relative fat distribution, with girls gaining more subcutaneous fat and boys more muscle mass (Benefice, 1992; Borms, 1986).

The results of the current study support the findings that gender differences regarding BMI in rural African adolescents and disadvantaged urban African adolescents become more apparent after menarche or age 14 years (Travill, 2000).

Girls had significantly higher skinfold than boys at all ages. None of the boys were either overweight or obese, while 11.1% and 3.3% of the girls were overweight and obese, respectively. These results are in agreement with the findings of Travill (2000); Monyeki et al. (1999) and Cameron and Getz (1997), who found similar low prevalence of overweight and obesity among African adolescents. Although obesity is common among African adolescent girls, it is not associated with increased risk of morbidity (Walker et al., 1990). Cameron et al. (1990a) postulate that the increase in body fat after menarche is a physiological adaptation to an energetically sub-optimal environment, which can potentially buffer the energy cost of reproduction.

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5.2.1 Comparisons with NCHS Reference Data

The mean height of rural school boys just exceeded the 25th centile of the National Center for Health Statistics (NCHS) at age 14-15 years and then dropped to between the 10th – 25th centile at age 16 years. With a mean height equal to the 25th centile, approximately 75% of the boys from this study are shorter than the NCHS reference group. Similar height growth patterns have been observed among rural "Cape Coloured" (Hennenberg and Louw, 1998), rural Ubombo (Cameron, 1990), and urban African (Travill, 2000)

boys. The pattern of falling away from the NCSH 50th centile seems to be a common phenomenon among children in developing countries (Cameron, 1990a).

The mean weight of the boys in this study followed a similar pattern as the height growth, starting between the 25th - 50th centile at age 14 years and dropping to below the 25th centile at age 16 years.

The mean height for rural school girls fell between the 25^{th} - 50^{th} centile at all ages. Height consistently increased with age but remained below the 50^{th} centile. This means that approximately 50% of the NCSH reference group was taller than the girls from this study. The mean weight of the girls fell between the 25^{th} – 50^{th} centile, with weight increasing from age 14 -15 years, where after it plateaued.

5.2.2 Nutritional Anthropometry

Nutritional status of rural school children aged 14-16 years was assessed by means of height-for- age, weight-for-age and BMI cut-off points and compared with National and Western Cape data from the South African National Youth Risk Behaviour Survey, 2002. The average for being underweight, as indicated by weight-for-age, was 9.3%. This is comparable with the National (9%), but higher than the Western Cape (6%) prevalence data (Department of Health, 2002). Significantly more boys (15.3%) than girls (4.4%) were underweight. This might partly explain the absence of either overweight or obesity among the boys in this study.

When children are shorter than expected for their age, they are stunted (Gibson, 1990). Overall, 4.3% of children were found to be stunted as indicated by height-for-age. This was notably lower than the National (11.4%) and Western Cape (9.5%) prevalence data (Department of Health, 2002). Significantly more boys (6.9%) than girls (2.2%) were stunted. According to the WHO (1995), a deficit in Height-for-age is an indication of long term accumulative inadequacies of health and nutrition. Children who lack food for extended periods of time grow more slowly than other children their age. However, it is important to remember that not all small children are malnourished. Some children are naturally small (Gibson, 1990).

Using the BMI cut-off points of 25 kg/m² (overweight) and 30 kg/m² (Obese) suggested by Cole et al. (2000), 11.1% and 3.3% of girls were found to be overweight and obese, respectively. This is notably lower than the National and Western Cape prevalence data. Nationally 17% and 4% of school girls are overweight and obese, respectively, while the prevalence is even higher for the Western Cape, 12.5% and 7.1%, respectively (Department of Health, 2002). No boys were found to be either overweight or obese.

5.3 Blood Pressure (BP)

The boys had higher mean systolic and diastolic blood pressure levels than the girls, except for a slightly higher diastolic blood pressure score for girls at age 14 years. This is likely due to the greater stature of the boys at all ages. Heavier and / or taller children

tend to have higher blood pressure levels in comparison to lighter and/or shorter children of the same age (Anderson and Haraldsdottir, 1995).

In consensus with the findings reported in the literature, this study showed that both SBP and DBP were positively associated with age (Wilton, 1983; De Cesaris, Balestrazzi, and Ranieri, 1980) and height, (Whincup, Bredow, Payne, and Golding, 1999; Rona, Qurashi, and Chinn, 1996; Maguire and Shelley, 1990). However, DBP showed a negative association with age, in girls. These findings emphasize that height and age offer more precision in detection of high blood pressure in children and adolescents and are supportive to the recommendations of the updated report on the 1987 American Task Force (National High Blood Pressure Education Program Working Group on hypertension control in children and adolescents, 1996) that, for more precision in detecting hypertension among children and adolescents, BP values should be reported for each age-sex-height percentile group.

In this study, Pearson's correlation coefficients showed a significant (p<0.05) relationship between weight, BMI, and systolic blood pressure (Table 4.7.5). The risk of hypertension in children increases across the entire range of BMI values and is not defined by a simple threshold effect. Rosner et al. (2000) reported a linear increase in the prevalence of diastolic hypertension in children of all race, gender, and age combinations as BMI increased across the "normal" range. Similarly, Sorof and Daniels (2002) found an increased prevalence of systolic hypertension (based on a single set of measurements)

as BMI percentile increased from the 5th to the 95th percentile. Among all factors analyzed, BMI was most strongly associated with hypertension.

5.4 Fitness

5.4.1 Cardiorespiratory Fitness

Cardiorespiratory fitness, expressed by indirect assessment of VO_{2 max} is comparable with other studies. Consistent with other studies (Guerra et al., 2002; Armstrong and Welshman, 1997; Janz and Mahoney, 1997), VO_{2 max}, expressed in relative values (ml/kg/min), showed an increase over the age period 14-16 years in boys, while the girls showed a decrease in mass-related VO_{2 max} with age. The data also revealed that the boys had consistently higher values of $VO_{2\,max}$ than the girls in this sample, which is consistent with several reports (Shephard and Lavallee, 1994; Borms, 1986). The difference reached significance at age 15-16 years. This gender difference has been attributed to boys' higher levels of hemoglobin concentration and lower levels of subcutaneous fat (Armstrong and Welshman, 1997), which might be, at least to percent fat (skinfold thickness), comparable to the findings of this study. Eliakim et al. (1997), postulate that the relationship between fitness and adiposity is particularly relevant in adolescent females whose fitness and fatness is known to decrease and to increase respectively, during puberty. This is a likely explanation for the lower levels of VO2 max found in the girls.

Regarding health related standards for cardiorespiratory fitness, the FITNESSGRAM assume that weight-relative VO_{2 max} remains constant during childhood, and for girls, the criteria values are adjusted taking into account the increase in adipose tissue with age. It therefore recommends criteria values for boys of 42 ml/kg/min, while for girls at age 11 the criterion value is 38ml/kg/min decreasing to 35ml/kg/min by age 14. Using these standards, most of the boys (52.4%) but not the girls (29.9%) had acceptable levels of cardiovascular fitness.

Engelbrecht et al. (2002) found similar low levels of cardiorespiratory fitness among 13-15 year old girls in the North-West Province of South Africa. In a study of socially disadvantaged boys and girls aged 8-17 years living in the Western Cape, Travill (2000), found the subjects to have fitness levels comparable to the lowest category of Dutch fitness standards. This, the author argues, is as a result of the negative effects of adverse socio-economic living conditions on the optimal growth and development of children.

5.4.2 Flexibility

Girls consistently recorded higher mean values than boys for flexibility. However, none of these gender differences were significant. For both sexes, flexibility reached a plateau from age 15-16 years. Travill (2002) recorded similar gender differences among urban adolescents.

5.4.3 Leg Power

Boys consistently recorded higher values for standing long jump than the girls, reaching significant levels at ages 15 and 16 years. Explosive strength, for both sexes, increased from age 14 to 15 years, after which a plateau was observed from age 15-16 years. In consensus with the literature, the results of this study showed that boys have greater leg power than girls and that the differences become more pronounced after sexual maturation or age 14 years (Travill, 2000; Borms, 1986).

5.4.4 Grip Strength

Boys consistently displayed greater grip strength than girls. The gender differences were significant for all ages. Grip strength increased with age for both sexes. These results were comparable to other studies. Similar finding were recorded for urban boys and girls in the Western Cape (Travill, 2000). Borms (1986) noted that, after the onset of the adolescent growth spurt, muscular development is influenced by androgenic hormones and the percentage of muscle mass increase from about 27% to over 40%. The author attributes boys' greater strength to their markedly higher increase in testosterone production.

5.5 Hypertension

The prevalence rate of definite hypertension reported in this study was 38.3%. This figure is higher than those reported among Irish (Boreham, Savage, Primrose, Cran, and Strain, 1993; Maguire and Shelley, 1990), Native American (Botash, Kavey, Emm, and Jones, 1992), Estonian (Grunberg and Thetloff, 1998), and Spanish (Soler, Gil, and Rey, 1992) schoolchildren and adolescents, which ranged from 5.2%-23%. The differences in prevalence rates could be, in part, related to differences in study designs, definition of hypertension, observer effect, and/or sample age range, but could also be attributed to ethnic differences in blood pressure values. The findings from studies (Steyn, Rossouw, Jooste et al., 1993; Steyn, Jooste, Fourie et al., 1986; Seedat, 1983) of blood pressure among South Africans indicate that Indians had significantly lower prevalence of hypertension than urbanized Zulus.

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5.6 The Impact of Physical Activity (PA) on Body Composition, Blood Pressure and Fitness

In order to assess the impact of physical activity on the body composition, blood pressure and fitness of rural school children in Caledon, subjects were divided into three physical activity groups based on their level of participation in moderate to vigorous health enhancing physical activity (MVHEPA).

5.6.1 PA and Body Composition

The "sufficiently active" group recorded the lowest mean scores for weight and BMI in both sexes, suggesting a positive inverse relationship between weight, BMI and physical activity. However, none of the differences were of statistical significance (p>0.05). The negligible differences in BMI were however not surprising, as all activity groups fell within the underweight (<18.5 kg/m²) and normal weight (18.6-24.9 kg/m²) cut-off points for BMI (Cole et al., 2000).

The low mean BMI (18.1 kg/m²) recorded for the "sufficiently active" boys classified them as underweight. This is a concern, as high and very low body mass index values are both related to a higher all-cause mortality rate (Van Itallie and Abrahams, 1985; Waaler, 1983).

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Significant differences (p<0.05) were observed in triceps and subscapular skinfolds with the higher activity levels group recording lower skinfold measurements than the low activity level group. This result was to be expected since higher activity levels implicate a higher muscular activity and higher energy demand which could result in lower percent body fat (Bouchard and Shephard, 1994). Rowlands et al. (2000) performed a meta-analysis on the relationship between habitual PA and body fatness in children and found a moderate correlation between the two variables. Consistent with this observation, Emiola et al. (2002), recorded a significant inverse relationship between the lean body weight, percent body fat and the habitual PA patterns of Nigerian primary school children, while

Engelbrecht et al. (2002), recorded a similar, although not significant, relationship for percent body fat among 13-15 year old girls in the North-West Province of South Africa. The inverse relationship between body mass, BMI, skinfolds, and physical activity observed in this study is therefore consistent with the literature.

5.6.2 PA and Blood Pressure

Systolic blood pressure was highest in the "active" and sedentary groups for boys and girls respectively, while for both sexes, diastolic blood pressure was highest in the "sufficiently active" group. For boys, blood pressure was positively correlated with PA, whereas for girls, blood pressure was negatively correlated with PA. However, none of the relationships was of statistical significance. The positive association between blood pressure and PA, although not statistically significant, for boys in this study is not consistent with the literature. Most cross-sectional epidemiological studies show an inverse relationship between resting blood pressure fitness levels, habitual physical activity, or exercise. In the majority of studies, the difference between the most and least physically active subjects was seldom more than 5 mmHg (Bouchard and Shephard, 1994). In this study, differences between the sedentary and sufficiently active groups range from -1.1 to 4.8 mmHg for girls, and -6.3 to -1.3 mmHg for boys.

Currently, the guidelines which are most widely used for blood pressure in children are those published in 1996 by the National High Blood Pressure Education Program Working Group on Hypertension Control in Children and Adolescents in the US

(National High Blood Pressure Education Program Working Group on Hypertension Control in Children and Adolescents, 1996). Because body size is the most important determinant of BP in childhood and adolescence, the Working Group adjusted the 1987 guidelines (which took account of age and sex only) to include differential growth rates in children. The Working Group created age-, sex- and height-specific blood pressure curves based on ten mixed-ethnicity samples of American children. These 1996 guidelines define high blood pressure as values above the 95th percentile of a child's age-, sex- and height-specific curve. High normal rates fall between the 90th and 95th percentiles.

In this study both boys and girls are within the range in both SBP and DBP, except for boys 14 and 15 years. Indeed, they belong to the 90-95th percentile for SBP.

Diastolic blood pressure values recorded for the total study sample and across physical activity levels were notably higher than those reported for children in England (Health Survey for England 1995-1997) and Portugal (Guerra et al., 2002).

The prevalence of hypertension was the highest among the sedentary subjects (43.3%) compared with the "active" (37.7%) and "sufficiently active" (42.9%) groups. This inverse relationship between physical activity and the development of hypertension, although not statistically significant, is consistent with the literature on blood pressure. Longitudinal and cross-sectional epidemiological studies suggest that regular physical activity and an improved fitness level may have a positive influence on hypotensive or

hypertensive states (; Al-Hazaa et al., 1994; Bouchard and Shephard, 1994; Hagberg, 1990).

The high prevalence rate (37.7% - 43.3%) of hypertension across activity levels reported in this study is a matter of concern, as hypertension is a risk factor for heart disease and stroke, as well as a major public health problem (Bouchard and Shephard, 1994). However, blood pressure in this study was measured during normal school hours over a period of one week. In studies of 24 hour blood pressure recordings it was found that blood pressure varies throughout the day, with many children having daytime readings above the reported normal range for casual blood pressure (De Man, Andre, and Bachmann, 1991; Task force on Blood Pressure Control in Children, 1987). O'Sullivan, Derrick, Griggs, Foxall, Aitkin, and Wren (1999) assessed the range and variability of ambulatory blood pressure in normal school children from Newcastle upon Tyne over a period of 24 hours and concluded that resting systolic blood pressure did not predict 24 hour mean systolic blood pressure. The authors found that systolic blood pressure in normal children has a wide range, with the 95th centile approximately 130 mmHg at rest, 160 mmHg during the school day, and 130 mmHg at night. The high prevalence rate of hypertension across activity levels reported in this study could have been influenced by environmental factors and should therefore be treated with caution.

5.6.3 PA and Fitness

Boys classified as "active" and" sufficiently active" recorded the best mean scores for all physical fitness variables, except for standing long jump, where the sedentary group performed the best. The sedentary group performed the poorest in handgrip strength, flexibility and $VO_{2\ max}$, while the sufficiently active group performed the poorest in the standing long jump. Girls classified as "sufficiently active" performed the best in all fitness tests. The sedentary group performed the poorest in standing long jump, sit-and-reach, and $VO_{2\ max}$ tests, while the active group performed the poorest in handgrip strength.

For boys, the greatest mean differences in all fitness variables, but standing long jump, were found between the "sedentary" and "active" group. For girls, the greatest mean differences in fitness variables were found between the "active" and "sufficiently active" group. However, for both sexes, only the differences in $VO_{2 \text{ max}}$ were of statistical significance (p<0.05).

Consistent with the findings reported in other studies (Emiola et al., 2002; Armstrong and Welshman, 1997; Pate and Ross, 1987) this data showed that physical fitness increase in relation to increased physical activity. However, only VO_{2 max} was found to be significantly associated with physical activity (p<0.01). The positive relationship found between physical fitness and PA is supported by the findings of other studies. Andersen (1994) reported a positive but non-significant correlation between PA and physical

fitness, while Emiola et al. (2002) found a significant correlation between the habitual PA and physical fitness of Nigerian school children.

The significant positive correlation between $VO_{2 \text{ max}}$ and PA for boys and girls in this study is supported by some researchers. Prista, (1994) reported that PA and physical fitness contribute to an improvement in physical fitness, while Armstrong and Welshman (1997), found that the physical fitness of children is significantly associated with certain physical activity behaviour of children.

A Pearson's correlation coefficients analysis was performed to analyse the associations between VO_{2 max} and selected CVD risk factors. Significant and negative associations between BMI, skinfolds, and VO_{2 max} were observed. This data agree with previous reports showing an inverse relationship between BMI, percent body fat and VO_{2 max} (Engelbregcht et al., 2002; Boreham et al., 2001; Beunen et al., 1992; Armstrong et al., 1991) with a stronger negative association of BMI among subjects with low fitness levels (Nielsen and Anderson, 2003; Ribeiro et al., 2003).

Other cross-sectional studies reported an inverse relationship between fitness and blood pressure (Al-Hazaa et al., 1994). In this study, only diastolic blood pressure showed a consistent significant relationship with VO_{2 max}. Leg power and arm strength showed a significant and positive relationship with VO_{2 max}. These findings are supported by Bouchard et al. (1997) and Leelarthaepin and Chesworth (1983) reporting a significant relationship between PA and strength endurance.

The girls consistently showed greater flexibility, although not significantly different, than the boys across all activity groups. The relationship between PA and flexibility was also not significant for both boys and girls. These findings are supported by the literature suggesting that flexibility is mostly determined by genetics rather than PA (Bouchard et al., 1997). Flexibility, defined as the range of movement at a joint, is specific for a given joint and is determined by a variety of factors including the bony and cartilaginous surfaces and the soft tissues around the articulation. It is believed that maintaining normal joint flexibility may help preventing upper and lower back pain and osteoarthritis (Bouchard and Shephard, 1994).



5.7.1 Contribution of CVD Risk Factors to Cardiorespiratory Fitness (VO_{2 max})

Stepwise regression analysis was performed to assess the relationship between known cardiovascular disease risk factors and cardiovascular fitness.

The sum of skinfolds (triceps and subscapular) was the most important determinant in $VO_{2 \text{ max}}$ variation in girls (31.5%, p=0.00), while sum of skinfolds (28%, p=0.00), BMI (17.3%, p=0.00) and age (7.2%, p=0.03) accounted significantly for the variation of $VO_{2 \text{ max}}$ in boys.

These results indicate that sum of skinfolds is a significant predictor of $VO_{2 \text{ max}}$ in rural boys and girls. It further suggests that BMI and age are also good predictors of maximal aerobic performance in rural boys but not in girls. It is known that maximal aerobic performance in girls reaches a plateau from 14 years onwards while in boys it increases up to the age of 18 years (Borms, 1986).

5.7.2 Contribution of CVD Risk Factors to Blood Pressure

Stepwise regression analysis was performed to assess the relationship between known cardiovascular disease risk factors and blood pressure.

Stepwise regression analysis showed that weight and BMI explain significantly (p<0.05) the variation in systolic blood pressure in rural boys and girls, respectively. Related to diastolic blood pressure, sum of skinfolds (14.2%, p<0.05) and height (10.6%, p<0.05) account significantly for the variation in diastolic blood pressure in girls.

These results suggest that weight and BMI are good predictors of systolic blood pressure in both boys and girls. It further showed that sum of skinfolds and height is good predictors of diastolic blood pressure in girls but not boys. In the study of Balogun et al. (1990), the stepwise regression analysis revealed that weight, BMI, and triceps skinfold thickness were strong determinants of blood pressure levels. In another study (Bachmann et al., 1987), the partial correlation coefficient identified body mass as the most important determinant of blood pressure, which in part, is confirmed by the findings of this study.

5.8 Summary and Conclusion

Overall, more than 50% of rural school children of mixed descent in the Caledon/Overberg region of the Western Cape engaged in sufficient health enhancing physical activity. This is encouraging since the levels are significantly higher than the national and provincial physical activity prevalence. The low physical inactivity prevalence among the children in this study is most likely as a result of their habitual activity patterns which include walking to school and sports participation.

The habitual mode of commuting to and from school for most of the respondents was walking (76.7%), while 23.3% commuted by bus or taxi. Sports participation (organized and unorganised) levels were also high with more than 50% of children reporting regular participation. Rugby and netball emerged as the most popular sports among boys and girls respectively.

Sedentary behaviour, as reflected in the number of hours watching TV or playing videogames, of the children in this study was more prevalent among girls and is comparable with the national prevalence. Almost 1 out of 4 (22.36%) children watched TV or played video games for more than 3 hours per day.

With regard to body composition, none of the boys were overweight or obese, while 11.1% and 3.3% of the girls were overweight and obese, respectively. Low prevalence of obesity among African adolescents has been reported by various South African studies

(Travill, 2000; Monyeki et al., 1999; Cameron and Getz, 1997; Simons et al., 1990). The overall average for being underweight, as indicated by weight-for-age, in this study was comparable with the national (9%) prevalence data (National Department of Health, 2002). Significantly more boys (15.3%) than girls (4.4%) were underweight. This might explain the absence of either overweight or obesity among the boys in this study.

Stunting (4.3%), as indicated by height-for-age, in this study was notably lower than the National (11.4%) prevalence (National Department of Health, 2002). Significantly more boys (6.9%) than girls (2.2%) were stunted, a factor contributing to the low weight recorded by the boys.

A comparison with NCHS reference data revealed that approximately 75% of the boys and 50% of the girls from this study are shorter than the NCHS reference group. According to Cameron (1990), the pattern of falling away from the 50^{th} centile is common among adolescents in developing countries. This view is supported by the findings of this study. The mean weight of the boys in this study followed a similar pattern as the height growth, starting between the 25^{th} - 50^{th} centile at age 14 years and dropping to below the 25^{th} centile at age 16 years. As for height, the mean weight of the girls fell between the 25^{th} - 50^{th} centile.

The high prevalence (38.3%) of hypertension among the rural children, especially boys, is a serious health concern and needs further investigation. It should however be noted

that blood pressure readings are influenced by various factors and should be interpreted with the necessary caution.

Using the FITNESSGRAM standards, most of the boys (52.4%) but not the girls (29.9%) had acceptable levels of cardiovascular fitness. Boys performed better than the girls in all fitness tests, but flexibility. The fitness levels (flexibility, leg power, and arm strength) of the rural children in this study are comparable with urban children of the same age from a disadvantaged community in the Western Cape (Travill, 2000). These levels are presumably low, as Travill (2000) found his subjects to have fitness levels comparable to the lowest category of Dutch fitness standards. The relatively smaller stature of the children in this study is most likely to have contributed to their low fitness scores, especially when measured against fitness standards for developed countries.

In consensus with the literature, analysis of the results of this study showed an inverse relationship between body mass, BMI, skinfold thickness and physical activity. These findings suggest that physical activity impacts positively on body composition.

No significant correlation was found between blood pressure and physical activity, suggesting that physical activity levels had no significant impact on the blood pressure measures of the children in this study. However, the prevalence of hypertension was the highest among the sedentary subjects (43.3%) when compared to the "active" (37.7%) and "sufficiently active" (42.9%) groups. This inverse relationship between physical activity and the development of hypertension, although not statistically significant, is

consistent with the literature on blood pressure. Of concern, as earlier mentioned, are the high levels of hypertension across activity levels. Hypertension is a risk factor for heart disease and stroke, as well as a major public health problem (Bouchard and Shephard, 1994).

Consistent with the findings reported in other studies (Emiola et al., 2002; Armstrong and Welshman, 1997; Pate and Ross, 1987) analysis of the data of this study showed that physical fitness increase in relation to increased physical activity. However, only $VO_{2\,max}$ was found to be significantly associated with physical activity (p<0.01). The positive relationship found between physical fitness and PA suggests that higher physical activity levels lead to improved fitness, especially cardiovascular fitness.

A Pearson's correlation coefficients analysis found significant inverse associations between BMI, skinfolds, and $VO_{2\,max}$. This data agree with previous reports showing an inverse relationship between BMI, percent body fat and VO_{2max} . It can thus be concluded that the "sufficiently active" children in this study had higher levels of cardiovascular fitness with lower BMI and percent body fat, when compared to the sedentary children.

Results from a stepwise regression analysis suggest that age and BMI significantly contributed to the variation in VO2max of the boys but not the girls, while sum of skinfolds is a good predictor of VO2max in both genders.

In conclusion, the results from this study demonstrate the positive impact of physical activity on the body composition and cardiovascular fitness of rural boys and girls. Physical activity was also found to have a positive impact on the hypertensive state of rural girls but not boys. The findings suggest that habitual physical activity such as active commuting to and from school and sports participation can enhance body composition, fitness and health in adolescents.

5.9 Recommendations

The findings of the study have implications for policy and practice, as well as challenges to the family, schools and National Education Department. The recommendations will address these challenges.

WESTERN CAPE

The findings suggest walking to-and-from school can make a significant contribution to overall fitness and health levels. Children should therefore be encouraged to walk rather than make use of motorized transport.

- Sport participation and physical education at schools should be encouraged, since
 the school provides a protective environment for children to engage in physical
 activity.
- The education department and schools should find creative ways to engage children in the daily recommended levels of physical activity. Children should

daily engage in at least 30 minutes of moderate to vigorous physical activities. The target should be 60 minutes or more since activity levels tend to decrease with age.

- Greater awareness raising programmes about the health benefits derived from physical activity are necessary.
- Girls should especially be targeted since they tend to be less active, with lower fitness levels.
- Lifelong habitual physical activities should be encouraged from a young age since activity and fitness levels seem to decrease with age, especially among girls.

Further research should be conducted, to investigate the impact of physical activity on the health and fitness levels of young children. This is especially needed in the context of the increase in obesity, hypertension and other CVD risk factors among children.

Mr. Phillip Wildschutt P.O. Box 227 CALEDON 7230

Dear Mr P. Wildschutt

RESEARCH PROPOSAL: THE RELATIONSHIP BETWEEN WALKING TO SCHOOL, FITNESS, BLOOD PRESSURE AND BODY COMPOSITION IN RURAL CHILDREN.

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

- 1. Principals, educators and learners are under no obligation to assist you in your investigation.
- 2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
- 3. You make all the arrangements concerning your investigation.
- 4. Educators' programmes are not to be interrupted.
- 5. The Study is to be conducted from 14th March 2005 to 31st May 2005.
- 6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December 2005).
- 7. Should you wish to extend the period of your survey, please contact Dr R. Cornelissen at the contact numbers above quoting the reference number.
- 8. A photocopy of this letter is submitted to the Principal where the intended research is to be conducted.
- Your research will be limited to the following schools: Swartberg Secondary, Swartberg Primary, Teslaarsdal Primary and Boontjieskraal Primary.
- 10. A brief summary of the content, findings and recommendations is provided to the Director: Education Research.
- 11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

The Director: Education Research Western Cape Education Department Private Bag X9114 CAPE TOWN 8000

We wish you success in your research.

Kind regards.

Signed: Ronald S. Cornelissen for: **HEAD: EDUCATION DATE: 14th March 2005**

TOESTEMMINGSBRIEF - Leerder

Ons nooi jou graag uit om deel te neem aan 'n navorsingsprojek oor die fiksheid - en gesondheidstatus van leerders in die Caledon/Overberg omgewing.

As jy'n seun of dogter tussen die ouderdom 14-16 jaar oud is, kan jy vrywillig aan die projek deelneem.

Die toetsing en meting sal deur die navorser by die skool gedoen word. Die toetse wat uitgevoer sal word sluit in:

Atropometriese metings: - Lengte (statuur)

- Gewig

Liggaamsomtrek (bo-arm, heupe, middel),Liggaamsvet (triceps, subscapular).

Fiksheidstoetse: - Krag (beenkrag, handgreep)

- Soepelheid (sit-en- strek)

- Kardiovaskulêre kapasiteit (20m shuttle run)

- Spoed (50m sprint).

Kliniese toets: Bloeddruk: (Dinamap-bloeddrukmonitor)

Bloeddruk en liggaamsmetings sal individueel in privaatheid gedoen word. Die fikheidstoetse sal in ouderdomsgroepe (seun en dogters afsonderlik) uitgevoer word.

Alle toetse sal gedemonstreer en verduidelik word sodat jy kan besluit of jy daaraan wil deelneem of nie.

As jy instem om deel te neem aan die navorsingsprojek, moet jy die vorm onderteken en inhandig. Jou samewerking word hoogs waardeer. **Jy behou die reg om op enige stadium aan die projek / toetse te onttrek.**

Die individuele uitslae van die projek sal streng privaat hanteer word en die data sal in groepsverband vrygestel word. Voel vry om te vra as jy enige iets oor die projek wil weet.

NB. JOU DEELNAME AAN DIE PROJEK IS VRYWILLIG.

Ek	Gebore
Stem toe om getoets en gemeet te word deur Universiteit van Wes-Kaapland.	'n opgeleide navorser van die
Datum:	
Handtekening:	
Beantwoord die volgende vrae as jy besluit h neem:	et om aan die projek deel te
Ly jy aan enige siekte/s waarvan jy bewus is?	
Noem indien enige:	
Het jy al enige operasies ondegaan of was jy al in	n hospitaal opgeneem?
Spesifiseer die siekte/kwaal en die operasie wat g	edoen is, indien enige:

TOESTEMMINGSBRIEF – Ouer / Voog

Geate Ouer / Voog

Ter voltooing van my Meestersgraad(Sport, Rekreasie en Oefeningswetenskap) aan die Universiteit van Wes-Kaapland, doen ek navorsing oor die fiksheid en gesondheid van leerders in die Caledon/Overberg omgewing. Met die regering se voorneme van herstukturering en ontwikkeling is dit belangrik om die algehele status van kinders se fiksheid en gesondheid te bepaal.

Alle kinders (seuns en dogters) tussen die ouderdom 14-16 jaar kan vrywillig aan die projek deelneem. Die toetsing en meting sal deur die navorser by die skool gedoen word. Die toetse wat uitgevoer sal word sluit in:

Atropometriese metings: - Lengte (statuur)

- Gewig

Liggaamsomtrek (bo-arm, heupe, middel),Liggaamsvet (triceps, subscapular).

Fiksheidstoetse: - Krag (beenkrag, handgreep)

- Soepelheid (sit-en- strek)

- Kardiovaskulêre kapasiteit (20m shuttle run)

- Spoed (50m sprint).

UNIVERSITY of the

Kliniese toets: Bloeddruk: (Dinamap-bloeddrukmonitor)

Bloeddruk en liggaamsmetings sal individueel in privaatheid gedoen word. Die fikheidstoetse sal in ouderdomsgroepe (seun en dogters afsonderlik) uitgevoer word.

Alle toetse sal gedemonstreer en verduidelik word sodat U kind/ers kan besluit om daaraan wil deelneem of nie.

As U toestem dat U kind mag deelneem aan die navorsingsprojek, moet U die vorm onderteken en saammet U kind stuur om in te handig by die skool. U samewerking word hoogs waardeer. Al het U toestemming verleen, behou U kind/ers die reg om op enige stadium aan die projek / toetse te onttrek.

Die individuele uitslae van die projek sal streng privaat hanteer word en die data sal in groepsverband vrygestel word. Voel vry om te vra as U enige iets oor die projek wil weet. Die uitslae van U kind sal sleg aan U beskikbaar wees.

	Verleen toestemming dat
(naam van ouer/voog)	(naam van kind)
Gebore	
getoets en gemeet mag word deur 'n op Wes-Kaapland.	ogeleide navorser van die Universiteit van
Datum:	
Handtekening:	
Verskaf asb. die volgende inligting:	
Ly U kind aan enige siekte/s waarvan U	bewus is?
Noem indien enige:	<u> </u>
UNIVER	SITY of the RN CAPE
W ESTE	XII. VAI I
Het U kind al enige operasies ondegaar	of was jy/sy al in 'n hospital opgeneem?
Spesifiseer die siekte/kwaal en die oper	asie wat gedoen is, indien enige:

Dui aan hoeveel keer jy die afgelope 12 maande (Maart 2004. – April. 2005) aan die ondestaande aktiwitiete deelgeneem het.. Dui sleg die aktiwiteite aan waanaan/waarin jy deelgeneem het.

ERAS survey – measuring physical activity of rural school children

Activities that were classified as	Aktiwiteite wat / Fiksheid en gesongheid				
HEPA:	bevorder				
	Hoeveel keer per jaar	Hoe lank duur die			
	(12 Maande)	aktiwiteit gewoontlik			
Rugby / raakrugby					
Sokker / Soccer					
netball indoor and outdoor / Netbal					
gym-workouts /Gimnasium oefeninge					
Athletics / Atletiek					
cricket-(indoor and outdoor) / Krieket					
TAI-BO					
Aerobics Aerobiese oefeninge					
Stap (15min en langer)					
Golf					
Badminton / Pluimbal IINIV	ERSITY of the				
Baseball / Korfbal					
Basketball / Basketbal	ERN CAPE				
Boxing / Boks					
Canoeing / Kanovaart					
Kayaking/					
Judo					
Karate					
cycling (including bmx) / Fietsry					
mountain bike) / Bergfiets					
jogging and running-cross / draf					
Country / Landlope					
Gymnastics / Gimnastiek					
hockey-indoor and outdoor / Hokkie					
blade skating /					
ice hockey / Yshokkie					
ice skating / Ysskaats					
snow skiing					
snow/ice sport					
lacross-outdoor					
chi kung					
eastern judo					

Llautalna / hauthana/ hauthanala	
Houtdra / houtkap/ houtmaak	
Inkopiesakke dra	
Kickboxing / Skopboks	
Taekwondo	
tai chi	
martial arts / Oosterse Vegkuns	
Orienteering / Velduitstappies	
Rogaining	
inline hockey	
roller-blading / rolskaats	
Skateboarding / Skaatsplankry	
roller sports	
Rowing / roei	
Houtmaak / houtdra	
Softball / Sagtebal	
Squash / Muurbal	
Swimming / Swem	
table tennis / Tafeltennis	
tennis (outdoor and / Tennis	
indoors)	
tenpin bowling /	
Triathlons / Driekamp	
volleyball-indoor outdoors / Vlugbal	
newcombe ball	
water-skiing / Waterski	`
Wrestling / Stoei	ERSITY of the
	-
lacross-indoor WES' canoe polo	ERN CAPE
weight training (including	
bodybuilding, circuit and /	
Liggaamsbou	
power team)	
dancing (including boot/ Dans / Ballet	
scooting and ballet)	
electric light cricket	
wheelchair hockey	
scuba diving / Duik (See)	
water polo/ Waterpolo	
Abseiling /	
Caving	
rock climbing	
Handball	
Fencing/	
gorila ball	
racquet ball	
ultimate Frisbee	
gaelic football	

horse racing		
tee ball		
Boomerang		
Boomerang		
winter Olympic		
Marching / Marseer/Brigade		
Aquarobics / Wateroefeninge		
/ tquarebies / vvatereereminge		
underwater hockey		
soft cross		
royal tennis		
commonwealth games		
broom ball		
polo cross		
leader ball		
weight lifting competition/		
gewigoptelkompetisie		
Grockey		
Activities that were		Ligte oefeninge en Ontspannings
classified as recreation	and	aktiwiteite
light physical activity	THE RE	THE HEAT OF THE SECOND
(RLPA)	77	
Ballooning		
Gliding		
Gyroplane flying	,111	
Hang gliding	IINIV	ERSITY of the
Model aeroplane flying	VIVE 0.0	
Ultra light flying	WES	TERN CAPE
Air sports – other		
Archery / Boogskiet		
Bow hunting		
Billiards		
Pool / Snoeker		
Snooker		
Bocce		
Carpet bowls		
Croquet		
Darts / veerpyltjie		
Trampolining / springmat		
Horse riding / Perdry		
Lawn bowls / rolbal		
Yoga		
Motor sports (all types)		
Rodeo		
Sailing / Seiljagvaart		
Hunting / Jag		

Surfing (all types)/ branderplankry	
Sailboarding	
Windsurfing	
Diving (board) / duik (swembad)	
Jet skiing	
Power boarding	
Fishing / Hengel	
Dog racing / Honderesies	
Sheepdog trail	
Water volleyball / Watervlugbal	
Pigeon racing / Duiwevlieg	
Putt-putt golf / Mini-golf	
Play / Speel	



AKTIWITEITSVRAELYS

PHYSICAL ACTIVITY QUESTIONNAIRE

Voltooi die vraelys so deeglik as moontlik. Ignoreer vrae wat nie op jou van toepassing is nie. Jou antwoorde sal streng vertroulik hanteer word.

Waar van toepassing, trek 'n kruise deur die letter/nommer van die antwoord wat op jou betrekking het.

DEMO	GRAFIESE INFORMASIE		
11	Naam	Van	
1.2	Geboortedatum	101 101 101 101	Ouderdom
1.3	Graad		
1.4		IKVERSITY 2 Vro	ulik
1.5	Ras: 1 Swart	2 Kleurling 3 Indi	iër 4 Wit
(Woonadres (Die straatadres van waar jy daagliks skooltoe kom)		
1.6.1	Hoe lank woon jy al by di	e adres?	
[A minder as 'n jaar B 1-	-2 Jaar C 3-4 Jaar D	meer as 4 Jaar
1.6.2	Naam van huidige skool:		
1.6.2.1	Hoe lank is jy al by die s	skool?	

	A min	der as	n jaar	B 1-2 Jaar	C 3-4	Jaar D n	neer	as 4 Ja	ar
1.7	Hoe g	ereeld	eet jy ont	byt voor jy	skoolto	e kom:			
	1 Elke	oggen	d 2	Soms	3 noo	it			
TRAN	ISPOR	T (hui	dige sko	ol)					
1.8	Hoe k	om jy b	y die sko	ol en terug	?				
Sogge	ens	1 stap	2	bus/ taxi		3 fiets		4 mot	or
Smide	dae	1 stap	2	bus/ taxi		3 fiets		4 mot	or
1.9		stap of te kom	-	oe lank nee	em dit jo	ou gewoo	ntlik	sogger	ns om by die
	A min	der as	5 minute	B 5-1	0 min	C 11-1	5 min	n D 16-2	20 min
	E 21-2	25 min	F	26-30 min		G meer	as 30) min	
1.10			•	s/taxi/motor ou huis te s					-
	A min	der as	5 minute	B 5-1	0 min	C 11-15 r	min		D 16-20 min
	E 21-2	25 min	F	26-30 min		G meer	as 30) min	
1.11	Teen watter pas stap jy gewoontlik skooltoe en terug?								
	Sogge	ens:	1 stadig	2 flink	<	3 vinnig			
	Smidd	lae:	1 stadig	2 flink	<	3 vinnig			
0005			- /1 . 1.						
SPORTDEELNAME (huidige en vorige skool)									

1.12 Neem jy deel aan sport?

1 Ja

2 Nee

- 1.13 Merk die sportsoort/e waaraan jy gereeld deelneem:
 - 1 netbal 2 rugby 3 atletiek 4 sokker 5 vlugbal
 - 6 landlope 7 tennis 8 ander (noem)
- 1.14 Hoe gereeld oefen jy vir die sport waaraan jy deelneem?
- 1.15 Hoeveel ure per dag kyk jy TV en/of Speel jy Video/rekenaar speletjies
- 15-30 min **A** 30-60 min **B** 1-2 ure **C** 2-3 ure **D** meer as 3 ure **E**



1. Anthropometric parameters

Absolute Size

Age (years), Mass (kg) and Height (cm)

Mass (kg)

Weight was measured to the nearest 0.1 kg using a calibrated digital scale manufactured by Soehnle (Nassau, Germany). Each subject was weighed wearing light clothing without shoes or stockings.

Height (Stature)

Height was measured to the nearest 0.1cm using a portable stadiometer.

Stature: The distance from the vertex to the sole of the feet. The subject stood erect with the heels together, buttocks, upper back and rear of the head in contact with the vertical section of the stadiometer, the upper limbs pendent and head held in the Frankfurt plane. Before taking the measurement, the subject was instructed to inhale deeply and stretch upwards to the fullest extent.

Skinfolds (mm)

The following subcutaneous skinfold measurements were obtained on the right-hand side of the body using the Harpenden skinfold calliper: triceps and subscapula.

<u>Triceps.</u> - At the mid-posterior point between the tip of acromion and the olicranon process.

<u>Subscapular</u>. - Just beneath the inferior angle of the scapula with the fold in an oblique plane descending laterally outwards and downwards 45 degrees to the horizontal plane. The subject stood erect with the upper limbs pendent.

Fitness Tests

1. 20m Shuttle Run Test / Multi-Stage Fitness Test

The maximal 20 m shuttle run test, described by Leger and Lambert (1982), was carried-out to predict maximal aerobic power ($VO_{2 \text{ max}}$).

Required Resources

To undertake this test you will require:

• A flat, non slippery surface at least 20 metres in length

• 30 meter tape measure

• Marking cones

• Pre-recorded CD

CD recorder

- Recording sheets
- Assistant

How to conduct the test

The test is made up of 23 levels where each level lasts approx 1 minute. Each level comprises of a series of 20m shuttles where the starting speed is 8.5km/hr and increases by 0.5km/hr at each level. On the tape a single beep indicates the end of a shuttle and 3 beeps indicates the start of the next level. The test is conducted as follows:

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- Measure out a 20 metres section and mark each end with a marker cone
- The athlete carries out a warm up programme of jogging and stretching exercises
- The test is conducted
 - The athlete must place one foot on or beyond the 20m marker at the end of each shuttle
 - If the athlete arrives at the end of a shuttle before the beep, the athlete
 must wait for the bleep and then resume running
 - The athlete keeps running for as long as possible until he/she can longer keep up with the speed set by the tape at which point they should voluntarily withdraw.
 - o If the athlete fails to reach the end of the shuttle before the beep they should be allowed 2 or 3 further shuttles to attempt to regain the required pace before being withdrawn
- Record the level and number of shuttles completed at that level by the athlete

At the end of the test the athletes conduct a warm down programme, including stretching exercises.

Knowing that the starting speed is 8.5km/hr and increases by 0.5km/hr at each level then the time for each 20m section, at each level, can be estimated from the following equation:

• 20m Time = 72 / (((Level - 1) * 0.5) + 8.5)

The time for 20m at level 11 is 5.33 seconds.

Knowing that the starting speed is 8.5km/hr and increases by 0.5km/hr at each level and the duration of each level is approximately one minute then the number of shuttles at each level, can be estimated from the following equation:

• Shuttles =
$$(((Level - 1) * 0.5) + 8.5) * 0.838$$

The result is rounded up to the nearest whole number.

2. Standing Long Jump

The standing long jump was used to assess explosive power. With both feet behind the take-off line, the subjects had to jump as far as possible horizontally. The distance was measured from the take-off line to the point where any part of the body touched the ground nearest to the take-off line. The better of two attempts were recorded as the final distance.

3. Grip Strength

Arm strength was assessed by means of the hand grip dynamometer. The test was performed with both hands. The dynamometer was adjusted according to the size of the subjects' hands. With the arm held away from the body and the subject standing free, the

dynamometer is squeezed as hard as possible, one hand at a time. The score of the dominant hand (highest score between the left and right hand) was recorded as the final score. The mean of the right and left hand scores were also recorded.

4. Flexibility

Flexibility was assessed by means of the sit and reach test. The subjects were lightly dressed and were asked to remove their shoes. With the knees kept straight, hands on top of each other, and the arms reaching forward, the subjects were asked to stretch forward slowly, as far as possible. The stretch had to be held for at least 3 seconds; hereafter the distance was measured to the tip of the middle finger.

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