

**THE RELATIONSHIP BETWEEN LEVELS OF  
CARDIORESPIRATORY FITNESS, BODY COMPOSITION  
AND PHYSICAL SELF-PERCEPTION IN ADOLESCENT  
GIRLS**

LIEZEL DU TOIT

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Master in Sport Science at Stellenbosch University



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## **DECLARATION**

**I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part, submitted it to any university for a degree.**

## ABSTRACT

There is a universal concern about the rapid decline in the physical activity levels of children, particularly adolescent girls. There is evidence of an increase in juvenile obesity that is associated with numerous health risks. During adolescence the majority of psychological problems associated with obesity stem from a disturbance in the self-concept. The purpose of this study was to determine the relationship between fitness, body composition and physical self-perception of a sample of 167 adolescent girls (14-17 years), and to compare these results with the results of similar studies from around the world. The results show a significant positive relationship ( $r = 0.47$ ;  $p < 0.01$ ) between levels of cardiorespiratory fitness and physical self-perception and significant negative relationships between percentage body fat and physical self-perception ( $r = -0.35$ ;  $p < 0.01$ ), as well as body composition and cardiorespiratory fitness ( $r = -0.47$ ;  $p < 0.01$ ). The results clearly illustrate the current prevalence of obesity associated with low cardiorespiratory fitness (due to inactivity) and low self-perception. The importance of being physically active for the physical and psychological well-being of adolescents is a valuable preventive and treatment measure.

**Key words:** Physical activity, cardiorespiratory fitness, body composition, obesity, physical self-perception, adolescence.

## OPSOMMING

Die bekommernis oor die toenemende afname in die fisieke aktiwiteitsvlakke van kinders, veral adolessente meisies, blyk 'n universele verskynsel te wees. Bewyse is gevind van 'n toename in obesiteit by kinders wat verband hou met verskeie gesondheidsrisikos. Tydens adolessensie word die meeste sielkundige probleme wat verband hou met obesiteit deur 'n versteuring in die selfkonsep veroorsaak. Die doel van hierdie studie was om vas te stel wat die verband tussen fiksheid, liggaamsamestelling en fisieke selfpersepsie is. Die steekproef het bestaan uit 167 adolessente meisies (14 – 17 jaar oud) en hierdie resultate is vergelyk met die resultate van soortgelyke studies van regoor die wêreld. Die resultate toon 'n beduidend positiewe verband ( $r = 0.47$ ;  $p < 0.01$ ) tussen kardiorespiratoriese fiksheidsvlakke en fisieke selfpersepsie vlakke en beduidend negatiewe verbande tussen liggaamsvetpersentasie en selfpersepsie ( $r = -0.35$ ;  $p < 0.01$ ) sowel as liggaamsamestelling en kardiorespiratoriese fiksheid ( $r = -0.47$ ;  $p < 0.01$ ). Die resultate toon dat die voorkoms van obesiteit met lae kardiorespiratoriese fiksheid (as gevolg van 'n gebrek aan fisieke aktiwiteit) en lae selfpersepsie verband hou. Die belangrikheid van fisieke aktiwiteit vir die fisieke en sielkundige welstand van adolessente is 'n waardevolle voorkomende en behandelingsmetode.

**Sleutelwoorde:** Fisieke aktiwiteit, kardiorespiratoriese fiksheid, liggaamsamestelling, obesiteit, fisieke selfpersepsie, adolessensie.

To my parents Gys and Jeanne du Toit

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## CHAPTER ONE

### SETTING THE PROBLEM

#### INTRODUCTION

Throughout the ages and until only a few decades ago, nearly all people were physically very active. The gathering of food was, for populations like the African tribes of Kenya or the Aboriginal hunter-gatherers of Australia, the main purpose of life, which kept these people physically fit throughout life (Walker, Walker & Adam, 2003). In contrast, nowadays more than 60% of American adults are not active on a regular basis, while 25% are not active at all (Walker *et al.*, 2003). Furthermore, an alarming decline in the physical activity levels of youth, especially adolescent girls, has been observed over the last decade (Barnett, O'Loughlin & Paradis, 2002). The reason for the increasing inactivity among youth is a growing research area.

This inactivity leads to a number of health risks and “Western diseases”, which a few decades ago were almost unheard of. These include diabetes mellitus, coronary heart diseases, hypertension and of particular interest here, obesity (Gavarry *et al.*, 2003). The number of overweight children and adolescents in the United States of America has more than doubled over the past 30 years (Vincent *et al.*, 2003). Table 1.1 shows the percentage of a sample of young American girls being overweight or obese.

Table 1.1: The percentage (%) of a sample of American girls classified as overweight or obese by age, according to Vincent *et al.* (2003)

Age	6	7	8	9	10	11	12	Total
Number of subjects (n)	28	49	66	64	78	72	28	385
% overweight or obese	7.1	22.4	36.4	35.9	46.2	43.1	35.7	35.6

Statistics like these, from around the world, cause major concern among researchers and health professionals.

On the other hand, teenage girls are being bombarded with images of the “perfect body”. The pressure on adolescent girls to be as thin as modern models is higher than ever, which raises the question of how their self-concepts are affected by this.

## **AIM OF THE STUDY**

The purpose of this study was to determine the levels of cardiorespiratory fitness, body composition and physical self-perception of adolescent girls in middle-class schools in Stellenbosch, and to answer the following research questions:

1. Is there a relationship between the subjects’ levels of cardiorespiratory fitness and their body composition?
2. Is there a relationship between the subjects’ body composition and their physical self-perception?
3. Is there a relationship between the subjects’ levels of cardiorespiratory fitness and their physical self-perception?

Another objective was to compare the results of this study with results from similar studies around the world, in an attempt to find out whether or not there is reason for concern for the future of Stellenbosch youth.

## **METHODOLOGY**

The study sample consisted of 167 adolescent girls from different schools in Stellenbosch. Levels of cardiorespiratory fitness were indirectly assessed by using the *Bleep Test*. Anthropometrical procedures as described by Norton *et al.* (2000) were followed to determine body composition. The Body Mass Index was calculated by using stature and body mass measurements. Waist and hip circumferences were taken to calculate waist-hip ratios, and skinfold measurements of the tricep and subscapular skinfolds were taken to determine percentage body fat. The subjects completed the *Physical Self-perception Profile* (PSPP) of Fox and Corbin (1989) to determine their physical self-perceptions.

## **LIMITATIONS**

The following limitations might have had an impact on the test results:

- Testing took place in the beginning of the second semester, which could have an influence on the fitness levels of the subjects.
- Only subjects who volunteered for the study, and whose parents gave their consent, were tested. This eliminated quite a few subjects who might have delivered interesting results.

## **CHAPTER OUTLINE**

Chapter two is a review of literature concerning physical activity, obesity and self-esteem. Chapter three is a description of the research protocol and Chapter four discusses the results of the study in detail. Conclusions and recommendations for future research can be found in Chapter five.

## CHAPTER TWO

# LITERATURE REVIEW

### INTRODUCTION

The importance of physical activity has been appreciated for centuries. The ancient Greeks, for example, clearly understood the importance of physical well-being and fitness. A high level of activity was universal until the 1800s (Walker *et al.*, 2003).

Numerous studies have recently been done on the benefits of physical activity, and the results are well-known in the western world. These benefits do not only include a healthy physical body, but also a healthy state of emotional or psychological well-being. Morris (1994:807) describes physical activity as today's "best buy" in public health, because of its manifold benefits. Yet a tremendous decline in the physical activity levels of today's children is prevalent, compared with a few years ago. According to Wang and Biddle (2001) the inactivity of modern youth has become a public health problem.

### DEFINITIONS AND PREVALENCE

Bouchard *et al.* (1990:6) define physical activity as "any bodily movement produced by skeletal muscles and resulting in energy expenditure". Energy expenditure can be measured in either kilocalories (kcal) or kilojoules. Physical activity can be categorised into three portions of daily life during which the activity occurs, namely while sleeping, at work (occupational) and at leisure (Caspersen, Powel & Christenson, 1985). While sleeping the energy expenditure is very low due to physical inactivity, and occupational physical activity is only applicable when working with an adult population. The focus of this study will therefore be on leisure-time physical activity, which can further be subdivided into categories

such as sports, conditioning, exercises and household tasks, for example cleaning the house or mowing the lawn (Caspersen *et al.*, 1985).

Exercise is one of the subcategories of physical activity and can be described as planned, structured, repetitive and purposeful leisure-time physical activity (McKardle, Katch & Katch, 1996). The terms “exercise” and “physical activity” have in the past (Taylor, 1983), and will in this study, be used interchangeably, because of a number of similar elements (see Table 2.1).

Table 2.1: Elements of physical activity and exercise (Caspersen *et al.*, 1985)

PHYSICAL ACTIVITY	EXERCISE
1. Bodily movement via skeletal muscles	1. Bodily movement via skeletal muscles
2. Results in energy expenditure	2. Results in energy expenditure
3. Energy expenditure (kcal) varies continuously from low to high	3. Energy expenditure (kcal) varies continuously from low to high
4. Positively correlated with physical fitness	4. Very positively correlated with physical fitness
	5. Planned, structured, and repetitive bodily movement
	6. An objective is to improve or maintain one or more of the physical fitness components

Physical fitness is defined by McKardle *et al.* (1996:635) as “a set of attributes that relate to one’s ability to perform physical activity”. Several measurable components contribute to physical fitness, and these are either health-related or skill-related fitness components (Caspersen *et al.*, 1985). Agility, balance, coordination and speed are examples of skill-related components, while muscular endurance and –strength, flexibility, body composition and cardiorespiratory endurance fall under the health-related category.

Caspersen *et al.* (1985:129) define cardiorespiratory endurance as one of the health-related components of physical fitness that “relates to the ability of the circulatory and respiratory systems to supply fuel during sustained physical activity and to eliminate fatigue products after supplying fuel”. That means, the ability to deliver and use oxygen during vigorous and prolonged exercise or work. In order to improve one’s cardiorespiratory fitness one can engage in exercises like jogging, hiking, swimming or cycling.

The American College of Sports Medicine (ACSM) recommends that children engage in moderate to vigorous physical activity for at least 30 minutes per day during the whole week (Swain & Leutholtz, 2002). In a study by Gavarry *et al.* (2003), conducted in France, the authors found that 41% of adolescents at senior high school did not achieve the above-mentioned recommendation. According to Walker *et al.* (2003), 25% of all children in the United States of America, between the ages of 12 and 21 engage in no physical activity at all. In a study to determine the lifestyle patterns of high school learners in the Western Cape, Van Deventer (1998/1999) found that 38% of 1243 subjects participated in organised school sport, 27% in physical leisure activities and 23% in club sports.

## **HEALTH RISKS**

The increase in the prevalence of coronary heart diseases, obesity, hypertension, diabetes and stress, is partly linked to the reduction in physical activity levels (Gavarry *et al.*, 2003). Physical inactivity is seen as one of the major modifiable risk factors for coronary heart diseases (Coetsee, 2003) and coronary artery diseases (Andersen *et al.*, 1998). The incidence of coronary heart diseases among sedentary individuals is approximately twice that of more active persons (Blair, 1993; Morris, 1994).

## **DETERMINANTS OF PHYSICAL ACTIVITY**

Healthy activity habits, established in childhood, will influence activity levels in adulthood (Moore *et al.*, 1991). Determinants of physical activity in childhood have become the focus of many researchers, in an attempt to understand why children and adolescents choose not to participate in organised sports or exercise.

### **Gender**

Consistent evidence shows that boys are more active than girls (Baranowski *et al.*, 1993; Sallis *et al.*, 1996; Andersen *et al.*, 1998; Van Deventer, 1998/1999). The relative fitness levels of adolescent males are 26% higher than that of their female counterparts (Sallis, 1993), and this gender difference seems to widen with age. Even though sport opportunities for women are growing every year, adolescent girls are still the least active segment of the United States of America's population (Watson, Poczwardowski & Eisenman, 2000). There seems to be a broad range of differences, including social and psychological variables, between adolescent boys and girls that influence participation in physical activity.

One of the reasons for girls being less active than boys is that they simply dislike physical activity, especially during physical educational classes (Sallis *et al.*, 1996). Girls also need more social support from their families and friends to keep on being involved in leisure-time physical activity (Garcia *et al.*, 1995). Boys, on the other hand, receive more physical activity modelling by their friends as well as more support for physical activity from their friends (Anderssen & Wold, 1992; Sallis *et al.*, 1996). They are exposed to more social systems that influence and encourage participation in sports than girls (Greendorfer & Lewko, 1978). Hasbrook (1986) states that sports participation for girls is not a societal expectation the way it is for boys.

There are also psychological factors involved. According to Garcia *et al.*, (1995) girls, in contrast with boys, feel that athleticism is less self-descriptive, and therefore the exercise domain may be of little personal salience as an aspect of the self. A low self-esteem (Garcia *et al.*, 1995) or less favourable body image (Sallis *et al.*, 1996) may also contribute to a lack of motivation to engage in exercise.

Another possible explanation for girls being less active than boys is the difference in their motivational orientation. Ryan and Deci (2000) point out that a person can be motivated because he/she values an activity, or because of strong external coercion. In the first case, the person is intrinsically motivated, in which case the person will “do something for its own sake in the absence of extrinsic rewards, and is related to feelings of mastery, control and self-determination” (Biddle & Armstrong, 1992:325). Intrinsically motivated people have more interest, excitement and confidence in what they do (Ryan & Deci, 2000). Harter (1981) is of the opinion that intrinsically motivated children perceive themselves as more competent than their peers. Researchers have found that boys participate in physical activity and sports because of intrinsic motivation (Biddle & Armstrong, 1992). Intrinsically motivated boys can enjoy physical activity for its own sake, but the opposite was found in girls, who showed a tendency towards extrinsic autonomous judgment (Biddle & Armstrong, 1992). Extrinsic motivation refers to “the performance of an activity in order to attain some separable outcome”, (Ryan & Deci, 2000:71) or reward. In the previously mentioned study (Biddle & Armstrong, 1992), the teacher’s opinion and judgment of how well they performed in physical education classes was very important to the girls.

The concept of *amotivation* is, “where no contingency between actions and outcomes is perceived and there is no perceived purpose in engaging in the activity” (Wang & Biddle, 2001:5). From an early age children should be introduced to physical activity and various sports, in order to discover the intrinsic

rewards that will motivate them to engage in physical activity when they are older.

## **Age**

The decline in children's, especially girls', physical activity levels is more pronounced in adolescence than in their childhood (Wolf *et al.*, 1993; Garcia *et al.*, 1995; Wang & Biddle, 2001). According to Sallis (1993) the mean decline in physical activity levels per year is 2.7% for adolescent males and 7.4% for females. Wolf *et al.* (1993) argue that this might be in response to social and biological cues. With increase in age girls become more interested in their appearance and begin to pursue more sedentary social interests (Wolf *et al.*, 1993). Malina (1990) also suggests that the social demands of adolescence, changing interests and the transition from school to work or school to college is related to this decline in physical activity after the growth spurt.

## **Television viewing**

Television viewing has been associated with decreased physical activity and (other than sleep) has become the single greatest reason for physical inactivity among children in the United States of America (Lowry *et al.*, 2002). In a recent survey it was found that 26% of North American children between eight and 16 years of age spend at least four hours per day in front of the television, with 67% that spend two hours per day on television viewing (Andersen *et al.*, 1998).

## **Parental influences**

The influence that parents have on their child's physical activity levels is based on three things: modelling of interests and skills, reinforcing behaviour and providing activity prompts and settings for exercise (Dishman, Sallis & Orenstein, 1985). A high degree of family support for exercise behaviour leads to a higher fitness level (Ferguson *et al.*, 1989; Freedson & Evenson, 1991).

Research shows that the activity levels of parents are strongly related to their children's activity levels (Kalakanis *et al.*, 2001) and is believed to be among the strongest determinants of children's activity patterns. Parental modelling seems to be more effective in influencing children's health behaviours than parental encouragement (Dielman *et al.*, 1982; Godin, Shephard & Colantonio, 1968). Moore *et al.* (1991) found that children of active parents are two to six times more likely to be active than those with non-active parents. Fathers appear to be the most significant family member influencing sport involvement of boys and girls, (Greendorfer & Lewko, 1978) but especially where both parents are highly active, their children are more likely to also be active (Freedson & Evenson, 1991).

An interesting fact is that physical inactivity exerts a more influential modelling behaviour than physical activity. Freedson and Evenson (1991) found that even though active parents tend to have active children, low active parents are more likely to have low active children. They concluded that "physical inactivity tracks more readily than physical activity" (Freedson & Evenson, 1991:388).

### **Socioeconomic status**

Children's physical activity levels are positively associated with their socioeconomic status (Gottlieb & Chen, 1985; Desmond *et al.*, 1990). Sallis *et al.* (1996) found that adolescents in a high socioeconomic group were twice more likely to participate in physical education classes than any other group, and the classes presented in this area were of higher quality than those in schools of low-income areas. Children that live in low socioeconomic conditions often have limited access to the necessary resources, for example, their parents are unable to drive them to after-school activities.

Hasbrook (1986) found that this relationship between socioeconomic status and physical activity only applies to females. In her study boys participate in sport to an equal degree, regardless of their social class. Sport participation is very much

associated with manhood in our society and because of this societal expectation boys are able to overcome these social barriers (Hasbrook, 1986).

## **Ethnic differences**

It is very difficult to determine the extent to which ethnic differences play a role in health behaviours, due to the confounding effect of socioeconomic status. These two variables are difficult, if not impossible to disentangle. In a review of the correlates of physical activity Sallis, Prochaska and Taylor (2000) reported that eight studies found ethnicity and physical activity to be related during adolescence as opposed to three studies finding no such relation. Socioeconomic status, however, was not included in many of these studies.

Wolf *et al.* (1993) believe that physical activity varies by ethnicity and studies confirmed that black women (Gorden-Larsen, McMurray & Popkin, 1999) as well as Asian women (Wolf *et al.*, 1993) are less likely to engage in physical activity than white women. Cultural differences might explain these findings, for example, Asian cultures may not consider physical activity to be feminine (Wolf *et al.*, 1993).

In contrast to the above-mentioned studies Desmond *et al.* (1990) reported no significant differences between black and white students. This might be due to the fact that their entire sample came from the same shared subculture, i.e. low socioeconomic conditions.

## **Environment**

The physical environment is another predictor of children's levels of physical activity. Outdoor activities are associated with increased levels of physical activity (Klesges *et al.*, 1990), and therefore the weather plays a crucial role. It has a direct effect on participation. In one study 90% of habitual runners reported the weather to influence their activity patterns (Dishman *et al.*, 1985).

A lack of time is, according to Dishman (1990), one of the most prevalent reasons given for inactive lifestyles, but whether it represents an environmental determinant, perceived determinant or poor behaviour skills like time management is yet unclear. It might also just be an excuse for a lack of motivation to be active.

The high crime rate in South Africa also contributes to the inactive lifestyles of children, especially in urban areas. As in parts of the United States of America, it is not safe to walk or ride a bicycle to school anymore, and after school children have a limited playing area in their fenced-in backyards (Bar-Or *et al.*, 1998).

## **Physical education**

Schools can reach large numbers of youth and are therefore in a unique position to make valuable contributions to the promotion of physical activity. Physical educators can, through physical education classes and school sports, help children to become more productive and healthy (Irwin, Symons & Dianne, 2003), counter destructive lifestyles and offer self-esteem-enhancing experiences (Van Deventer, 1989/1999). During the development of a physical education programme called *New Moves*, Neumark-Szteiner *et al.* (2003) found that having a community guest instructor presenting different classes (such as aerobic dance, kick boxing and water aerobics), exposed the learners to the wide range of physical activities available in the community. Van Deventer (2000) agrees and states that physical education is the nursery of participation in different forms of physical activity. Yet many schools do not regard physical education as a priority.

In the United States of America only one third of primary schools offer physical education classes (De Klerk, 2002) and from 1991 to 1995 enrollment in physical education classes among high-school girls has decreased from 41% to 25% (Neumark-Szteiner *et al.*, 2003). In most African countries there is no such thing as physical education classes on school timetables and where it is indeed

presented it is a case of extremes and inadequacies (Van Deventer, 2000). Irwin *et al.* (2003) are of the opinion that inadequate physical education presented by unqualified teachers can be very harmful, especially to the obese population who experience these sessions negatively.

Important to note is the difference between physical education and organised school sport. Where physical education forms part of the formal curriculum and is presented during school hours, school sport is an extra-curricular activity that is optional to the learners and offered after school.

### **Physical education in South Africa**

The current situation of physical education in South Africa looks grim. More than 80% of schools do not offer physical education as part of the curriculum and 95% of schools do not have the necessary qualified teachers (Van Deventer, 2000). The apartheid era gave rise to insufficient funding in most South African schools. Physical education is still mainly presented in historically White schools and to a minor degree in historically Black and Coloured schools (Van Deventer, 1998/1999). A reason for this is the fact that township schools are overcrowded (with 60-70 learners per class), with hardly any facilities, equipment or teachers interested in physical education as a subject (Van Deventer, 2000). Also, physical education (as a non-examination subject) has been neglected and is seen as inferior in comparison with other school subjects (Van Deventer, 2000).

After the 1994 democratic election reconstruction started in most governmental systems, including education. New teacher-learner ratios caused many teachers to become redundant and as a result physical education in secondary schools either disappeared or was only offered in Grade 8 and 9 (Van Deventer, 2000).

*Curriculum 2005* was first published in 1997 and is based on the principles of Outcomes Based Education, with learning organised into eight different learning areas. The learning area Life Orientation consists of five learning outcomes:

*Physical Development and Movement, Health Promotion, Social Development, Personal Development and Orientation to the World of Work* (Van Deventer, 2003). Physical education falls under the focus *Physical Development and Movement*. *Curriculum 2005* specifies that teachers are responsible for learning programmes (Van Deventer, 2000) and because physical education specialists are no longer appointed physical education can disappear easily.

In February 2000, at an Inter-Governmental Consultative Meeting on School Sport Policy, it was decided that a combined effort should be made to develop a policy for physical education and school sport and that the Department of Education should take responsibility for this (Van Deventer, 2003). An Inter-Departmental Task Team was formed and the final draft of the policy on the placement of physical education and school sport was completed on 3 May 2000. Both the Ministers of Education (Kadar Asmal) and Sport (Ncgonde Balfour) confirmed the importance of physical education in their budget speeches in Parliament, announcing that specific teaching time should be allocated to physical education in every grade (Van Deventer, 2003).

More than four years later quality physical education still has no place in the curriculum of most schools. Life Orientation is compulsory up to Grade 9, but there are no monitoring strategies in place to ensure that schools follow these regulations (Van Deventer, 2000). Schools simply do as they please. In the present study, three different secondary schools were assessed. One of them still offers physical education classes to all pupils (up to Grade 12). The second school only offers physical education up to Grade 8 and 9 pupils, while the third school offers no such subject.

Researchers are very concerned about the rapid decline in the physical activity levels of children. Despite all the research and physical activity promotion programmes, today's youth is less active than ever before. As a result of this

there is now evidence showing an alarming acceleration in obesity (Wang & Biddle, 2001).

## **OBESITY**

The increasing prevalence of obesity in both adults and children is a matter of great concern among researchers and health professionals. It has become the most prevalent nutritional disease of children and adolescents in the western world (Ortega *et al.*, 1995). The World Health Organization issued a statement in 1997, stating that obesity is “one of the greatest neglected public health problems of our time” (Hall & Jones, 2002:657).

## **DEFINITION AND CLASSIFICATION**

Obesity is defined by McKardle *et al.*, (1996:603) as “an excess accumulation of body fat”. According to Kalk (2001:576 ) obesity is “a disease in which excessive body fat has accumulated to the extent that health may be adversely affected”.

There are different ways in which to determine whether a person is overweight or obese. The best methods to use are those that distinguish between body fat and lean muscle (Heyward, 1998), because a person can be overweight but not too fat. In this study the author will look at Body Mass Index, Skinfold measurements and Waist-hip ratio to determine body composition.

## **The measurement of obesity**

### **Body Mass Index**

The Body Mass Index (BMI) is most frequently used by researchers to measure how fat a person is. According to Popkin and Udry (1998) major scientific advisory groups (after reviewing different methods of measuring excess body fat)

came to the conclusion that BMI is the best measure of adolescent adiposity. It is the most epidemiologically useful measure of adiposity (Kalk 2001).

BMI is very easy to assess, and is computed as follows (McKardle *et al.* 1996):

$$\text{BMI} = \text{Body mass, kg} \div \text{Stature, m}^2$$

The higher a person's BMI, the higher the risk of diseases such as cardiovascular diseases and diabetes. Individuals with a BMI between 20 and 25 fall into the lowest health-risk category, whereas a BMI higher than 40 puts a person in the highest risk category (McKardle *et al.*, 1996). With a BMI equal to or more than 30kg/m<sup>2</sup>, a person is defined as obese (McKardle *et al.*, 1996; National Demographic and Health Survey, 1998; Kalk, 2001).

BMI is, however, also affected by other factors besides fat mass, for example, bone and muscle mass. An athlete can have a high BMI and not be overweight, due to a higher than normal muscle mass.

### **Skinfolds**

The relation between skinfolds and percentage body fat is well established. The use of skinfolds to determine percentage body fat in adults is widely accepted and frequently used by researchers, nutritionists and other professionals. Well over 100 different equations for the prediction of body composition have been developed, using skinfold measurements in the equation (Brodie, Moscrip & Hutcheon, 1998). Many of these skinfold prediction formulae were developed specifically for a particular sample of the population, which should be taken into account when choosing the right formula.

Children are chemically immature (Slaughter *et al.*, 1988) for they have a higher water and lower bone mineral content than adults. Therefore body density (estimated from hydrostatic weighing) overestimates a child's percentage fat

(Lohman, 1987). Slaughter *et al.* (1988) saw the need to formulate equations that can accurately estimate body fat from skinfolds in children.

Numerous studies now suggest that the use of two skinfold measurements are adequate to determine percentage body fat in children. Both triceps and subscapular skinfolds and triceps and calf skinfolds are equally successful in estimating percentage body fat (Lohman, 1987).

### **Waist-hip ratio**

The waist-hip ratio is an indicator of a person's body fat distribution. The localisation of the body's adipose tissue creates different health risks.

Central (also called android-type) obesity, where fat deposition is centred in the abdominal area, is associated with hypertension, Type II diabetes, hypercholesterolemia, arteriosclerosis and endometrial cancer (McKardle *et al.*, 1996; Fontanive, Costa & De Abreu Saures 2002). Peripheral (or gynoid-type) obesity, with fat mainly situated in the gluteal and femoral regions, has less serious consequences caused by mechanical problems associated with the increased weight (De Klerk, 2002). Plowman and Smith (1997) refer to a third type of fat pattern known as the intermediate pattern, where fat is stored both in the upper and lower body extremities to create a rectangular cubic appearance.

The waist-hip ratio is a strong predictor of diabetes, coronary artery disease and overall death risk (Brownell, Nelson Steen & Wilmore, 1987; Folsom *et al.*, 1993). The waist measure is divided by the hip measure and according to McKardle *et al.* (1996:609), waist-hip ratios that exceed 0.8 for women and 0.95 for men are associated with increased risk of death from coronary artery disease and other illnesses.

## PREVALENCE OF OBESITY

Approximately 97 million people in the United States of America are either overweight or obese (Hall & Jones, 2002). More than 60% of the entire adult population (Faith, Matz & Jorge, 2002) and 37% of all North American children are overweight or suffer from obesity (*Time*, 2003b). *Time* magazine (2003a) reported that more than 50% of European adults and 20% of their children (5-17 years old) are overweight or obese. China's policy of only one child per family has created millions of spoilt and overfed children, the so-called "little-emperor syndrome", with up to 30 million of the 290 million children classified as overweight or obese (a figure that is expected to double within the next decade) (*Time*, 2003b).

In South Africa, the picture does not look much better. According to the *National Demographic and Health Survey* conducted in 1998, 29.4% of adult women in South Africa are obese (see Table 2.2). Determinants of obesity for women were race, (most common in Black and Coloured, and least frequent in Indian women) and lower levels of education (Kalk, 2001). The opposite was found for South African men concerning race: Black men (especially in rural areas) had the lowest prevalence of obesity (7.7%) and White men had the highest rate (19.8%).

Table 2.2: Prevalence (%) of obesity in South Africa

	<b>African/Black</b>	<b>Coloured</b>	<b>Indian/Asian</b>	<b>White</b>	<b>All</b>
<b>Men</b>	7.7	9.1	8.7	19.8	9.1
<b>Women</b>	30.5	28.3	20.2	24.3	29.4

Health organisations and the public media are trying their best to make people aware of the dangers of obesity. The United States of America's population is spending an enormous 33 billion dollars annually in an attempt to lose weight (Hall & Jones, 2002), and unfortunately are often using harmful dietary practices. Despite all the low-fat and non-fat food choices available, as well as the numerous ways, advertised daily, of how to lose weight, there still is an increase

in the prevalence of obesity every year. One study speculates that by the year 2230, all Americans will be obese (Walker *et al.*, 2003). Many researchers are now shifting their focus to childhood obesity, because of the fact that healthy lifestyle habits are easier to instill in children than in adults (Bar-Or, 2000).

## **HEALTH RISKS**

Juvenile obesity is related to morbidity and mortality rates in adulthood (Must *et al.*, 1992; Garrison & Kannel, 1993; Fontanive *et al.*, 2002). Hypertension, respiratory disease, diabetes mellitus and several orthopedic disorders are only a few of the numerous health risks associated with adolescent overweight (Gortmaker *et al.*, 1993).

Much research has been done on the relationship between obesity and coronary heart disease (CHD). Obesity is not seen as a primary risk factor for CHD, but rather an independent risk factor (Coetsee, 2003). Increased blood pressure is a risk factor for CHD, and studies have shown that being overweight or obese increases blood pressure (Fontanive *et al.*, 2002). A disturbing fact is that nowadays there is an increase in the prevalence of Type II diabetes among children (Swain & Leutholtz, 2002), which used to be called adult- or late onset diabetes, for it was only prevalent in adults above 30 years of age.

The negative impact of obesity goes far beyond its physical health risks. Obese individuals are subject to mental and emotional damage that society inflicts on them (Irwin *et al.*, 2003). Being overweight during adolescence also has social, economic and psychological consequences, including psychosocial functioning (Gortmaker *et al.*, 1993).

## **ETIOLOGY**

One of the problems of juvenile obesity is that it tracks from childhood into adulthood. Many studies have been done to demonstrate this, and researchers agree that childhood obesity is a major antecedent of adult obesity.

Obese children have a three times greater chance to be obese when they reach adulthood than children having a normal amount of body fat (McKardle *et al.*, 1996). According to Bar-Or (2000) 50% of obese children older than six years of age will become obese adults. The older an obese child and the higher the percentage body fat, the greater the chances of becoming an obese adult (Lohman, 1987; Popkin & Udry, 1998). It has been estimated that 70-80% of obese adolescents become obese adults (Kolata, 1986).

### **Heredity**

There is no doubt that parents' obesity is directly related to that of their children. There is a common association of obesity in children above three years of age where one or two parents are obese (Kalk, 2001). In one study 40% of the children in families with one obese parent were obese, and a striking 80% of the children with two obese parents, whereas only 9% of the children of non-obese parents were obese (Johnson, Burke & Mayer, 1956). Another study showed that 25% of overweight adolescents have obese relatives, as opposed to only 5.5% among the eutrophic group (Fontanive *et al.*, 2002). Eck *et al.* (1992) state that the number of obese biological parents may be the best predictor of childhood obesity.

In his study about the emotions and attitudes related to being overweight, Plutchik (1976) concluded that an additional factor in the form of a genetic predisposition influences metabolism, causing overeating to result in overweight. McKardle *et al.* (1996) state that a person's genetic makeup does not cause

obesity, but may lower the threshold of the development of the disease, because of the susceptibility of the genes.

Another important consideration is the familial role model that the child pursues. It is difficult to determine the exact role of the parents' genetic makeup, because the family's poor dietary and exercise habits are also influencing the child's weight (McKardle *et al.*, 1996). Eck *et al.* (1992) found that children with one or two obese parents consume a higher percentage of fat and lower percentage of carbohydrates than those with normal weight parents, thus creating a much higher risk for the first group to develop obesity.

### **Socioeconomic status**

Stunkard and Sorensen (1993) addressed the issue of the complex relation between obesity and socioeconomic status. A strong inverse relation exists between obesity and socioeconomic status, especially among women in developed countries (Stunkard & Sorensen, 1993). This relationship indicates the influence of environmental factors on obesity.

Evidence exists to support at least three possible factors responsible for the above-mentioned association: obesity influences socioeconomic status, socioeconomic status influences obesity, or a common factor influences both obesity and socioeconomic status (Stunkard & Sorensen, 1993). In a study by Moore, Stunkard and Srole (1962) extreme overweight was seven times more frequent among women in the lower socioeconomic level of New York City than among women in higher status levels. A possible explanation for this phenomenon is that people of lower socioeconomic status do not follow the correct diet, but rather a diet high in carbohydrates and fats (the cheaper option).

While looking at the influence of obesity on socioeconomic status, Gortmaker *et al.* (1993) found that overweight adolescents and young adults were less likely to

marry, and have lower household incomes than people with other chronic illnesses. Compared to the group of subjects, who suffered from either asthma, musculoskeletal abnormalities, epilepsy, cerebral palsy or other chronic physical conditions, no evidence of social disability was found. The authors explain these findings as a result of the intense stigmatisation of obesity (Gortmaker *et al.*, 1993).

## **Inactivity**

A sedentary lifestyle clearly contributes to excessive weight gain during childhood (Kalk, 2001). Some researchers go as far as to suggest that a decrease in daily energy expenditure (without a simultaneous decrease in total energy intake) is the primary factor causing obesity (Bar-Or *et al.*, 1998; Hill & Melanson, 1999).

There seems to be a strong relationship between juvenile obesity and the extent of television viewing (Dietz & Gortmaker, 1985; Gortmaker *et al.*, 1996). Despite displacing physical activity, television viewing also increases dietary energy intake, either while watching or as a result of food-related commercials (Dietz & Gortmaker, 1985). Dietz and Gortmaker (1985) reported that with each additional hour spent in front of the television per week, the risk of obesity increases by 2%. The same applies to a person that wants to lose weight. In their study Gortmaker *et al.* (1996) found that the probability of recovering after four years of being obese is inversely related to the amount of television viewing.

## **Caloric intake**

The general assumption one usually makes is that overweight and obese individuals eat much more than their normal weight counterparts. Research has shown that this is not always true.

According to Bar-Or (2000) the positive energy balance needed to become obese can be very small. For an individual to gain 4kg over a one year period, the excess energy intake per day over energy needs is less than 80kcal. For a 50kg child this equals one slice of bread or 8-10 minutes of playing basketball (Bar-Or, 2000).

The results of studies comparing the caloric intake of obese versus non-obese adolescents either show no significant difference regarding ingested energy, (Fontanive *et al.*, 2002) or a significantly lower caloric intake by the obese adolescents (Johnson *et al.*, 1956). This is also true for young and middle-aged men. According to Meredith *et al.* (1987) and Heath *et al.* (1981) the amount of time adult men spend engaging in physical activity is inversely related to body fat level, but no relationship exists between body fat and caloric intake.

As a result of these findings recent investigations focus on the differences in dietary composition. Ortega *et al.* (1995) also did not observe a difference in energy consumption between overweight and non-overweight adolescents, although the former derived a higher percentage of their energy from lipids and less from carbohydrates.

All these studies indicate that the inactivity of the obese groups accounted for their caloric surplus. Therefore physical activity promotion, together with educational programmes of dietary consumption, would be very useful to adopt as a strategy to deal with obesity.

Another great concern is the fact that children today are part of the fast-food generation. Fast-food chains specifically target children by advertising special meals which sometimes include incentives like a free toy. Extra-large or super-size meals cost only a fraction more than the regular meals, and soft drinks are available in one-liter cups (*Time*, July 2003a). The television programme, *Carte Blanche* (27 April 2003) ran a story on fast-food chains in South Africa and the

nutritional values of their kiddies meals, and found the fat content of an average meal to be between 19.1g - 35.2g, or 32 - 39%. The recommended daily allowance of fat content is less than 30% (McKardle *et al.*, 1996; Plowman & Smith, 1997).

## **OBESITY AND EXERCISE**

Millions of individuals are trying to lose weight and often adopt harmful practices in their attempt. New weight-loss methods are being advertised daily and are often very expensive. Safe and effective weight-loss programmes need to be adopted. Studies have shown that programmes combining exercise and a balanced diet are the most effective (Wood *et al.*, 1988; Wood *et al.*, 1991; Stefanick, 1993).

One of the problems with dieting only (no exercise) is that it causes the body to store up energy (Hill *et al.*, 1987). In sedentary individuals resting metabolic rate (RMR) comprises about 60-70% of total daily energy expenditure (Stefanick, 1993), and a low caloric diet causes a decline in RMR which leads to a decline in total energy expenditure (Hill *et al.*, 1987). Another problem that stems from the first one is the amount of fat free mass that is being lost when going on a food restriction diet (ACSM, 1983), while the primary goal of a weight-loss programme should be to lose fat mass but maintain fat free tissue (Stefanick, 1993). Pavlou *et al.* (1985) compared the nature of weight loss between an exercise group and a group that dieted only. After an eight-week walking/jogging programme, 95% of the exercise group's total weight loss was due to the loss of fat, compared to the 64% in the sedentary group. In other words, 36% of the total weight loss of the non-exercise group was in the form of lean body tissue. Similar results were found in a study by Hill *et al.* (1987), where 43% of the total weight loss in the sedentary group was the loss of fat-free mass. It might take longer to lose fat weight compared to weight-loss strategies where one loses total weight, but it also takes longer to regain lost fat weight than lost lean body mass (Stefanick, 1993). This data clearly show that fat-free mass significantly adds to weight loss

from food restriction, and that exercise has most important effects on the composition of weight loss.

The American College of Sports Medicine (ACSM, 1983) made, amongst others, the following statements and recommendations concerning weight-loss programmes:

- Prolonged fasting and diet programmes that severely restrict caloric intake are scientifically undesirable and can be medically dangerous.
- Fasting and diet programmes that severely restrict caloric intake result in the loss of large amounts of water, electrolytes, minerals, glycogen stores, and other fat-free tissue, with minimal amounts of fat loss.
- Dynamic exercise of large muscles helps to maintain fat-free tissue, including muscle mass and bone density. Weight loss resulting from an increase in energy expenditure is primarily in the form of fat weight.
- A nutritionally sound diet resulting in mild calorie restriction, coupled with an endurance exercise programme along with behavioural modification of existing eating habits is recommended for weight reduction. The rate of sustained weight loss should not exceed 1kg per week.
- To maintain proper weight control and optimal body fat levels, a lifetime commitment to proper eating habits and regular physical activity is required.

The type, frequency and intensity of exercise are of great importance when trying to lose weight. Heyward (1998) is of the opinion that cardiorespiratory endurance is one of the most important components of physical fitness, and that body fat decreases with an increase in cardiorespiratory fitness. It is classified by Caspersen *et al.* (1985) as one of the health-related components of physical fitness, and defined by Heyward (1998:47) as “the ability to perform dynamic exercise involving the large muscle groups at moderate to high intensity for prolonged periods”. Morrow and Freedson (1994) suggest that children and

adolescents should engage in physical activity that provides an aerobic stimulus (for example, running, cycling, rope skipping or swimming) and is of the opinion that walking will not provide the necessary increase in aerobic power for health benefits in children, adolescents and youth.

For a proper weight-loss programme the ACSM (1983) recommends the inclusion of an endurance exercise programme of at least three days per week, 20-30 minutes in duration, and at a minimum intensity of 60% of maximum heart rate. The ACSM (1998) also emphasises the importance of the subject's initial level of fitness. A person with a very low level of fitness can attain a significant training effect with a training heart rate of as low as 40-50%, whereas a person with a higher fitness level may need a higher training stimulus.

## **THE MEASUREMENT OF CARDIORESPIRATORY FITNESS**

Maximal aerobic power ( $VO_2\text{max}$ ) is a universally accepted laboratory measure of cardiorespiratory fitness (Boreham, Paliczka & Nichols, 1990). It reflects the ability of the cardiorespiratory system to deliver oxygen to the working muscles (Ramsbottom, Brewer & Williams, 1988). The higher a person's  $VO_2\text{max}$  value, the higher his level of cardiorespiratory fitness. The direct measurement of  $VO_2\text{max}$  is unfortunately unsuitable for fieldwork where there are limitations on time, equipment or expertise. A simpler test that indirectly measures  $VO_2\text{max}$  is required under such circumstances. Examples of such tests include the 12-minute run, the 1-mile run, the assessment of physical work capacity at a heart rate of 170 beats per minute ( $PWC_{170}$ ) and the *Multistage Fitness Test* (MFT) which was used in this study. The MFT was first described by Léger and Lambert (1982) and is also known as the *Bleep Test*, *PACER* or 20m-shuttle-run test. It was designed mainly for adults, but recently Freedson, Cureton and Heath (2000) identified it as a reliable and valid test to use when testing children and adolescents.

The 1-mile run test for time is a field test most often used to determine cardiorespiratory fitness (Freedson *et al.*, 2000). Its reliability as well as the reliability of distance run tests (for example, the 12-minute run) has generally been high (Freedson *et al.*, 2000). The MFT is, however, an attractive alternative to these tests, because the more fit rather than the less fit participants finish last, which might eliminate a psychological burden for the less fit (Liu, Plowman & Looney, 1992).

In a study comparing the PWC<sub>170</sub> test with the MFT, the results showed consistently high validity for both tests as predictors of maximal aerobic power in adolescents (Boreham *et al.*, 1990). There were, however, signs of gender differences. In the girls, a higher correlation was found between VO<sub>2</sub>max and the MFT than in the PWC<sub>170</sub>, whereas the correlation was the same for boys in both tests. The reason for this is quite simple, the PWC<sub>170</sub> is based on the linear relationship between oxygen consumption and heart rate at submaximal work loads, and this relationship can be disturbed by emotional factors. The MFT, on the other hand, is based on maximal running speed and oxygen consumption, which means that emotional factors may be less important to the results of the MFT, and thus a higher correlation between VO<sub>2</sub>max and MFT scores is found (Boreham *et al.*, 1990).

Other advantages of the MFT include the fact that it can be performed in a relatively small space (indoors or outdoors) and without extensive facilities (Liu *et al.*, 1992). It does not require self-monitored pacing (the pace is controlled throughout the test), is fun and acquires few motivational problems (Freedson *et al.*, 2000). Liu *et al.* (1992:363) concluded that the MFT is “at least as good as, if not better” than any other run tests of cardiorespiratory fitness in adolescents.

## **STIGMATISATION OF OBESE INDIVIDUALS**

Despite their increasing numbers, overweight youth continue to experience negative stereotyping, stigmatisation and discrimination. Discrimination against

obese individuals is often considered to be acceptable (Irwin *et al.*, 2003). Studies have shown that obesity was the least preferable physical characteristic to possess, even when physical handicaps like a disfigured face or having no left hand, were included in the choices (Richardson *et al.*, 1961; Maddox, Back & Liederman, 1968). An overweight child was consistently ranked least likeable by both adults and children (Maddox *et al.*, 1968). A possible explanation for this is that obese persons are held responsible for their own disability, while people with other physical handicaps are not to blame. When stigmatised individuals are believed to be the cause of their own condition, the prejudicial attitudes of their peers exaggerate (Martin *et al.*, 1988). One area of their life that is easily affected by this, is the self-concept.

## **THE SELF-CONCEPT**

### **A multidimensional construct**

For many years the self-concept was dealt with as a unidimensional entity (Figure 2.1: 1a). Researchers and psychologists began to question this concept in the early 1980s and their findings led to the widespread acceptance of the self-concept as a multidimensional construct (Figure 2.1: 1b), composing of characteristics, competencies, attributes and roles possessed by the individual (Fox, 2000). The possibility of a hierarchical model was suggested by Shavelson, Hubner and Stanton (1976) and investigated by Marsh and Shavelson (1985). This model marks a network of domain-specific constructs (Figure 2.1: 1c), for example social, academic and physical selves, with global self-esteem at the apex. Each of these domains is in turn fed by subdomain self-perceptions (Fox, 1990), for example, sports ability and physical appearance in the physical domain. The lower levels of the model become increasingly situation-specific. The assumption is that the satisfaction of performing well in a rugby match, for example, may generalise to physical and eventually global self-worth.

Higgins (1987) made a distinction between three different possibilities namely the actual, ideal and ought-to-be selves. The actual self refers to the attributes an individual ascribes to himself (Higgins, 1987), while the ideal and ought-to-be selves are conceptions of the self in future states and is referred to as “possible selves” (Markus & Nurius, 1987:157). The ideal self involves those attributes a person would *like* to possess, and the ought-to-be self those characteristics a person feels he/she *should* possess (Higgins, 1987).

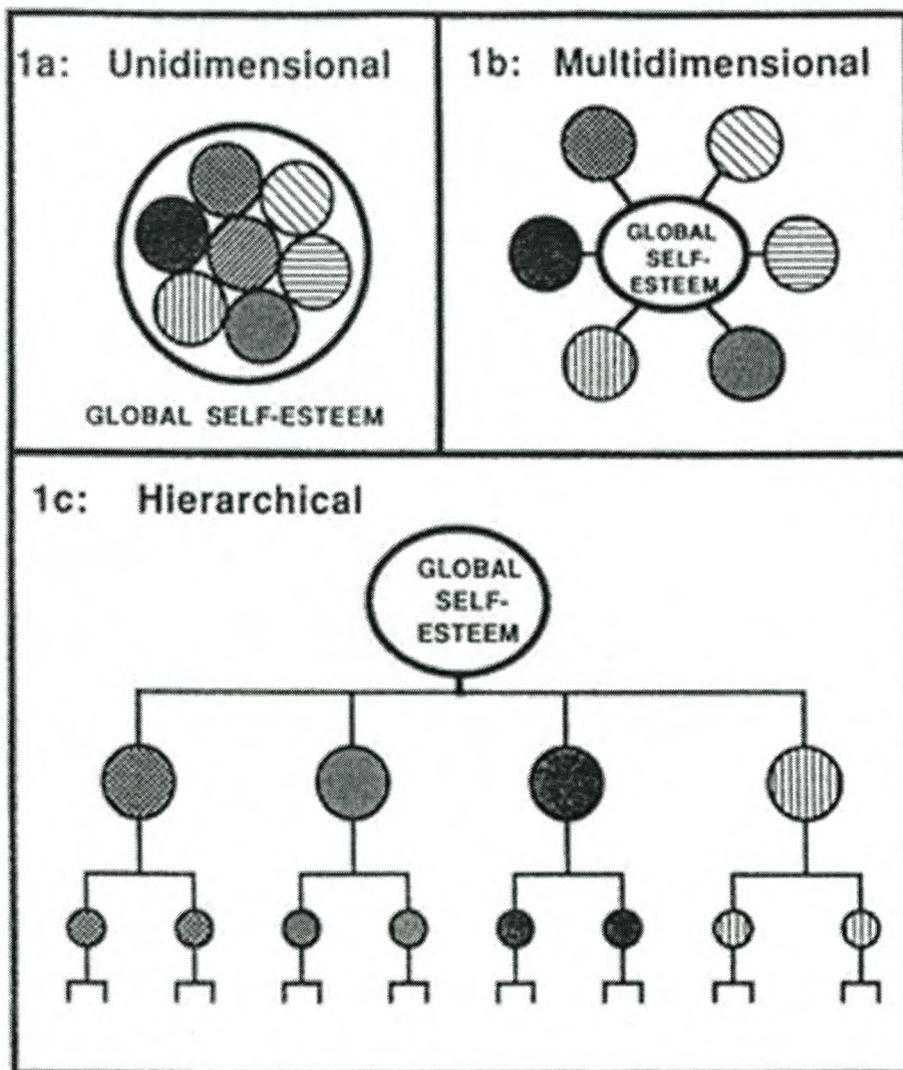


Figure 2.1 Different models of self-esteem

Fox (1990), Harter (1982) and Marsh and Shavelson (1985) followed a different approach and identified several subscales or sub-selves within the global self-esteem. Fox (2000) for example, identified the family self, the working self, the emotional self, the social and the physical self. Of particular interest to the field of exercise is the physical self, but we need to define several terms in order to avoid confusion.

## **DEFINITIONS**

### **Self-esteem and self-concept**

Self-esteem is defined by Gergen (1971) as the extent to which an individual feels positive about himself. It reveals an attitude of approval or disapproval (Coopersmith, 1967) and shows the degree to which the person believes himself to be competent, important and valued (Kalliopuska, 1990). Campbell (1984:8) sees self-esteem as “the awareness of good possessed by self”. Important to note is that the term “good” does not always have moral connotations, but is rather based on the person’s value system (Fox, 1997). For example, a criminal can feel very good about himself/herself and the way he/she performs in his/her “work”. High self-esteem in childhood has been linked to satisfaction and happiness in later life, while a low self-esteem is associated with depression, anxiety and maladjustment in social relationships (Muris, Meesters & Fijen, 2003).

Self-esteem refers to the feelings a person has about himself, while the self-concept gives a description or picture of the self (Sonstroem & Potts, 1996). Self-descriptive statements such as “I am female” or “I am Black” portrays an individual’s self-concept, whereas self-esteem has an evaluative component evident in statements such as “I am the second best swimmer in my class”.

Due to the complexity of the relationship between self-esteem and self-concept Burnett (1994) believes that descriptive and evaluative statements about

characteristics of the self should not automatically be treated as separate constructs. Within this study the terms self-esteem and self-concept will be used interchangeably, for it is difficult to define one's self without undergoing evaluation or emotions (Wells & Marwell, 1976).

### **Physical self-concept and body image**

With the recognition of the multidimensionality of the self, researchers were forced to focus on component parts and single elements, such as the physical self. The contribution of the physical self to global self-concept is often seen in the literature, and according to Fox (2000) the physical self has occupied a unique position in the self-system. The body (through its appearance, attributes and abilities) provides a surface of separation between the individual and the world; it serves as a vehicle for social communication and expresses status and sexuality (Fox, 2000). It is therefore important in overall self-rating.

Stein (1996) defines physical self-concept as an individual's perceptions and/or estimations of his/her physical performance and physical appearance. This term is often confused with the construct of body image, which refers more directly to evaluations of physical appearance (Stein, 1996). Body image can be seen as the picture a person has of the physical appearance of his/her body (Stunkard & Mendelson, 1973).

### **ADOLESCENCE, OBESITY AND SELF-ESTEEM**

The excessive attention that the media pays to physical appearance places a great deal of pressure on adolescents (especially girls), who are part of a culture that bombards them with images of the "body ideal". These images often become the standard by which individuals define themselves (Pesa, Syre & Jones, 2000:330).

According to Page and Fox (1997) this pressure comes at a time of vulnerability and identity inexperience. Erikson (1968) places emphasis on the physical attributes of the adolescent as a source of identity and self-concept. Adolescence is a time for the formation of a strong and well-organised sense of identity (Erikson, 1968), which is very challenging for the adolescent while experiencing high levels of stress, profound physiological changes and increasing social demands (Norris, Carrol & Cochrane, 1992).

While the adolescent hangs precariously between the extremes of childhood and adulthood (no longer a child, not yet an adult), many psychological problems arise (Flaks, 1976). This is particularly true for overweight and obese adolescents, for they have a greater tendency to suffer from depression, anxiety and impulsivity (Plutchik, 1976). In his study about the personality of the obese adolescent female Flaks (1976) states that the majority of psychological problems associated with obesity stem from a disturbance in the self-concept. Overweight and obese adolescents tend to have lower self-esteem scores than their normal-weight counterparts (Stunkard & Mendelson, 1967; Mendelson & White, 1985).

## **GENDER DIFFERENCES**

The literature on differences between boys' and girls' self-concepts is inconsistent and ambiguous. Before the recognition of the multidimensionality of the self-concept, many researchers found no convincing evidence that the global self-concepts of boys differ from that of girls at any age (Wylie, 1974). Since the mid 1980's researchers began to investigate the possibility of gender differences in domain-specific self-concepts.

In a series of studies, Marsh and colleagues have found consistent differences between boys and girls in domain-specific self-concepts. These studies showed that boys have higher self-concepts than girls in areas of maths, the general self, physical appearance and physical abilities, but girls scored higher in the areas of

reading and general school (Marsh, Relich & Smith, 1983; Marsh, Parker & Barnes, 1985). In a review study Crain (1996) concluded that the physical domain (physical abilities as well as physical appearance) reflects the largest difference between the sexes. A possible explanation for boys having higher physical self-concepts than girls can be the greater emphasis placed on boys' participation in sports and the fact that they receive more encouragement from family and peers.

Lerner, Karabenick and Stuart (1973) followed a different approach by measuring male and female adolescents' feelings of "satisfaction" with 24 parts of their bodies, and found in both sexes that satisfaction with the body was a moderate predictor of self-concept. However, because the possibility existed that males and females could have different reasons for being satisfied with their bodies (either because of its attractiveness or its effectiveness), later studies were conducted where the subjects were asked how physically attractive they thought each of the 24 body parts were. The correlation between attractiveness and self-concept was significant for females but not for males (Lerner & Karabenick, 1974). During their third study, the authors found that for males, self-concept was more highly related to body attitudes pertaining to physical effectiveness than attractiveness, whereas females' self-concepts were based more on physical attractiveness (Lerner, Orlos & Knapp, 1976).

Kostanski and Gullone (1998) found that 80% of females and 40% of males have high levels of dissatisfaction with their body image. Most females reported their dissatisfaction at being too large, whereas males rated themselves too large or too small, depending on their body mass distribution. These results are consistent with the findings of Mendelson and White (1985), who concluded that females are generally less satisfied with their bodies than males.

## EXERCISE AND MENTAL HEALTH

The effect of exercise on mental health has been a long-standing matter in question which became more clearly identified in the 1980s. It is now evident that certain forms of physical activity can enhance psychological well-being and reduce the risk of some mental health problems (Biddle, 1993).

For the developing adolescent sport not only represents physical and mental challenges, but also provides him/her of an identity reference (Alexander, 1998), for example, "I am a netball player". Hughes (1984) has identified self-esteem as a variable with the greatest potential to reflect psychological benefit gained from exercise. Research has shown that adolescents participating in sport have higher perceived physical competence (Roberts *et al.*, 1981) and higher physical self-concept (Alfermann & Stoll, 2000).

Self-esteem is, however, not the only variable benefiting from exercise. Consensus statements from the *National Institute of Mental Health* in the United States of America concluded the following (Morgan & Goldston, 1987:156):

- Physical activity is positively associated with mental health and well-being.
- Exercise is associated with the reduction of stress emotions such as state anxiety.
- Exercise has been associated with a decreased level of mild to moderate depression and anxiety.
- Long-term exercise is usually associated with reductions in traits such as neuroticism and anxiety.
- Exercise can be an adjunct to the professional treatment of severe depression.
- Exercise results in reductions in various stress indices such as neuromuscular tension, resting heart rate, and some stress hormones.
- Exercise has beneficial emotional effects across all ages and in both sexes.

In a cross-sectional study of life stress and well-being Brown and Lawton (1986) found the negative impact of life events to be significantly lower among adolescents who exercised frequently as opposed to those that are not so active. Consistent with these findings, Brown and Siegel (1988) concluded exercise to be the one variable acting as a buffer against the negative impact of stress. In their study, including more than 200 American girls (aged 11-15), the authors found that the negative impact of stress on physical health declined as the amount of time spent on vigorous physical activity increased.

Certain types of exercise, i.e. cardiorespiratory endurance, muscular strength and endurance, flexibility and body conditioning, are known to be health-related components of physical fitness (Caspersen *et al.*, 1985). According to the American College of Sports Medicine (ACSM, 1998) exercise sessions should be at least three times per week, continuing for 20-30 minutes each at 60-90% heart rate to obtain the desired psychological benefit.

## **THE DEVELOPMENT OF PHYSICAL SELF-CONCEPT INSTRUMENTATION**

Prior to the 1980s researchers had failed to develop instrumentation that can accurately measure the multidimensional self-concept. The need for new self-concept instrumentation was first addressed in a classic review article by Shavelson *et al.* (1976). The authors evaluated five of the most popular self-concept measurers of the time, namely Bookover's *Self-Concept of Ability Scale*, Coopersmith's *Self-Esteem Inventory*, Gordon's *How I See Myself Scale*, the *Piers-Harris Children's Self-Concept Scale (The Way I Feel About Myself)* and finally Sears' *Self-Concept Inventory*. Shavelson *et al.* (1976) found that not one of these instruments was able to distinguish between different domains, not even among the broad academic, social and physical domains.

While self-esteem was still regarded as a unidimensional construct, it was measured by inventories that simply totalled responses to different true/false items (Fox & Corbin, 1989). According to Fox (2000) self-esteem instrumentation consisted of single scales made up of a number of items, each asking the subjects to rate themselves on different personal qualities and competencies. The answers were simply totalled to produce a self-esteem score. This type of instrumentation has since been criticized by Wylie (1974) and Marsh (1997) for missing the fundamental quality of the multidimensional self-concept. Rosenberg (1979:21) strongly opposes the use of these total scores:

Hence, simply to add up the parts in order to assess the whole is to ignore the fact that the global attitude is the product of an enormously complex synthesis of elements which goes on in the individual's phenomenal field. It is not simply the elements per sé but their relationship, weighting, and combination that is responsible for the final outcome.

With the acceptance of the multidimensionality of the self-concept researchers realised that children (from the early age of seven to eight years old and onwards) are able to judge themselves differently according to the specific area in their lives being addressed (Fox & Corbin, 1989). The possibility of an educationally-orientated hierarchical model has been suggested by Shavelson *et al.* (1976) and was later also investigated by Marsh and Shavelson (1985). Figure 2.2 illustrates a general construct of self-concept at the apex of the model, with individual experiences in certain life situations at the very base. Shavelson *et al.* (1976) state that the general self-concept is stable, but as one descends the hierarchy, self-concept relies more on specific situations and therefore becomes less stable. Many situation-specific instances (inconsistent with general self-concept) would be necessary in order to change general self-concept.

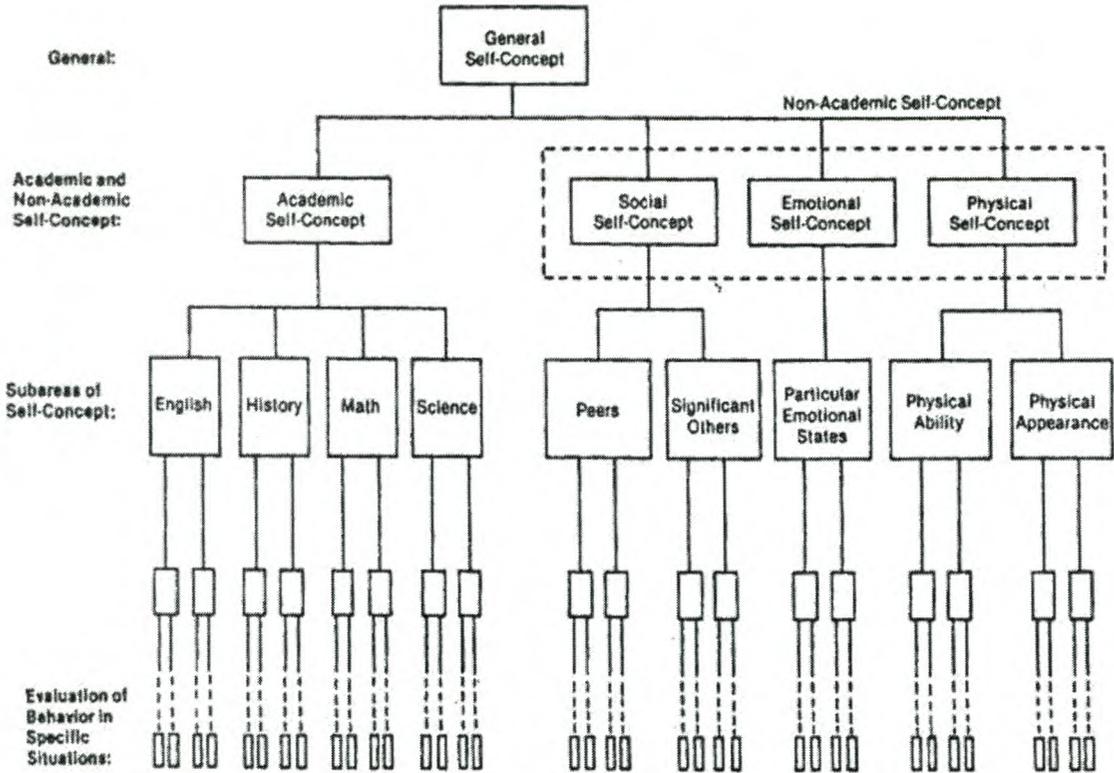


Figure 2.2 Structure of self-concept (Shavelson, Hubner & Stanton, 1976)

In the light of these findings researchers began to develop profiles where various subscales are used to separately assess self-perceptions in different areas of life, for example, work, family, friendship and appearance. Harter's *Self-Perception Profile for Children* is a good example of such a profile and includes five dimensions: perceptions of scholastic ability, social competence, behavioural conduct, physical appearance and athletic competence (Fox, 1988). Along similar lines Marsh and Shavelson (1985) developed self-descriptive questionnaires (SDQ), respectively for preadolescents (SDQI), adolescents (SDQII) and late adolescents and young adults (SDQIII). The SDQ led to the development of the *Physical Self-descriptive Questionnaire* (PSDQ) (Marsh,

1997), which measures nine specific components of self-concept (strength, body fat, activity, endurance/fitness, sports competence, coordination, health, appearance and flexibility).

Another popular model is the *Exercise and Self-Esteem Model (EXSEM)* of Sonstroem and Morgan (1989), which is also based on the hierarchical approach of Shavelson *et al.*, (1976). This model however, was specifically designed for research where an intervention programme is used.

## **THE PHYSICAL SELF-PERCEPTION PROFILE**

Fox and Corbin (1989) identified the need to develop an instrument that specifically measures self-perception in the physical domain. Based on Harter's methodology they constructed a physical self-perception profile, with the main purpose of reflecting salient self-perception content and allowing a test of dimensionality and hierarchical structuring (Fox & Corbin, 1989). Figure 2.3 is an illustration of Fox and Corbin's hypothesised three-tier hierarchical organisation of self-perception structuring at subdomain, domain and apex levels.

After several phases of development and preliminary validation (Fox & Corbin, 1989), the final version of the *Physical Self-perception Profile (PSPP)* consisted of four 6-item subscales designed to assess perceptions within specific subdomains of the physical self (Fox, 1990). These subdomains are sports competence, physical conditioning, body attractiveness and physical strength. In addition to these subdomain subscales a fifth 6-item subscale was constructed at the domain level to measure general overall physical self-worth (see Figure 2.3). In answering the six questions concerning physical self-worth, the subject's general feelings of happiness, satisfaction, self-respect, pride and confidence in the physical self are reflected (Fox, 1990).

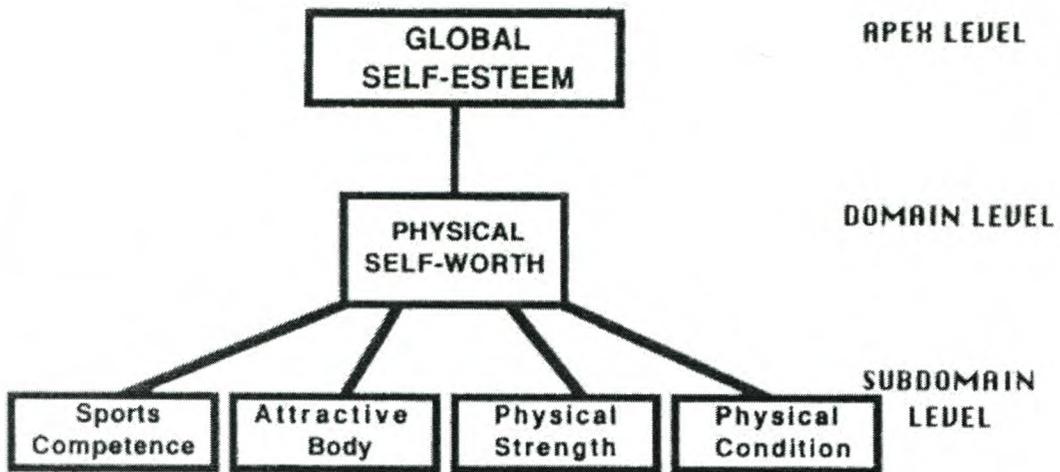


Figure 2.3 Three-tier hierarchical organisation of self-perceptions (Fox & Corbin, 1989)

Harter's (1982) investigation of self-esteem inventories revealed that the typical response format (*true/false, like me/unlike me*), used by many researchers, give rise to socially desirable responding. Harter (1982) designed a new question format to prevent this tendency and the PSPP uses this alternative format of questioning (see Appendix B).

Prior to the development of the PSPP, the items in self-perception instrumentation used to refer to personal features and attributes such as intelligence or good looks (Fox & Corbin, 1989). The PSPP provides a more complete coverage of perceptions including process, product and perceived confidence items (Fox, 1990). Examples of statements in the sports competence subscale are: "some people seem to learn sports very slowly" (process), "some people are good at most sports" (product) and "some people feel very confident when it comes to playing sports" (perceived confidence).

## **SUMMARY**

The decline in the physical activity levels of especially girls causes a great deal of concern among researchers and health professionals. Adolescent girls seem to become less and less active. This inactivity goes hand in hand with numerous health risks, including coronary heart disease, hypertension, diabetes and stress.

Research has shown that generally girls are less active than boys, and that the inactivity increases with age. Computer-, video games and especially the television are some of the reasons why modern youth live such sedentary lives. Parental modeling can help overcome the problem, for it seems to be one of the strongest determinants of children's physical activity patterns. Physical activity is positively associated with socioeconomic status. The higher their socioeconomic status, the more likely children are to participate in physical activity, school sport and exercise. Environmental factors, including the weather and high crime rate are also determinants of how often a child would engage in physical activity. Schools have great potential to make an important contribution to the promotion of physical activity, but physical education does not have its rightful place in the National Curriculum.

The increasing prevalence of obesity is partly linked to inactivity. Several health risks are associated with juvenile obesity, including Type II diabetes which, a few years ago, was only prevalent in adults. Heredity is one of the strongest determinants of obesity; obese parents tend to have obese children. Socioeconomic status again plays a role, in that people of lower socioeconomic status suffer more from obesity than people of a higher socioeconomic class. According to researchers inactivity plays a bigger role than caloric intake when looking at reasons for obesity, and the right exercise together with a healthy diet can help obese individuals to lose weight. Obesity causes not only physical-, but also psychological health problems, which greatly affect the self-concept.

The self-concept is seen as a multidimensional construct, composing of different characteristics, competencies and attributes possessed by the individual. Many psychological problems associated with obesity are the result of a disturbance in the self-concept, and teenage girls are under pressure to have the “ideal body”. An individual’s self-esteem can also be improved by the appropriate exercise.

## CHAPTER THREE

# RESEARCH PROTOCOL

### STUDY POPULATION

The research group comprised adolescent girls in Grade 9 and Grade 10. This specific age group and gender was chosen because adolescent girls are at a very vulnerable stage in their lives and at risk of becoming inactive and overweight. Three middle-class schools in Stellenbosch were selected for the study in an attempt to minimise the effect that socioeconomic status might have on the results. More reasons for using this convenient sample were its feasibility and the fact that the subjects had to volunteer to participate (Steyn *et al.*, 1994).

### SAMPLE

The sample consisted of 167 girls, of whom 89 were in Grade 9 and 78 in Grade 10. Their ages ranged from 14 to 17 years old.

Appointments were made with the school principals, who granted their permission for and support to the study, and delegated the rest of the procedures to one teacher. After a brief explanation of the study and what can be expected, the girls were given letters of informed consent (Appendix A) to complete and sign with permission from their parents. Only those who volunteered for the study were tested.

### STUDY PROCEDURE

The survey was conducted from July to October 2003. The subjects were informed of the confidentiality of the study and reminded that they participate voluntarily. In cases where individuals chose not to know some of their own results (for example weight), this information was withheld from them. One class

(approximately 20 subjects) was tested at a time and each class was seen a second time on a different day to complete all the tests.

The subjects were asked to wear light clothing. The *Physical Self-perception Questionnaire* (Appendix B) was always completed first, to avoid the possibility that other test results might influence their answers. Afterwards a personal information form was completed which also inquired about their weekly participation in sports or exercise (Appendix C).

Anthropometrical procedures as described by Norton *et al.* (2000) were followed. Skinfold measurements were always taken in a different room or behind a curtain, allowing just one subject at a time to minimise anxiety. The *Bleep/Multistage Fitness Test* was always done last.

## **PHYSICAL SELF-PERCEPTION**

The *Physical Self-perception Profile* (PSPP) of Fox and Corbin (1989) assesses self-perceptions in the physical domain. It is a 30-item inventory (Appendix B) that consists of four specific scales namely perceived sports competence, physical condition, body attractiveness, physical strength and one general scale, namely physical self-worth. Each of these scales consists of six items in which participants are presented with two opposite descriptions (statements) of people, for example people who are good at sports versus those who are not so good at sports. The subject had to first choose which of the two statements better describes her, and then had to select whether that statement is “sort of true” or “really true” for her. Item scoring ranges from one to four, which means scale scores can range from 6-24 (each scale composing of six items) (Fox, 1990).

How to complete the questionnaire was explained in detail to the subjects before they started. They were asked to be completely honest in completing the questionnaire and were reassured of the confidentiality of their responses. An

assistant was present at all times to answer any questions and the subjects could finish in their own time.

## **BODY COMPOSITION**

### **Stature**

Standing height was measured by means of a meter stick and a head board. The meter stick was fixed to a wall and always thoroughly checked for its vertical position and the correct height from the ground.

The subjects stood upright (without shoes) with their feet together and heels, buttocks and upper part of the back touching the wall. The *Frankfort Plane* is achieved when the lower edge of the eye socket (the orbitale) is in the same horizontal plane with the notch superior to the flap of the ear (the tragion) (Norton *et al.*, 1996). When these two are aligned, the vertex is the highest point on the skull.

### **Body mass**

Body mass was determined with a TANAKA 150kg electronic scale and was recorded to the nearest 0.1kg. The scale was calibrated before and during the months of testing with SABS weights.

Subjects were weighed without shoes, wearing light clothing. They were asked to stand still with their weight evenly on both feet in the centre of the scale. In the case of a subject being a bit anxious, she was asked to take a deep breath and the measurement was taken at the end of expiration.

### **Body Mass Index (BMI)**

The Body Mass Index was calculated by using stature and body mass measurements (see Appendix D for formula).

## **Waist-hip ratio**

The waist-hip ratio was determined by dividing the waist measure by the hip measure. These measurements were taken with a plastic non-extensible tape.

## **Waist circumference**

The waist circumference was measured at the narrowest point between the lower border of the last rib and the iliac crest. In cases where it was hard to find the narrowest point, the measurement was taken at the middle point between the last rib and the iliac crest. The subjects were asked to stand erect with arms hanging at their sides. The measurement was taken at the end of expiration.

## **Hip circumference**

The hip circumference was taken at greatest protuberance of the gluteals. The subjects stood with feet together, while the measurement is taken from the side to ensure that the tape is horizontal.

## **Skinfolds**

Tricep and subscapular skinfolds were measured as described by Parizkova (1961), Lohman (1987) and Slaughter *et al.* (1988). Percentage fat was calculated using, Slaughter's formula (Appendix D). Both skinfolds were taken at the right side of the body.

The procedure was first explained to each subject and measurements were always taken in a private room. The same anthropometrist took all the skinfold measurements and is of the same sex as the subjects. To determine the accuracy/reliability of the anthropometrist's measurements, eight subjects were tested for a second time after five days and the technical error of measurement (TEM) was calculated as described in Norton *et al.*, (1996:83). A relative TEM of 5% or less is acceptable for skinfold measurements and the anthropometrist of

this study obtained a TEM of 3.8% for tricep measurements and 3.7% for subscapular measurements.

### **Tricep skinfold**

The subjects were requested to keep their arms relaxed. The point at the superior and lateral border of the acromion process was identified, as was the point at the proximal and lateral border of the head of the radius. Midway between these two points lies the mid-acromial-radiale point, where a vertical fold was taken and the skinfold picked up.

### **Subscapular skinfold**

The subjects were again asked to stand comfortably erect with arms relaxed at the side of the body. The inferior tip of the inferior angle of the scapula was identified and a diagonal fold was taken two centimeters along the line running laterally and obliquely downwards from the identified point at an approximately 45° angle.

## **CARDIORESPIRATORY FITNESS**

Levels of cardiorespiratory fitness were indirectly assessed by using the *Bleep Test*, also known as the *Multistage Fitness Test* (MFT), 20m-shuttle run test or *PACER*.

Participants are required to run between two lines which are 20m apart (one lap), starting at 8.5km.h<sup>-1</sup> and increasing by 0.5km.h<sup>-1</sup> every minute, in synchrony with a cadence tape. Each increase corresponds with a change in level. The subjects were tested in groups of no more than 15 at a time (to ensure adequate spacing) and the test was supervised by at least two assistants. The subjects were given numbered shirts to wear to help the assistants in the recording of results for they did not know all the participants by name.

The number of laps completed was determined by the subjects failing to keep pace with the cadence tape for two successive laps (at which point they were withdrawn from the test) or by the subject withdrawing of her own volition. Verbal encouragement was given by the assistants and the subjects' peers to boost motivation and enhance performance. The stage and level completed by each subject was later converted into number of laps for the analysis.

## **PHYSICAL ACTIVITY**

The subjects completed a personal information form (Appendix C) in which they also reported weekly participation in physical activity, sports or exercise.

## **DATA ANALYSIS**

The Centre for Statistical Consultation at Stellenbosch University assisted in the data analysis. The Statistica 6 programme was used.

## **CHAPTER FOUR**

# **RESULTS AND DISCUSSION**

### **INTRODUCTION**

The decline in the physical activity levels of adolescent girls, and the subsequent increase in the prevalence of obesity and low self-perceptions are the main issues addressed in this study. Body composition, cardiorespiratory fitness levels and physical self-perceptions of 167 adolescent girls were determined as described in Chapter Three. The results are discussed in detail below.

### **VARIABLE ANALYSIS**

The means and standard deviations of all the variables tested are reported below. Frequency histograms are included for all the variables tested.

The results of this study are being compared to the results of similar studies from around the world. Descriptive statistics of the anthropometric variables are presented in Appendix E.

## AGE

The subjects' ages ranged from 14.76 years to 17.84 years (Figure 4.1). The subjects' mean age was 15.92 years (SD = 0.63).

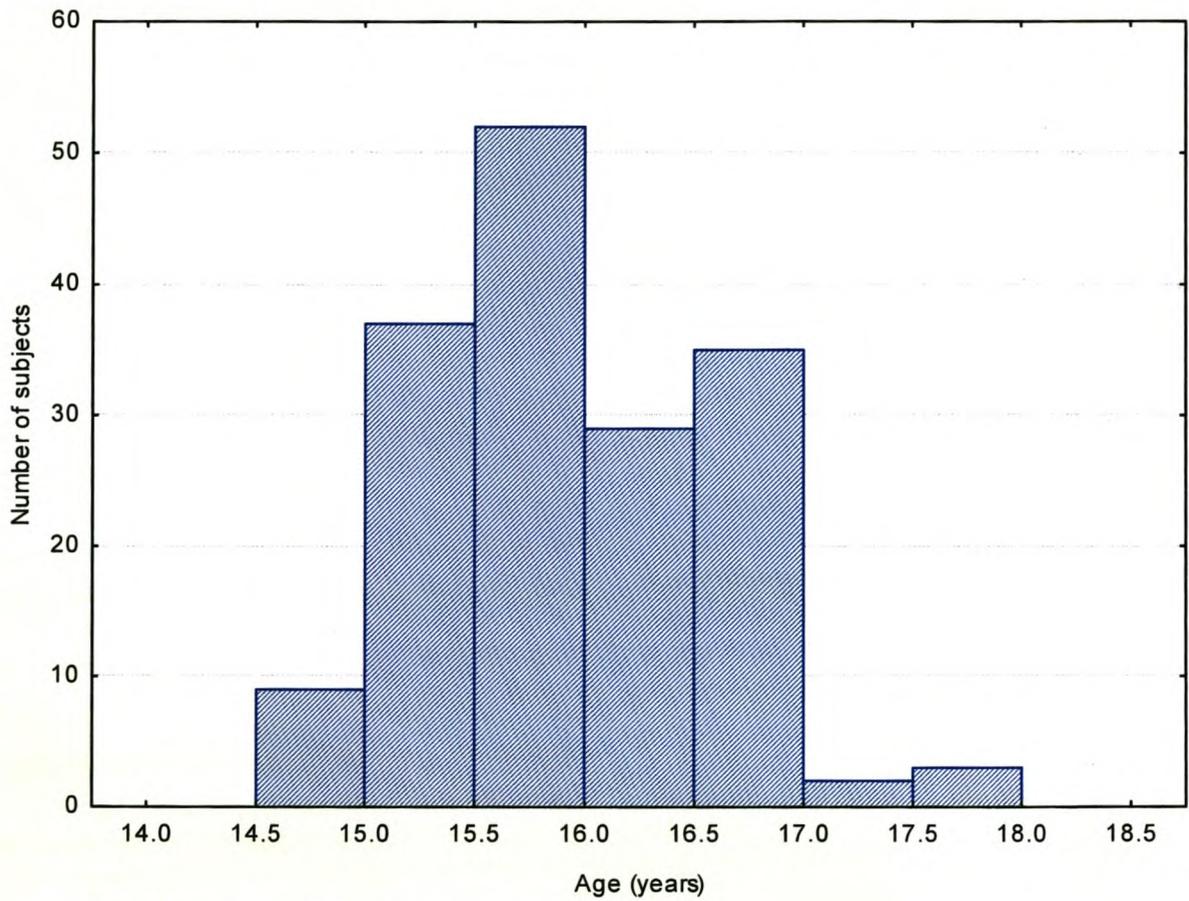


Figure 4.1 Sample's age

## STATURE

The height of the subjects ranged from 1.47m to 1.83m (Figure 4.2). The mean height of the subjects was 1.65m (SD = 0.06).

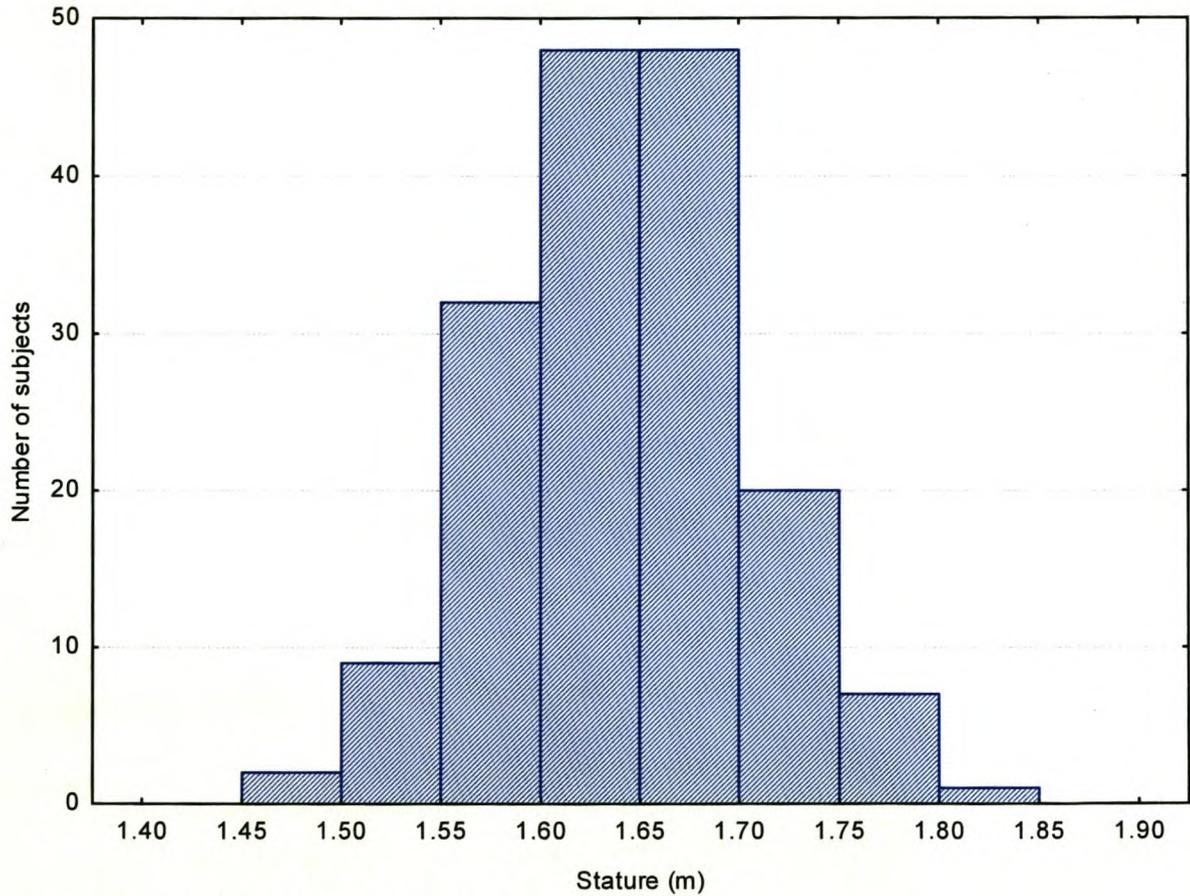


Figure 4.2 Stature of subjects

The findings on the stature of adolescent girls in other studies are presented in Table 4.1.

Table 4.1 The stature of adolescent girls in other studies (means  $\pm$  SD)

	<b>Age (years)</b>	<b>Number of subjects</b>	<b>Stature (cm)</b>
Slaughter <i>et al.</i> (1984)	15.2 $\pm$ 1.5	58	162.2 $\pm$ 6.0
Boreham <i>et al.</i> (1997)	15	254	161.1 $\pm$ 5.9
Schmidt <i>et al.</i> (1998)	16	106	160 $\pm$ 5
Guerra <i>et al.</i> (2002)	14 – 15	123	158.1 $\pm$ 5.7
This study (2003)	15.92 $\pm$ 0.63	167	165 $\pm$ 6

The study population of Slaughter *et al.* (1984) consisted of adolescent girls from Champaign, Illinois. The subjects in the second study (Boreham *et al.*, 1997) were adolescent girls from 16 different schools in Northern Ireland. The sample of Schmidt, Walkuski and Stensel (1998) consisted of subjects from Singapore and the study by Guerra *et al.* (2002) was conducted in Portugal.

The mean stature of the subjects in this study was significantly higher than those of the other studies ( $p < 0.01$ ), but this might be due to the wider age range. Almost half of the subjects in this study (41%) were 16 years or older.

A breakdown of the sample's age was done (see Table 4.2) in order to compare the results with Canadian norms (presented in percentile tables by Martin & Ward (1996). The mean height of the 15- and 17-year olds in this study lies more or less on the 60<sup>th</sup> percentile of Canadian norms, and the mean height of the 16-year olds in this study lies on the 70<sup>th</sup> percentile of Canadian norms. This indicates more accurately that the subjects in this study are taller than those in a similar study.

Table 4.2 The subjects' stature compared with Canadian norms.

Age (years)	Number of Subjects	Mean stature (m)	Percentiles of Martin & Ward (1996)
15	46	1.64 ± 0.07	60 <sup>th</sup>
16	81	1.65 ± 0.06	70 <sup>th</sup>
17	37	1.65 ± 0.06	60 <sup>th</sup>

## BODY MASS

Body mass of the subjects tested ranged between 36.7kg and 95kg (Figure 4.3).

The mean body mass of the subjects was 58.84kg (SD = 9.8).

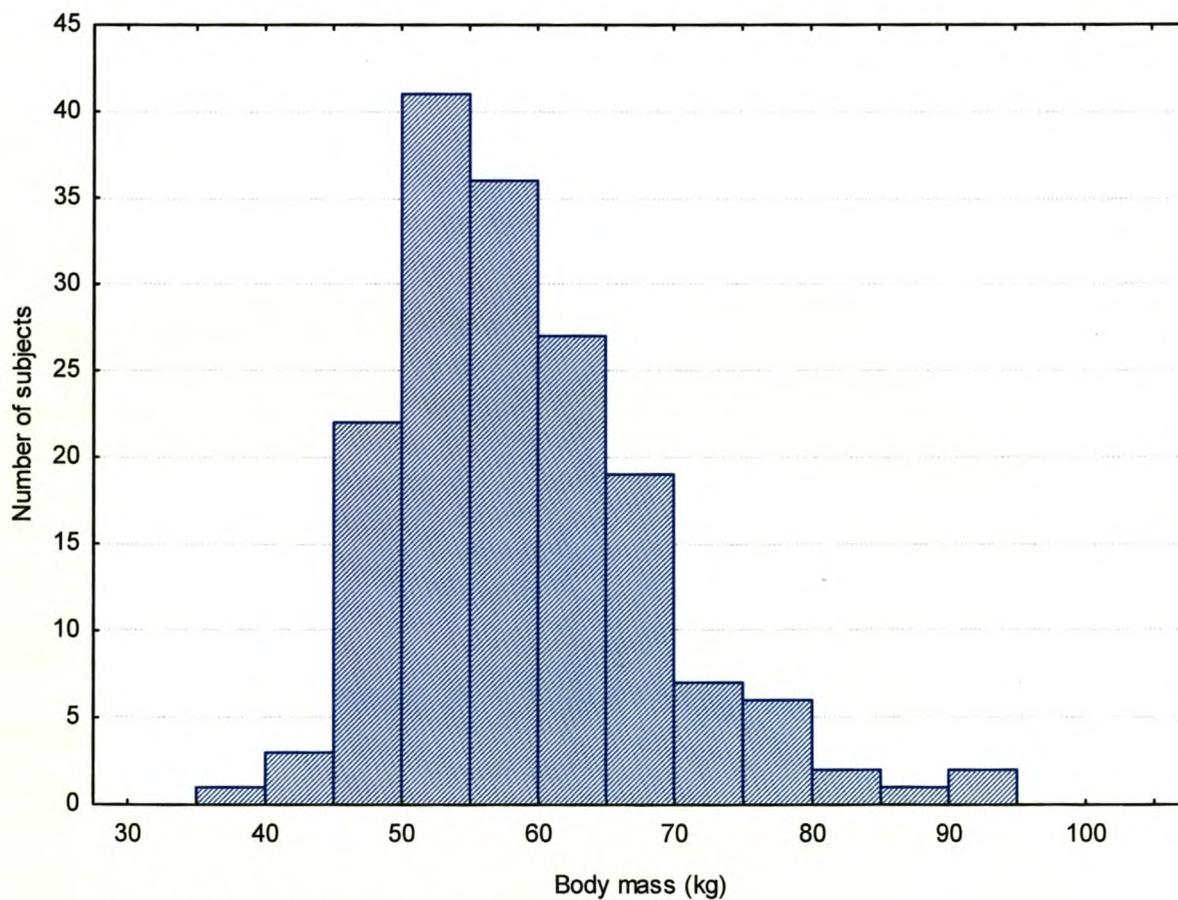


Figure 4.3 Subjects' body mass

The findings on the body mass of adolescent girls in similar studies are presented in Table 4.3.

Table 4.3 The body mass of adolescent girls in similar studies

	<b>Age (years)</b>	<b>Number of subjects</b>	<b>Body mass (kg)</b>
Slaughter <i>et al.</i> (1984)	15.2 ± 1.5	58	56.6 ± 8.3
Boreham <i>et al.</i> (1997)	15	254	56.6 ± 8.6
Schmidt <i>et al.</i> (1998)	16	106	49.2 ± 5.9
Guerra <i>et al.</i> (2002)	14 – 15	123	54.3 ± 8.7
This study	15.92 ± 0.63	167	58.84 ± 9.8

The mean body mass of the subjects in this study was higher in comparison with the mean body mass found in other studies (as seen in Table 4.3), but it should be kept in mind that the subjects' mean stature in this study was also a higher.

Table 4.4 indicates where the mean weight of the 15, 16 and 17-year olds in this study lies on the percentile scale of Canadian children with the same age. The subjects in this study clearly had a higher mean body weight than Canadian children.

Table 4.4 The subjects' body mass compared with Canadian norms

<b>Age (years)</b>	<b>Number of subjects</b>	<b>Mean weight (kg)</b>	<b>Percentiles of Martin &amp; Ward (1996)</b>
15	46	57.51 ± 12.85	60 <sup>th</sup>
16	81	59.15 ± 8.84	70 <sup>th</sup>
17	37	59.8 ± 7.66	70 <sup>th</sup>

## BODY MASS INDEX (BMI)

The subjects' BMI ranged from 15.58kg/m<sup>2</sup> to 35.35kg/m<sup>2</sup>. The mean BMI was 21.69kg/m<sup>2</sup> (SD = 3.37). Figure 4.4 shows that the majority (74%) of subjects had a BMI of between 18kg/m<sup>2</sup> and 24kg/m<sup>2</sup>. The desirable value for BMI is at or below 24kg/m<sup>2</sup> and 83% of the subjects in this study had a BMI at or below this value.

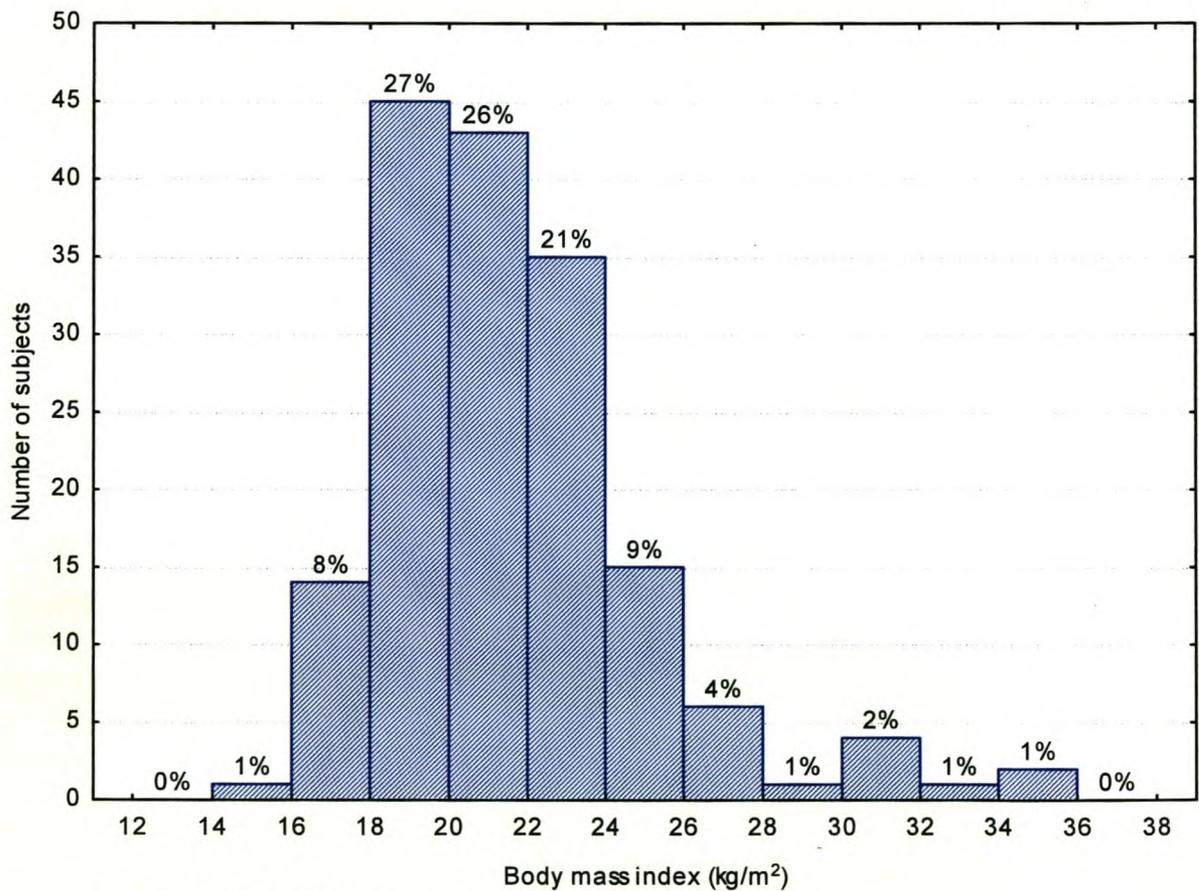


Figure 4.4 Subjects' body mass index

## WAIST-HIP RATIO

The waist-hip ratio of the subjects ranged from 0.66 to 0.89 (Figure 4.5). The subjects' mean waist-hip ratio was 0.75 (SD = 0.04). The limit for significant health risk of adult women is >0.8, but whether this is applicable to children is still in question. As seen in Figure 4.5, 89% of the subjects had a waist-hip ratio of less than 0.8. This means that the majority of the subjects are not at risk of death from coronary artery disease or other illnesses because of their high waist-hip ratio.

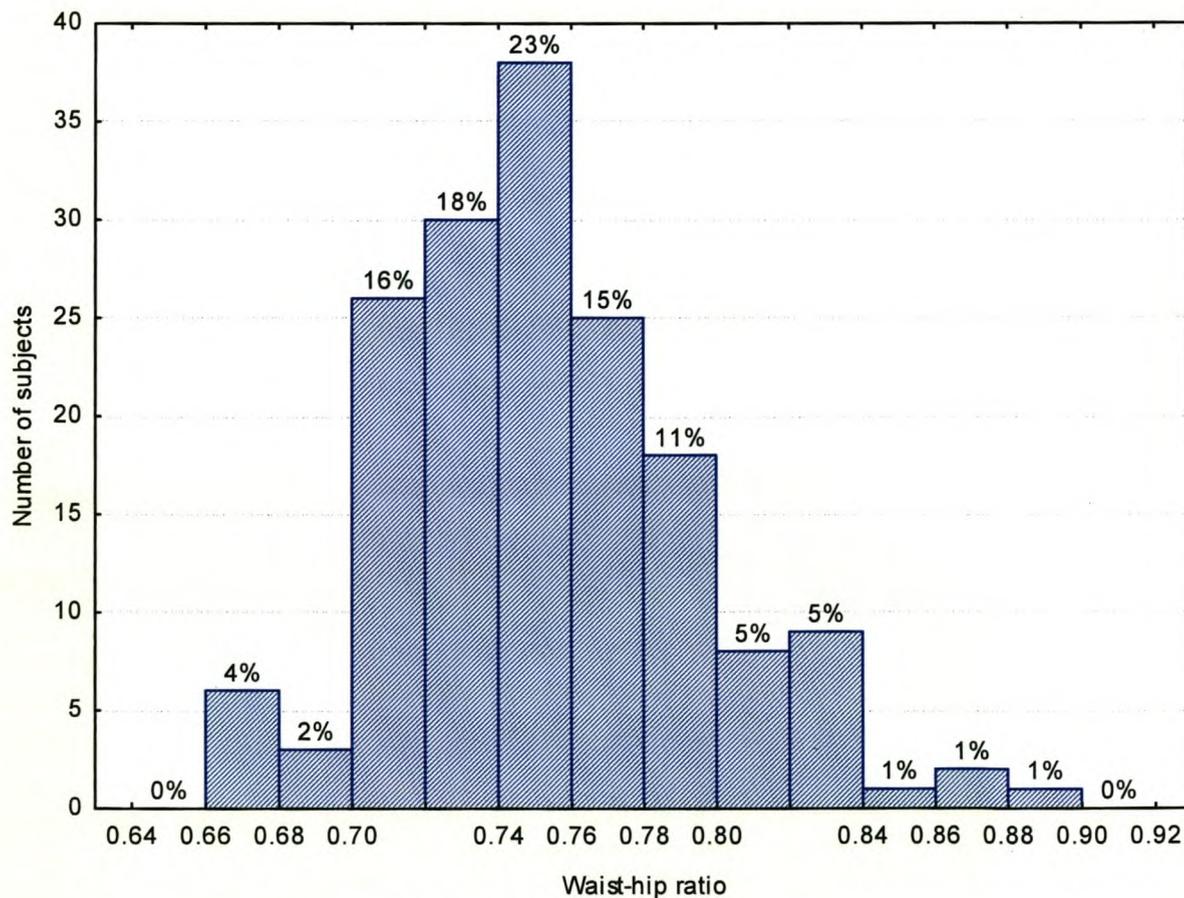


Figure 4.5 Subjects' waist-hip ratio

Norms for waist- and hip circumferences are presented in Table 4.5.

Table 4.5 Norms for waist- and hip circumferences according to Crawford (1996)

Age	Waist (cm)		Hip (cm)	
	Crawford (1996)	This study (2003)	Crawford (1996)	This study (2003)
15	67.974 ± 6.131 (n = 199)	71.8 ± 9.1 (n = 46)	91.035 ± 5.992 (n = 196)	95.1 ± 9.8 (n = 46)
16	68.110 ± 6.866 (n = 205)	72.3 ± 6.3 (n = 81)	91.143 ± 6.552 (n = 202)	95.9 ± 7.6 (n = 81)
17	68.783 ± 7.021 (n = 177)	72.8 ± 7.0 (n = 37)	92.104 ± 6.669 (n = 177)	96.9 ± 6.9 (n = 37)

The subjects' waist circumference ranged from 59cm to 106cm, with a mean of 72.29cm (SD = 7.3). The hip circumference of the subjects tested ranged from 78cm to 132cm, with a mean of 95.93cm (SD = 8.06). When comparing these results with the norms given by Crawford (1996) for the individual age groups (Table 4.5), significantly higher values ( $p < 0.01$ ) are observed. Even though most of the subjects had a waist-hip ratio of less than 0.8, their waist and hip circumferences were higher than those of Canadian children.

### TRICEP SKINFOLD

The subjects' tricep skinfolds ranged between 8mm and 60mm. The mean tricep skinfold was 20.56mm (SD = 8.02). Figure 4.6 illustrates that two of the subjects had remarkably higher tricep skinfold thicknesses (55mm and 60mm) than the rest of the sample. This causes the wide range of skinfold thickness. Even without these two extremes there is a disturbingly high number of subjects (43%) with very high deposits of subcutaneous fat (>20mm).

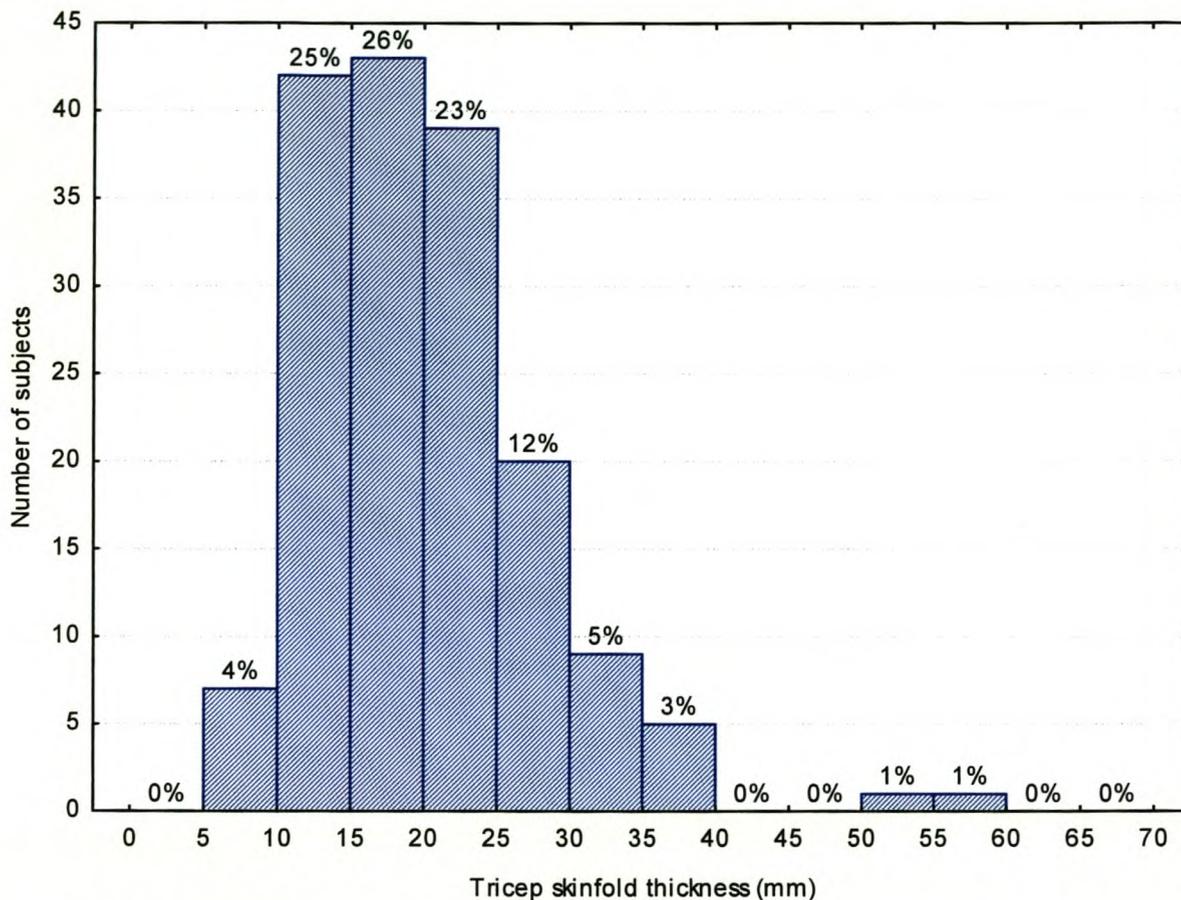


Figure 4.6 Subjects' tricep skinfolds

Table 4.6 indicates that the mean tricep skinfolds of the subjects in this study are much higher than that of Canadian children with the same age. The mean tricep skinfolds of both the 15- and 17-year olds in this study lie on the 80<sup>th</sup> percentile of Canadian norms, and the mean tricep skinfold of the 16-year old subjects lies on the 90<sup>th</sup> percentile of Canadian norms. In other words, the subjects in this study had much higher tricep skinfold measurements than Canadian children of the same age.

Table 4.6 The subjects' tricep skinfolds compared to Canadian norms

Age (years)	Number of subjects	Mean tricep skinfold (mm)	Percentiles of Martin & Ward (1996)
15	46	20.08 ± 9	80 <sup>th</sup>
16	81	21.07 ± 8.34	90 <sup>th</sup>
17	37	19.84 ± 6.07	80 <sup>th</sup>

### SUBSCAPULAR SKINFOLD

The subscapular skinfolds of the subjects ranged from 4mm to 45mm (Figure 4.7). The mean subscapular skinfold was 14.74mm (SD = 7.67).

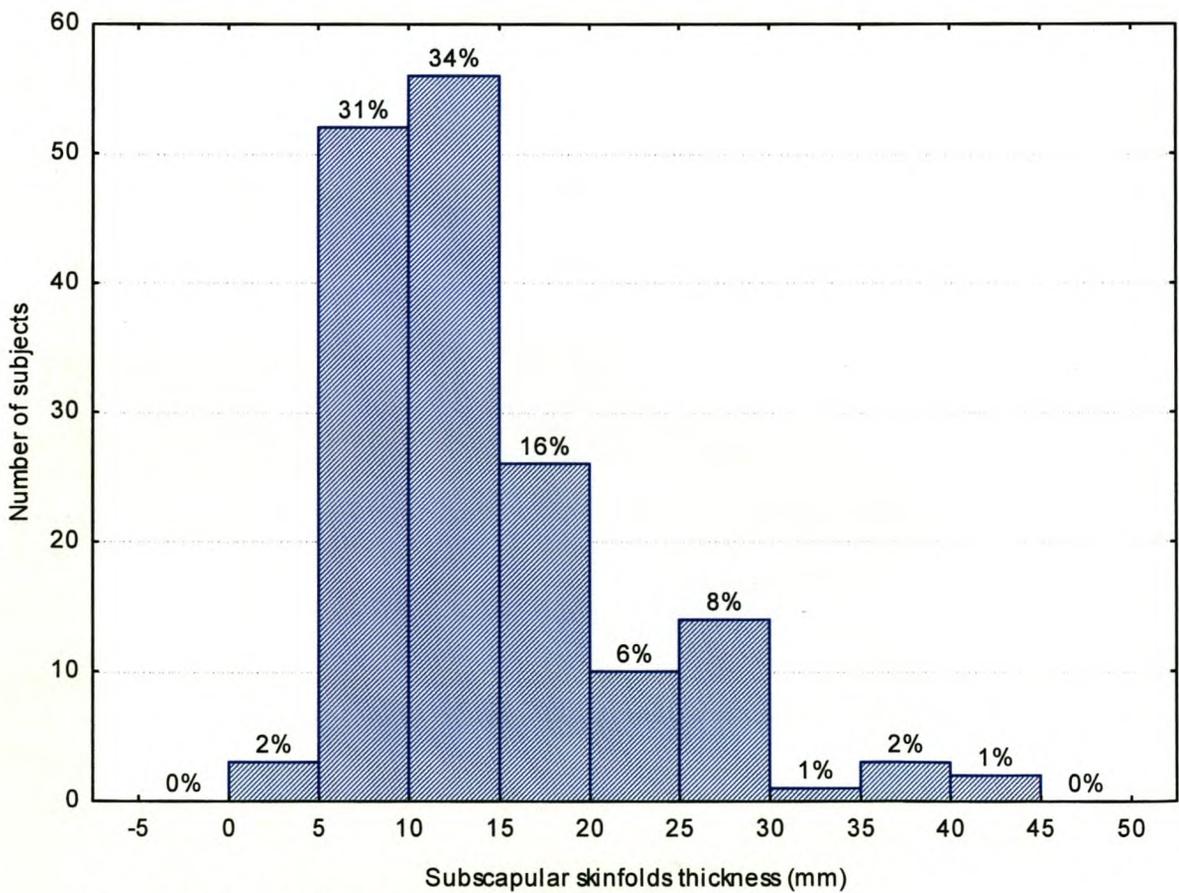


Figure 4.7 Subjects' subscapular skinfolds

Table 4.7 indicates where these results lie on the percentile scale of Martin and Ward (1996), and again much higher mean scores are observed in the current study.

Table 4.7 The subjects' subscapular skinfolds compared to Canadian norms

Age (years)	Number of subjects	Mean subscapular skinfold (mm)	Percentiles of Martin & Ward (1996)
15	46	14.87 ± 9	80 <sup>th</sup>
16	81	15.17 ± 7.82	80 <sup>th</sup>
17	37	13.73 ± 5.58	70 <sup>th</sup>

## PERCENTAGE BODY FAT

The fat percentage of the subjects ranged from 12.59% to 67.03%, with a mean body fat percentage of 28.37% (SD = 8.73).

In young women a body fat content of above 30% is regarded as obese (McKardle *et al.*, 1996). Figure 4.8 shows that the majority of the subjects fall below this value, but a disturbing 36% has a fat percentage of higher than 30%, which classifies them as obese. In a study by Guerra *et al.* (2002) on 14- to 15-year old girls (n = 123), the mean percentage body fat was 22.3 (SD = 5.9). The authors calculated this from the same skinfold sites and equations that was used in the current study. These findings are significantly lower than the findings of the current study ( $p < 0.01$ ), but it should be kept in mind that the subjects of this study has a higher mean age.

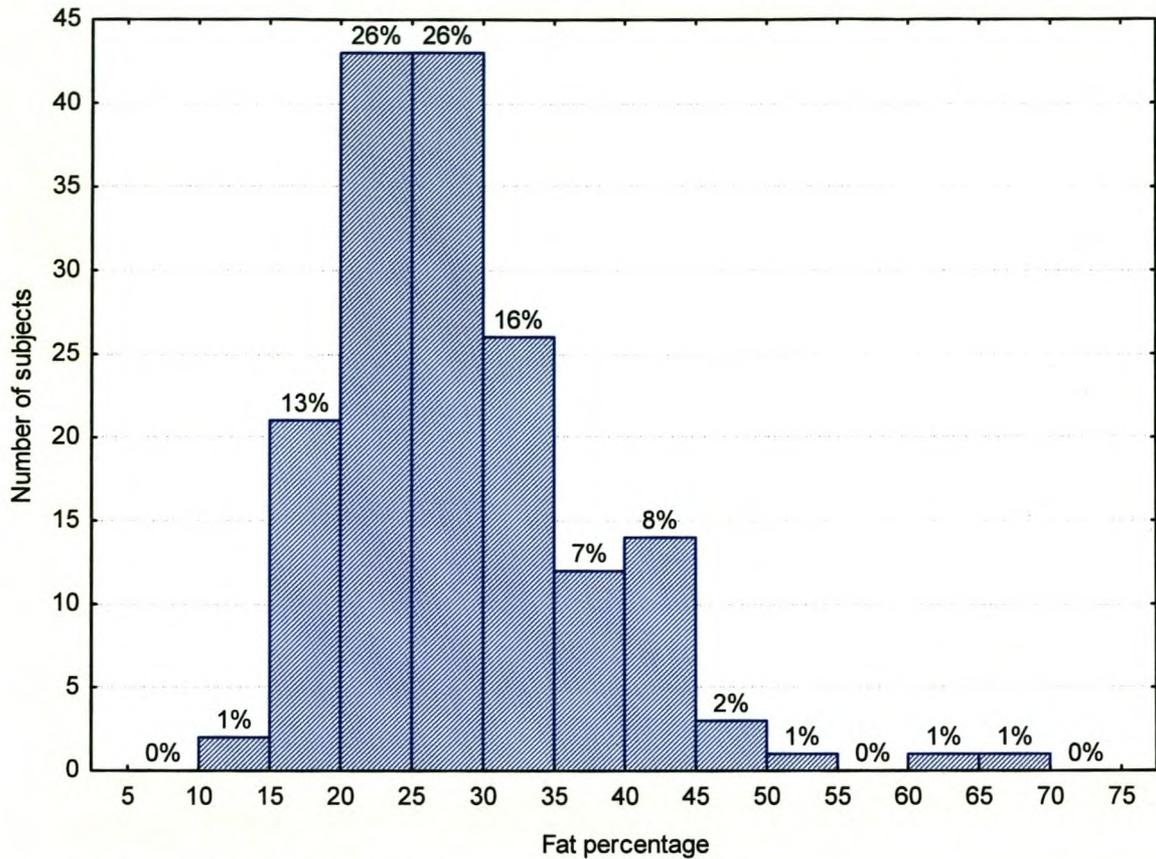


Figure 4.8 Subjects' fat percentage

Body composition assessment through skinfold measurements, as with most techniques, has its limitations. One of these limitations, as identified by Brodie *et al.* (1998), is the difficulty in obtaining interpretable measurements in overly obese subjects. Two of the obese subjects in this study (numbers 49 and 64, Appendix E), weighed 94.5kg and 95kg respectively, with Body Mass Indexes of 35.35 kg/m<sup>2</sup> and 34.27 kg/m<sup>2</sup>. It is their body fat percentages that, according to Slaughter's formula, exceed 60% (Figure 4.8).

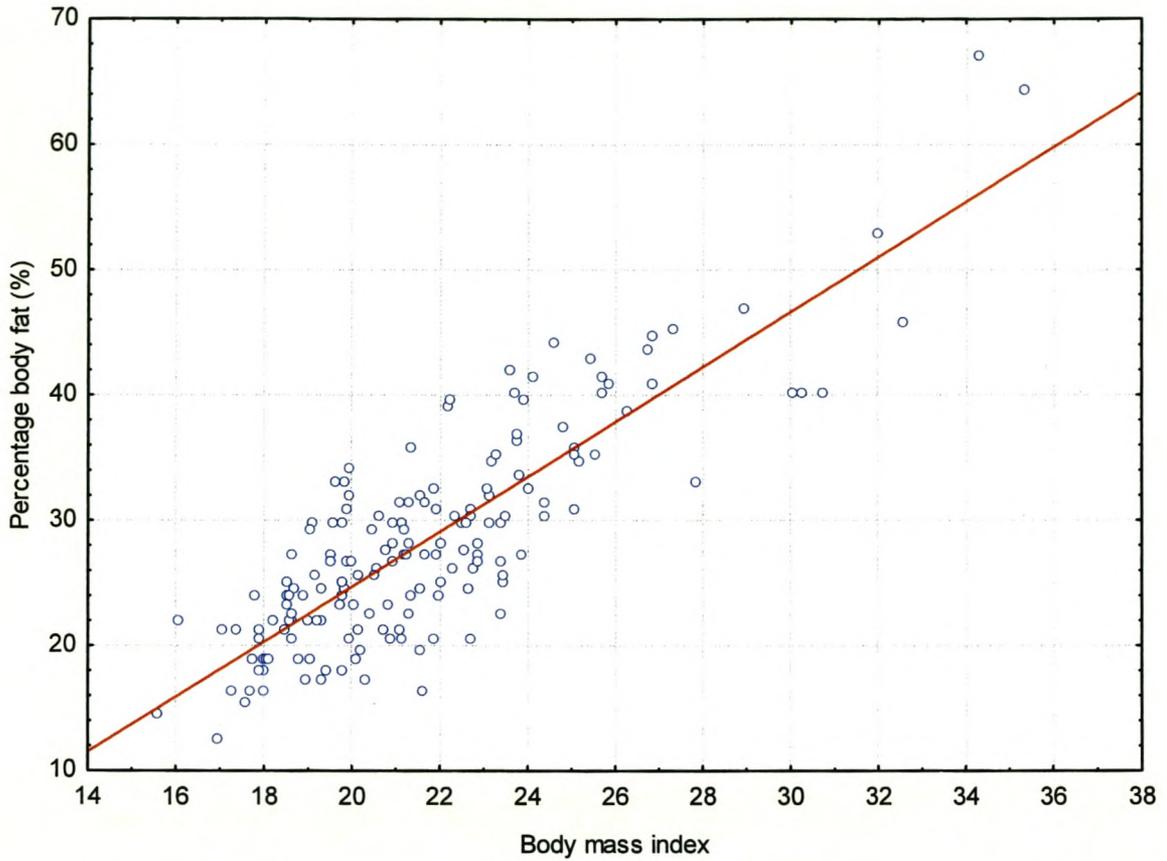


Figure 4.9 The correlation between body mass index and percentage body fat.

Figure 4.9 illustrates the correlation between BMI and percentage body fat. This strong positive correlation ( $r = 0.85$ ;  $p < 0.01$ ) clearly shows that BMI can also be used as an indicator of body composition.

## PARTICIPATION IN ORGANISED SCHOOL SPORT

Figure 4.10 shows that 69% of the subjects tested, participated in organised school sport, and 31% did not.

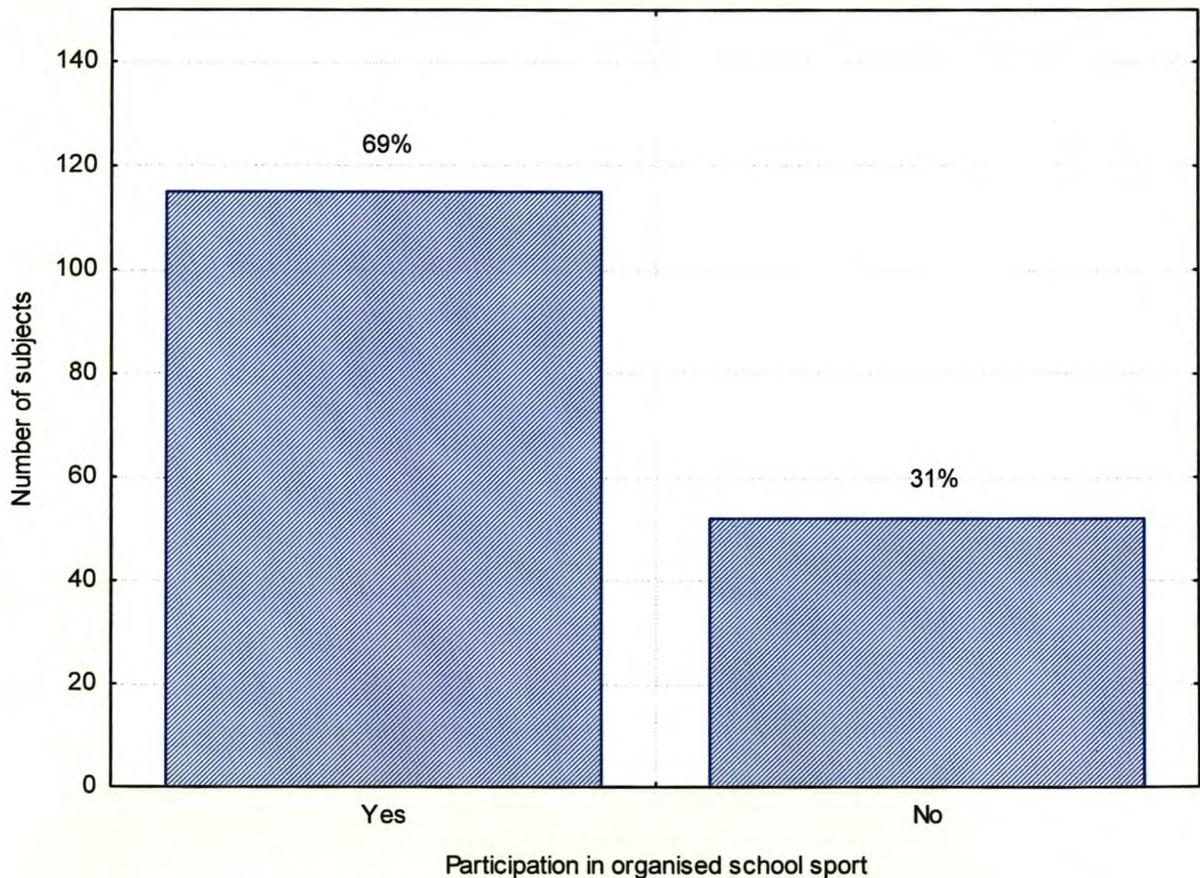


Figure 4.10 Participation in organised school sport

Different reasons were given by 52 subjects (31%) as to why they do not participate in any school sport. The main reason stated by 28.85% of these subjects was that they were too busy. After-school activities such as drama, art classes and music often coincide with school sport, which forces children to choose between these two. The second most frequent reason given was that they simply do not like sport (21.57%). Thirdly, 11.54% said that they were too lazy. Some (7.69%) reported that the schools do not offer the kind of sports they

are interested in. Different forms of dancing (for example, ballet, hip-hop, modern dancing) seem to become very popular among girls, because 23% of those not participating in school sport reported taking dancing classes elsewhere. Other reasons given for not participating in school sports include medical (5.77%) and transport problems (5.77%).

### WEEKLY PARTICIPATION IN SPORT/EXERCISE

The subjects' self-reported weekly participation in sport or other exercise is presented in Figure 4.11.

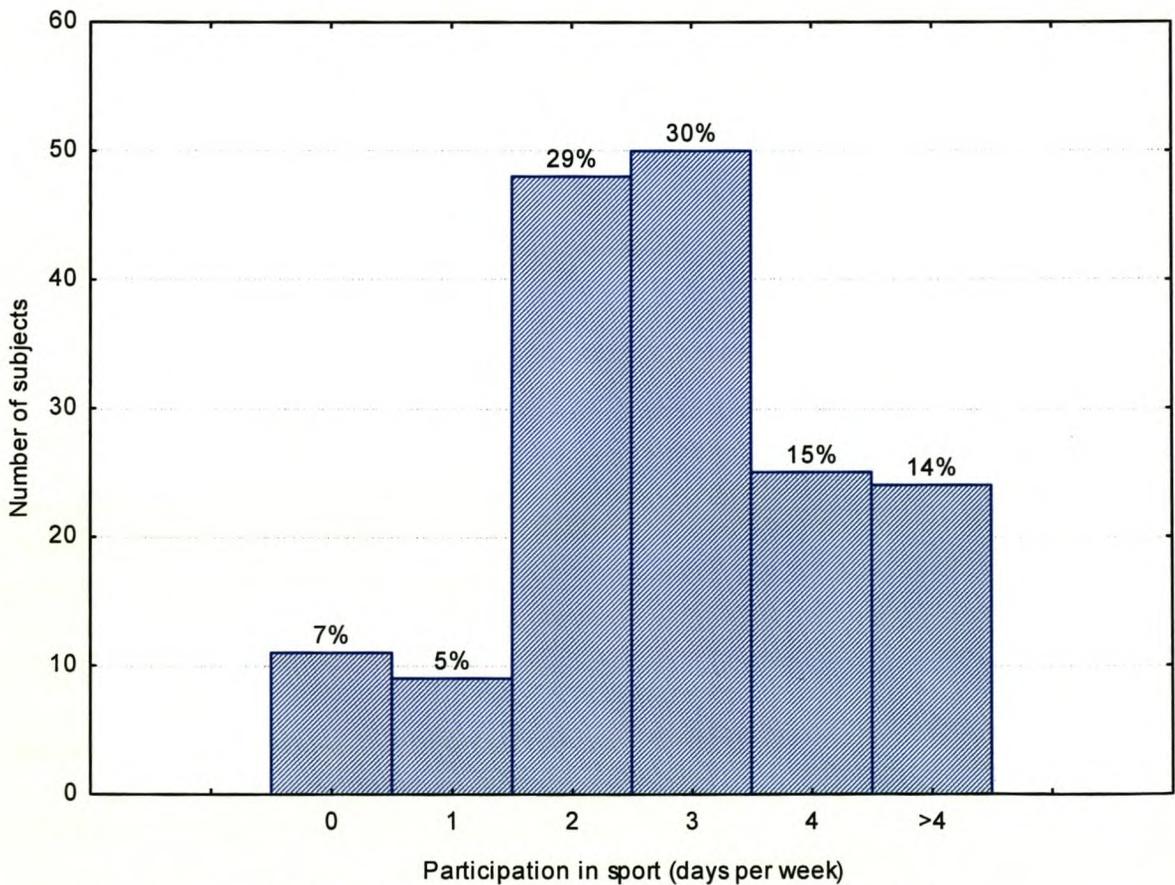


Figure 4.11 Subjects' weekly participation in sport or exercise

As seen in Figure 4.11, 71% of the subjects reported to participate in sport (or other types of exercise) less than three times a week. Self-reported data are not always very reliable (Sallis *et al.*, 1996) which means that there might even be more subjects exercising less than three times per week. These low levels of exercise probably explain the high prevalence of obesity in the study sample.

These results are compared in Table 4.8 with the results of a similar study conducted on 14- to 16-year old girls (N = 617) of the United States.

Table 4.8 Weekly participation in sport of girls in a similar study

	<b>0 times per week</b>	<b>≤ 1 time per week</b>	<b>2 times per week</b>	<b>≥ 3 times per week</b>
Andersen <i>et al.</i> (1998)	8.7%	20.1%	14.9%	65%
This study (2003)	7%	12%	29%	59%

The biggest difference between the results of the current study and that of Andersen and colleagues is seen in the number of subjects engaging in exercise once or less a week (12% of current study and 20.1% of Andersen's study) and those exercising twice a week (29% versus 14.9%). The subjects of this study are clearly exercising more often than those of Andersen *et al.* (1998).

## **LEVELS OF CARDIORESPIRATORY FITNESS**

The results of the subjects' performance in the *Multistage Fitness Test* (Bleep Test) are illustrated in Figure 4.12. The number of completed shuttles by the subjects ranged from 6 to 98, with a mean of 32.6 (SD = 17.9).

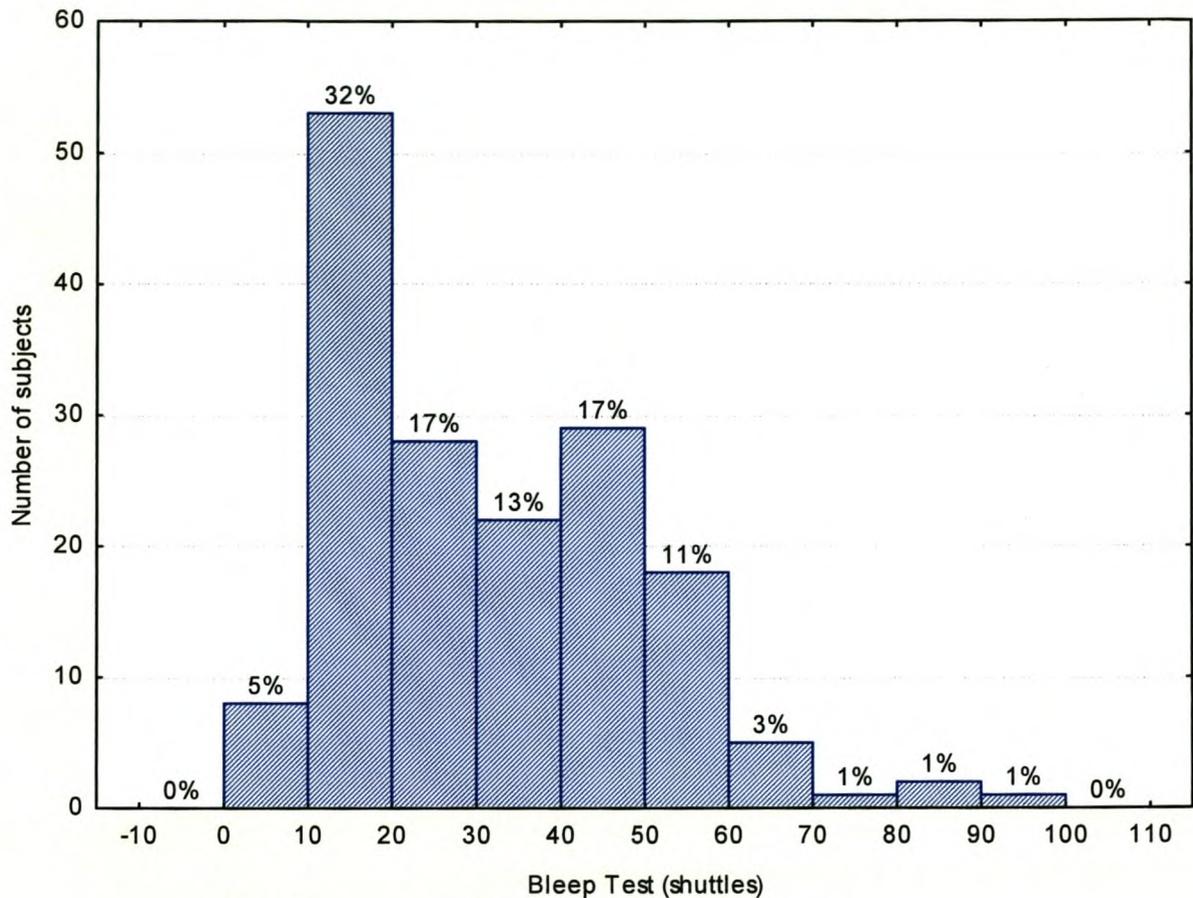


Figure 4.12 Subjects' performance in the Bleep Test

As seen in Figure 4.12, 67% of the subjects completed 40 shuttles or less, which means that they have reached Level 5 or lower. When looking at the age groups individually (Table 4.9), it is interesting to note the decrease (although not statistically significant) in fitness levels with each successive year.

Table 4.9 Bleep Test scores of different age groups

Age	Number of subjects	20m shuttles (no of laps)
15	46	34.59 ± 20.23
16	81	33.67 ± 17.93
17	37	27.95 ± 14.45

Table 4.10 compares the results with the results of a study conducted in New South Wales, Australia (Okely *et al.*, 2001). The subjects in this study performed almost as well as the Australian subjects in the Bleep Test, with no significant difference between the two.

Table 4.10 Performance on the Bleep Test by subjects in a similar study

	<b>Age (years)</b>	<b>Number of subjects</b>	<b>20m shuttles (number of laps)</b>
Okely <i>et al.</i> (2001)	15.3	430	35.72 ± 18.93
This study (2003)	15.92 ± 0.63	167	32.6 ± 17.9

When comparing these results to similar studies (Table 4.11) conducted more than 10 years ago (Boreham *et al.*, 1990 & Liu *et al.*, 1992) the dramatic decrease in fitness levels ( $p < 0.01$ ) is evident over the last couple of years. The study of Liu *et al.* was conducted in the USA and that of Boreham *et al.* in the United Kingdom.

Table 4.11 Performance on the Bleep Test by subjects in similar studies, conducted more than 10 years ago, compared with this study

	<b>Age (years)</b>	<b>Number of subjects</b>	<b>20m shuttles (number of laps)</b>	<b>Levels reached</b>
Liu <i>et al.</i> (1992)	12-15	26	47.77 ± 13.7	
Boreham <i>et al.</i> (1990)	15.4 ± 0.7	18	50.4 ± 12.5	5.8 ± 1.4
This study (2003)	15.92 ± 0.63	167	32.6 ± 17.9	4.9 ± 2.0

Figure 4.13 is the result of the Kruskal-Wallis test done to determine whether there is a correlation between the subjects' levels of cardiorespiratory fitness and their self-reported weekly participation in sport or exercise.

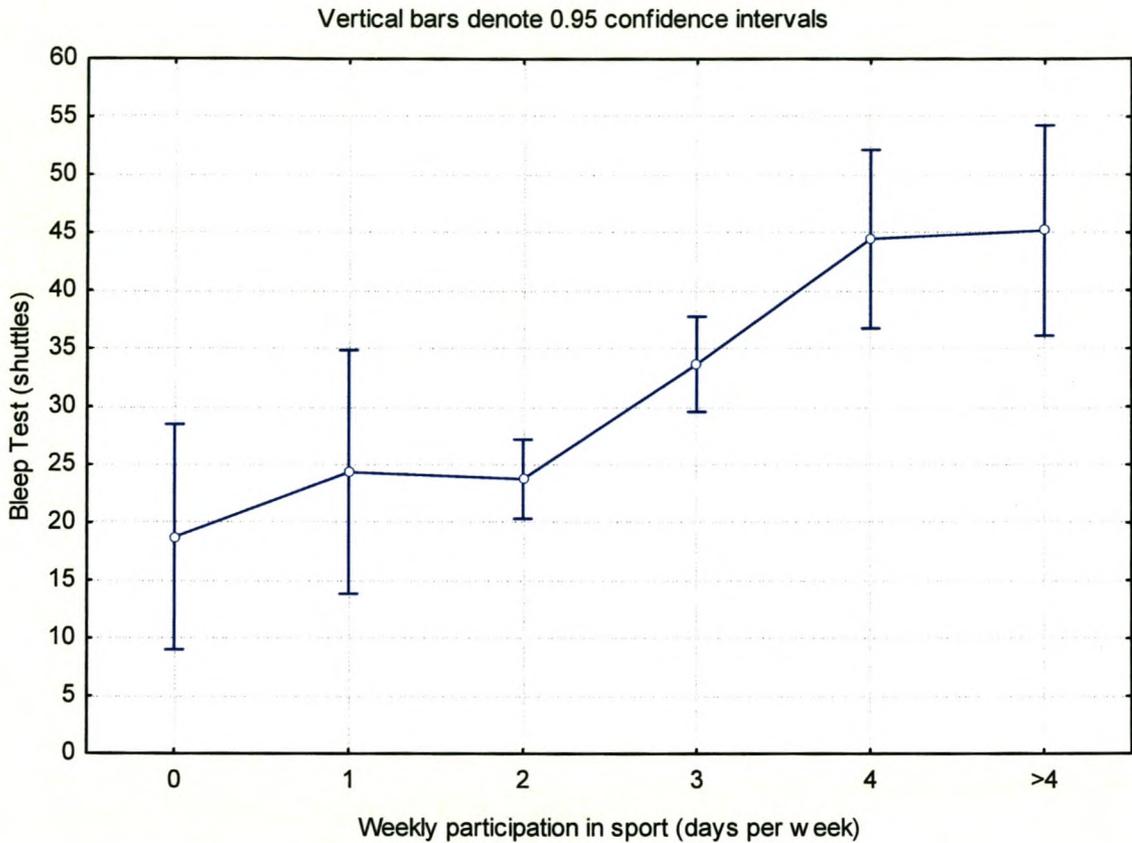


Figure 4.13 Average Bleep Test scores for each of the weekly “Participation in sport” categories.

Figure 4.13 clearly illustrates that the average bleep scores increase with increasing weekly participation in sport ( $p < 0.01$ ). This result is underlined by the positive Spearman correlation of 0.49.

This strong positive correlation is an indication that the self-reported data of weekly participation in sport or exercise are reliable. The more days the subjects reported to participate in sport during the week, the better their performance were in the Bleep Test.

As seen in Figure 4.14, a negative correlation ( $r = -0.47$ ;  $p < 0.01$ ) was found between levels of cardiorespiratory fitness and percentage body fat. In other words, subjects with a low percentage body fat performed better in the Bleep Test than those with a higher percentage body fat, indicating higher levels of fitness among the leaner subjects.

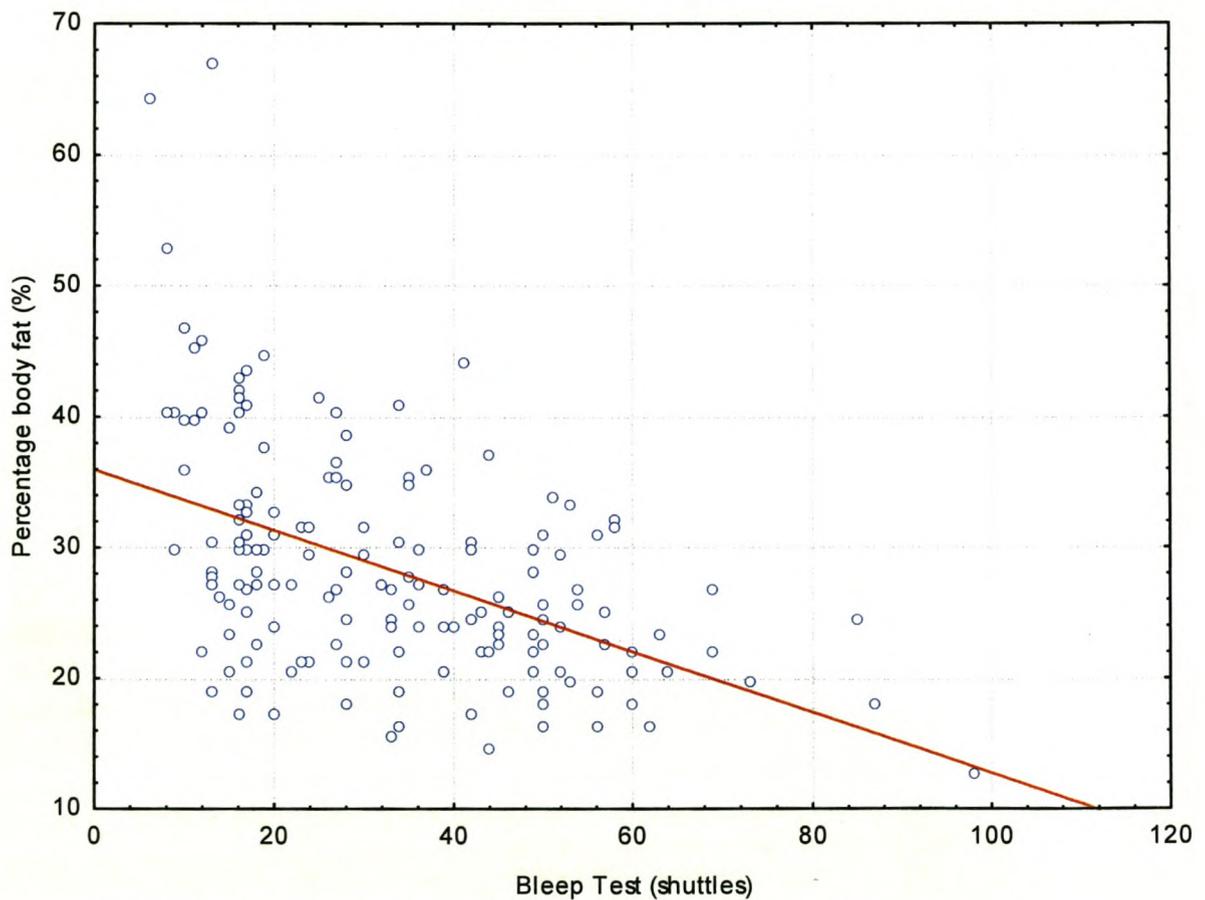


Figure 4.14 The correlation between cardiorespiratory fitness and percentage body fat

## PHYSICAL SELF-PERCEPTION

The subjects' total scores on the *Physical Self-perception Profile* (PSPP) ranged from 33 to 116, with a mean total score of 71.31 (SD = 14.17). Figure 4.15 shows the distribution of the subjects' total scores on the PSPP.

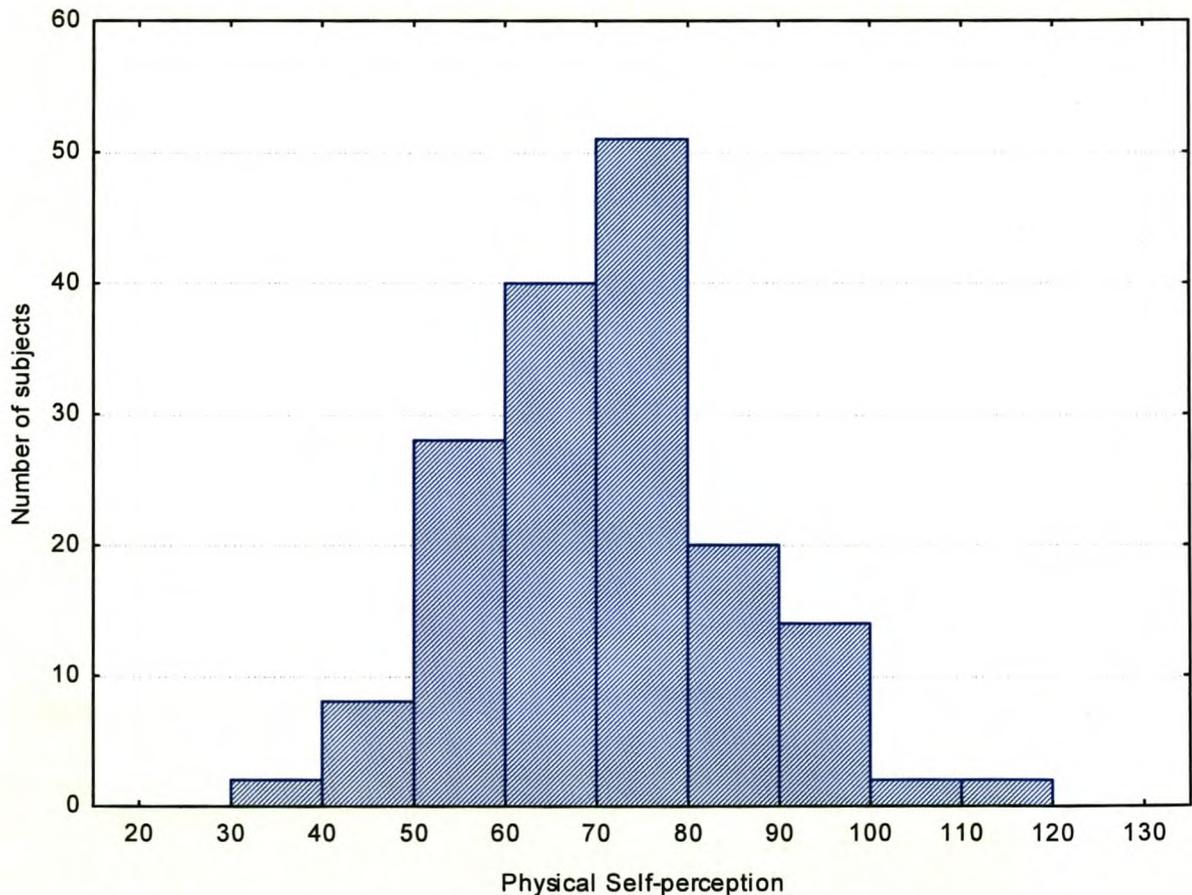


Figure 4.15 Subjects' total scores on the Physical Self-perception Profile.

The development of the PSPP has been carried out on a young student population (subjects a few years older than those in the current study), and few studies have used this instrumentation on adolescents. A reliability analysis was therefore done to determine whether or not the subjects understood the different questions and answered them correctly. Results of this analysis showed that for all five different subscales the cronbach alpha values were higher than 0.7, indicating sufficient reliability.

Table 4.12 compares the physical self-perception scores of this study with the results of a study by Aşçi (2002), on university students in Turkey. The mean age of Aşçi's study sample was higher (21.59 years, SD = 1.42) than the mean age of the adolescents in this study, but Table 4.12 shows that in the different subscales the older subjects scored only slightly higher than the adolescents. The biggest difference can be seen in the scores on body attractiveness, where the adolescents of this study scored significantly lower ( $p < 0.01$ ) than Aşçi's subjects. This might be the result of the distorted picture teenagers have of an attractive body.

Table 4.12 Mean scores and standard deviations of the different subscales of the PSPP compared with the results of Aşçi (2002)

<b>Subscale</b>	<b>This study</b>	<b>Aşçi (2002)</b>
Sport competence	14.49 ± 3.98	15.54 ± 3.78
Physical condition	14.77 ± 3.84	15.24 ± 3.24
Body attractiveness	12.89 ± 4.29	15.51 ± 3.65
Physical strength	14.49 ± 3.15	14.38 ± 3.68
Physical self-worth	14.66 ± 3.91	15.24 ± 3.37

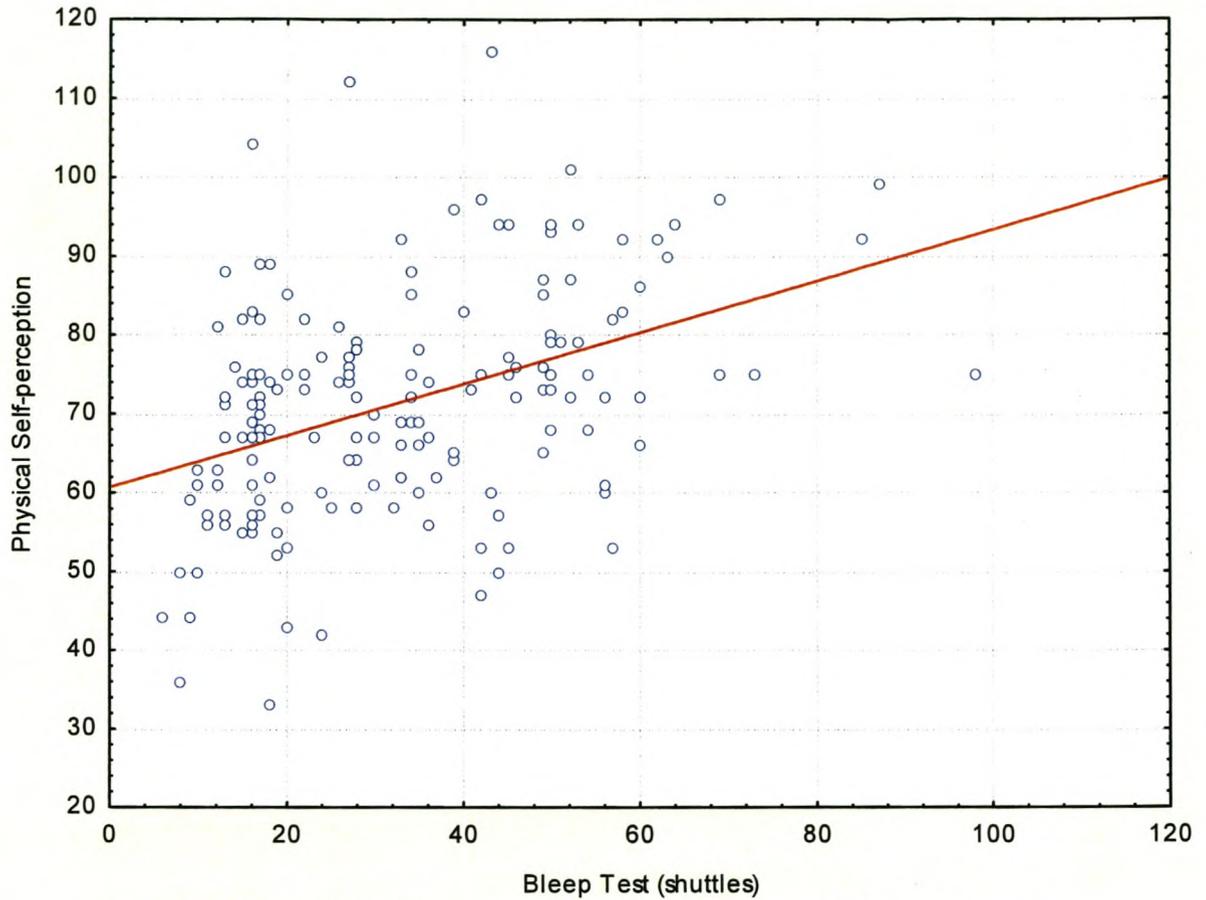


Figure 4.16 The correlation between cardiorespiratory fitness and physical self-perception.

Figure 4.16 shows a positive correlation ( $r = 0.47$ ;  $p < 0.01$ ) between the subjects' performance in the Bleep Test and their physical self-perception. The better the subjects performed in the Bleep Test, the higher were their physical self-perception. The less fit subjects had lower physical self-perceptions.

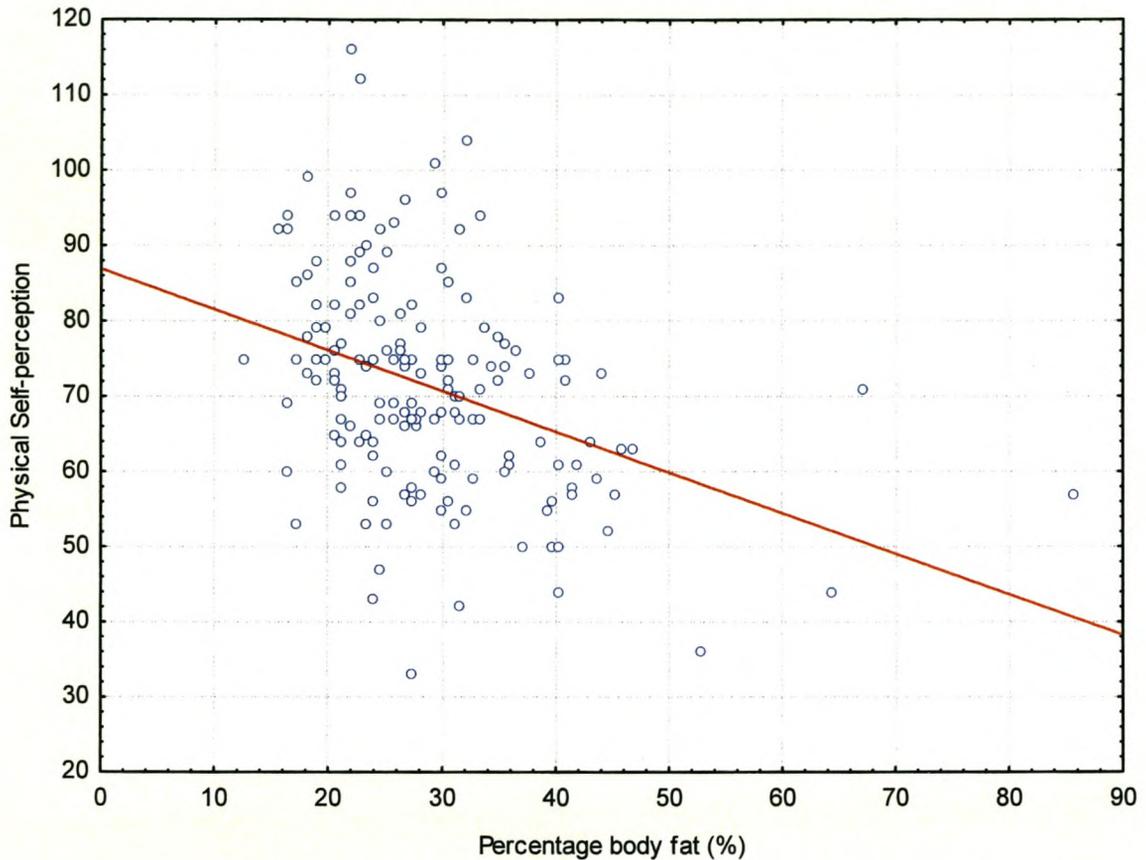


Figure 4.17 The correlation between percentage body fat and physical self-perception

A negative correlation ( $r = -0.35$ ;  $p < 0.01$ ) was found between percentage body fat and physical self-perception. This indicates that overweight children suffer from low levels of physical self-perception, but as seen in Figure 4.17, a higher level of fitness can have a positive influence on physical self-perception.

## Summary

The results of this study first of all showed that, compared with subjects in other studies, these adolescents were significantly ( $p < 0.01$ ) taller. This is something one has to keep in mind when one considers that the subjects' mean body weight was also higher than that of the other studies. The waist and hip circumferences of the subjects in this study were significantly larger compared with Canadian norms.

The subjects' tricep skinfold thicknesses were disturbingly high compared with that of Canadian children of the same age. Almost half of the study sample (45%) had tricep skinfolds of 20mm or more, indicating very high deposits of subcutaneous fat. The same applies for the subscapular skinfolds that are also more than those of Canadian children.

The result of these high measurements of skinfolds is evident in the subjects' percentage body fat. The mean percentage body fat of the subjects was 28.37% (SD = 8.73). This gives definite reason for concern when keeping in mind that a body fat content of 30% corresponds with obesity. This means that an alarming 36% of the subjects can thus be classified as obese.

The high number of subjects that suffer from obesity can be a result of the low participation in sports and exercise. Participation in organised school sport seems to become less important to girls, with 31% of the subjects reporting that they do not participate in any sport offered by their school and 7% saying that they do not engage in any form of exercise. This is clearly evident in their low fitness levels, with only 67% reaching Level 5 or lower on the Bleep Test.

When comparing the subjects' scores on the *Physical Self-perception Profile* with the scores of subjects that are a few years older, the adolescents scored

significantly lower ( $p < 0.01$ ) in the body attractiveness subscale. This might be a result of the wrong impression adolescents have of an “ideal body”.

The subjects with low fitness levels had a higher fat content, which is evident in the negative correlation ( $r = -0.47$ ;  $p < 0.01$ ) between levels of cardiorespiratory fitness and percentage body fat. These same subjects also suffered from low physical self-perceptions. The positive correlation ( $r = 0.47$ ;  $p < 0.01$ ) between levels of cardiorespiratory fitness and physical self-perception indicated that the fitter subjects had much stronger physical self-perceptions.

## CHAPTER FIVE

# CONCLUSIONS AND RECOMMENDATIONS

### INTRODUCTION

There is a universal concern about the rapid decline in the physical activity levels of children, particularly adolescent girls. As a result of this there is now evidence of an increase in juvenile obesity that is associated with numerous health risks, including psychological problems. These problems often stem from a disturbance in the self-concept. The purpose of this study was to determine the relationship between fitness, body composition and physical self-perception of a sample of 167 adolescent girls from Stellenbosch, and to compare these results with the findings of similar studies from around the world.

### RESEARCH QUESTIONS

The following research questions were asked and answered:

*Research question 1:* Is there a relationship between the subjects' levels of cardiorespiratory fitness and their body composition?

Yes, the results indicated that there is a negative correlation ( $r = -0.47$ ;  $p < 0.01$ ) between the subjects' levels of cardiorespiratory fitness and body composition. In other words, the fitter subjects had lower percentage body fat compared with the less fit subjects.

*Research question 2:* Is there a relationship between the subjects' body composition and their physical self-perception?

Yes, a negative correlation ( $r = -0.35$ ;  $p < 0.01$ ) was found between the subjects' body composition and physical self-perceptions. Subjects with a higher fat content had lower levels of physical self-perception.

*Research question 3:* Is there a relationship between the subjects' levels of cardiorespiratory fitness and their physical self-perception?

Yes, a positive correlation ( $r = 0.47$ ;  $p < 0.01$ ) was found between levels of cardiorespiratory fitness and physical self-perception, indicating that the fitter subjects had scored higher on the *Physical Self-perception Profile*.

## **SUMMARY OF FINDINGS**

The results clearly illustrate the current prevalence of obesity associated with low cardiorespiratory fitness (due to inactivity) and low self-perception. The mean percentage body fat of the subjects in this study was unexpectedly high (28.37%; SD = 8.73) and is a major area of concern. An alarming 36% of the subjects were classified as obese as their body fat percentage was more than 30. A corresponding 31% did not participate in any organised school sport, and 71% reported to exercise only three times or less per week. Low activity levels were directly related to low levels of cardiorespiratory fitness, which might be one of the causes for the high prevalence of obesity.

No significant difference in the fitness levels was found between Australian and the Stellenbosch girls, and when one looks at weekly participation in sport or exercise, the Stellenbosch girls actually exercised more than those in the United States of America. A reason for concern is the magnitude of the difference between the fitness levels of adolescent girls about ten years ago compared with

the current study, indicating a dramatic decrease in physical activity over the years and not predicting anything positive for the future. A snowball effect is observed, where the inactivity had a bearing on obesity and obesity resulted in lower self-perceptions. The importance of being physically active for the physical and psychological well-being of adolescents is a valuable preventive and treatment measure.

## **RECOMMENDATIONS**

The results of this study, consistent with related research findings, showed that there is a definite need for the promotion of physical activity among children and adolescents, and that even more attention should be given in this regard to adolescent girls. The best place to start with this is at home. Research has shown that parental modeling is of utmost importance when it comes to the promotion of physical activity (Kalakanis *et al.*, 2001). Parents should be encouraged to engage in a physically active lifestyle and model this behaviour to their children. A session on the benefits of exercise and the importance of parental modeling during a parent-teacher's meeting, for example, can assist in making parents and teachers aware of their important role in children's physical activity patterns. Forcing children to exercise is not an option, for it might create negative attitudes towards exercise and sport (Sallis *et al.*, 1996).

Physical educators are in a unique position to influence children's lives positively through physical education classes. The focus should be on enjoyment of the activity. Having fun in physical education classes might provide the impetus for children to engage in similar activities outside of school. When young children discover the intrinsic rewards of exercise, it is more likely that they will stay active throughout life. It is the physical educator's task to expose children to as many different sports as possible, so that each child has the chance to find out what he/she enjoys most, or discover his/her natural talent. Lifelong fitness activities and sports, such as hiking, cycling and tennis, should be highlighted in the curriculum, in an attempt to prevent the child from becoming inactive after he/she

leaves school. These activities should preferably involve the large muscle groups and provide an aerobic stimulus. Adventure-based games are a good example of the kind of exercise that children will find enjoyable. These games are also successful at individually inducing a child's abilities, and this can enhance the self-esteem of obese individuals (Irwin *et al.*, 2003).

In order to ensure that physical education is a positive experience for all children, but especially the obese individuals, the physical educator should be understanding and show compassion. This can help with the strengthening of the overweight child's self-esteem (Irwin *et al.*, 2003). Only when the Department of Education gives physical education its rightful place in the curriculum, and monitor the system properly, can physical education in South African schools achieve its long-term potential.

With the media's unrealistic portrayal of the perfect body, parents and teachers trying to decrease childhood obesity should be careful not to put an even greater emphasis on weight, thus increasing the already high social pressure. Research has shown that dieting for weight loss is only a temporary solution and associated with depression and low self-esteem (Pesa *et al.*, 2000). When introducing physical fitness- and nutritional information, the focus should be on health and well-being and not on weight loss or physical appearance, in an attempt to enforce healthy behaviour patterns and minimise dissatisfaction with body image. The latter could be accomplished by helping adolescents abolish weight and physical appearance as the centre of self-esteem (Bar-Or *et al.*, 1998). The overweight individual must be encouraged to recognise his/her strengths in other areas of his/her life.

Increasing physical activity is a big step towards the prevention and treatment of obesity, but other dietary and behaviour modifications are also necessary. Parents need to reduce the sedentary behaviour of their children, for example, by limiting the amount of television viewing per day. At all times parents and

teachers should “practise what they preach”, which includes television viewing restrictions and a healthy diet.

## **RECOMMENDATIONS FOR FUTURE RESEARCH**

- Only subjects from middle-class schools in Stellenbosch were tested during this study. Subjects from other socioeconomic groups or different demographic areas can be the study population of a similar study in the future.
- The development of an exciting physical education programme that adolescents will find enjoyable can be the focus of a future study.

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## Appendix A

# INFORMED CONSENT

### Consent of Subject:

I, \_\_\_\_\_ (name and surname)  
from (address) \_\_\_\_\_  
\_\_\_\_\_

confirm that:

1. I was invited to participate in a project conducted by the Department of Sport Science of Stellenbosch University.
2. I was informed that the information obtained during this study will be held confidential.
3. It was explained to me that:
  - 3.1 the aim of this project is to determine the fitness levels of teenage girls in the Stellenbosch region, and how it compares to their self-perception and body composition.
  - 3.2 I will participate in three tests: a fitness test, body composition test and a questionnaire.
  - 3.3 no invasive procedures (e.g. injections, drawing of blood) or administration of any substances will be administered.
4. The above-mentioned information was explained to me in English/ Afrikaans. I was also given the opportunity to ask questions and all my questions were answered satisfactorily.
5. It was explained to me that my participation is voluntarily and that I can withdraw from the project at any time.
6. I was informed that there are no costs linked to my participation.
7. I indemnify Stellenbosch University and the testers against any injury which might stem from my participation in the project.

**With this I volunteer** to participate in the above-mentioned project.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Witness

\_\_\_\_\_  
Date

**Parent/Guardian of the subject:**

I hereby give permission that my child may participate in above-mentioned project.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Witness

\_\_\_\_\_  
Date

## Appendix B

### Physical Self-perception Profile

#### WHAT AM I LIKE?

These are statements which allow people to describe themselves. There are no right or wrong answers since people differ a lot. First, decide which one of the two statements best describe you. Then, go to that side of the statement and check if it is just "sort of true" or "really true" FOR YOU.

#### EXAMPLE

Really True for Me	Sort or True for Me				Really True for Me	Sort of True for Me
<input type="checkbox"/>	<input type="checkbox"/>	Some people are very competitive	BUT	Others are not so competitive	<input checked="" type="checkbox"/>	<input type="checkbox"/>

#### REMEMBER to check only ONE of the four boxes

#### Questions:

1.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel that they are not very good when it comes to playing sports	BUT	Others feel that they are really good at just about every sport	<input type="checkbox"/>	<input type="checkbox"/>
2.	<input type="checkbox"/>	<input type="checkbox"/>	Some people are not very confident about their level of physical conditioning and fitness	BUT	Others always feel confident that they maintain excellent conditioning and fitness	<input type="checkbox"/>	<input type="checkbox"/>
3.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel that compared to most, they have an attractive body	BUT	Others feel that compared to most, their body is not quite so attractive	<input type="checkbox"/>	<input type="checkbox"/>
4.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel that they are physically stronger than most people of their sex	BUT	Others feel that they lack physical strength compared to most others of their sex	<input type="checkbox"/>	<input type="checkbox"/>

	Really True for Me	Sort or True for Me			Really True for Me	Sort of True for Me	
5.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel extremely proud of who they are and what they can do physically	BUT	Others are sometimes not quite so proud of who they are physically	<input type="checkbox"/>	<input type="checkbox"/>
6.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel that they are among the best when it comes to athletic ability	BUT	Others feel that they are not among the most able when it comes to athletics	<input type="checkbox"/>	<input type="checkbox"/>
7.	<input type="checkbox"/>	<input type="checkbox"/>	Some people make certain they take part in some form of regular vigorous physical exercise	BUT	Others don't often manage to keep up regular vigorous physical exercise	<input type="checkbox"/>	<input type="checkbox"/>
8.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel that they have difficulty maintaining an attractive body	BUT	Others feel that they are easily able to keep their bodies looking attractive	<input type="checkbox"/>	<input type="checkbox"/>
9.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel that their muscles are much stronger than most others of their sex	BUT	Others feel that on the whole their muscles are not quite so strong as most others of their sex	<input type="checkbox"/>	<input type="checkbox"/>
10.	<input type="checkbox"/>	<input type="checkbox"/>	Some people are sometimes not so happy with the way they are or what they can do physically	BUT	Others always feel happy about the kind of person they are physically	<input type="checkbox"/>	<input type="checkbox"/>
11.	<input type="checkbox"/>	<input type="checkbox"/>	Some people are not quite so confident when it comes to taking part in sports activities	BUT	Others are among the most confident when it comes to taking part in sports activities	<input type="checkbox"/>	<input type="checkbox"/>

	Really True for Me	Sort or True for Me			Really True for Me	Sort of True for Me	
12.	<input type="checkbox"/>	<input type="checkbox"/>	Some people do not usually have a high level of stamina and fitness	BUT	Others always maintain a high level of stamina and fitness	<input type="checkbox"/>	<input type="checkbox"/>
13.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel embarrassed by their bodies when it comes to wearing few clothes	BUT	Others do not feel embarrassed by their bodies when it comes to wearing few clothes	<input type="checkbox"/>	<input type="checkbox"/>
14.	<input type="checkbox"/>	<input type="checkbox"/>	When it comes to situations requiring strength some people are one of the first to step forward	BUT	When it comes to situations requiring strength some people are one of the last to step forward	<input type="checkbox"/>	<input type="checkbox"/>
15.	<input type="checkbox"/>	<input type="checkbox"/>	When it comes to the physical side of themselves some people do not feel very confident	BUT	Others seem to have a real sense of confidence in the physical side of themselves	<input type="checkbox"/>	<input type="checkbox"/>
16.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel that they are always one of the best when it comes to joining in sports activities	BUT	Others feel that they are not one of the best when it comes to joining in sports activities	<input type="checkbox"/>	<input type="checkbox"/>
17.	<input type="checkbox"/>	<input type="checkbox"/>	Some people tend to feel a little uneasy in fitness and exercise settings	BUT	Others feel confident and at ease at all times in fitness and exercise settings	<input type="checkbox"/>	<input type="checkbox"/>
18.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel that they are often admired because their physique or figure is considered attractive	BUT	Others rarely feel that they receive admiration for the way their body looks	<input type="checkbox"/>	<input type="checkbox"/>

	Really True for Me	Sort or True for Me			Really True for Me	Sort of True for Me	
19.	<input type="checkbox"/>	<input type="checkbox"/>	Some people tend to lack confidence when it comes to their physical strength	BUT	Others are extremely confident when it comes to their physical strength	<input type="checkbox"/>	<input type="checkbox"/>
20.	<input type="checkbox"/>	<input type="checkbox"/>	Some people always have a really positive feeling about the physical side of themselves	BUT	Others sometimes do not feel positive about the physical side of themselves	<input type="checkbox"/>	<input type="checkbox"/>
21.	<input type="checkbox"/>	<input type="checkbox"/>	Some people are always a little slower than most when it comes to learning new skills in a sports situation	BUT	Others have always seemed to be among the quickest when it comes to learning new sports skills	<input type="checkbox"/>	<input type="checkbox"/>
22.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel extremely confident about their ability to maintain regular exercise and physical condition	BUT	Others don't feel quite so confident about their ability to maintain regular exercise and physical condition	<input type="checkbox"/>	<input type="checkbox"/>
23.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel that compared to most, their bodies do not look in the best of shape	BUT	Others feel that compared to most their bodies always look in excellent physical shape	<input type="checkbox"/>	<input type="checkbox"/>
24.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel that they are very strong and have well developed muscles compared to most people	BUT	Others feel that they are not so strong and their muscles are not very well developed	<input type="checkbox"/>	<input type="checkbox"/>
25.	<input type="checkbox"/>	<input type="checkbox"/>	Some people wish that they could have more respect for their physical selves	BUT	Others always have great respect for their physical selves	<input type="checkbox"/>	<input type="checkbox"/>

	Really True for Me	Sort or True for Me			Really True for Me	Sort of True for Me	
26.	<input type="checkbox"/>	<input type="checkbox"/>	Given the chance, some people are always one of the first to join in sports activities	BUT	Other people sometimes hold back and are not usually among the first to join in sports	<input type="checkbox"/>	<input type="checkbox"/>
27.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel that compared to most they always maintain a high level of physical conditioning	BUT	Others feel that compared to most their level of physical conditioning is not usually so high	<input type="checkbox"/>	<input type="checkbox"/>
28.	<input type="checkbox"/>	<input type="checkbox"/>	Some people are extremely confident about the appearance of their body	BUT	Others are a little self-conscious about the appearance of their bodies	<input type="checkbox"/>	<input type="checkbox"/>
29.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel that they are not as good as most at dealing with situations requiring physical strength	BUT	Others feel that they are among the best at dealing with situations which require physical strength	<input type="checkbox"/>	<input type="checkbox"/>
30.	<input type="checkbox"/>	<input type="checkbox"/>	Some people feel extremely satisfied with the kind of person they are physically	BUT	Others sometimes feel a little dissatisfied with their physical selves	<input type="checkbox"/>	<input type="checkbox"/>

## Appendix C

### Personal information

Name \_\_\_\_\_

Surname \_\_\_\_\_

Date of birth \_\_\_\_\_

Do you participate in organised school sport, for example, hockey or netball?

Yes  No

Specify \_\_\_\_\_

If yes, why? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

If no, why not? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Do you participate in any other exercise, for example, training in the gymnasium or jogging?

Yes  No

Specify \_\_\_\_\_

How many times per week do you participate in sport / training on your own?

One  Two  Three  Four  More than four

## Appendix D

### Formulas used

#### 1. Formula used to calculate BMI

$$\text{BMI} = \frac{\text{weight}(\text{kg})}{\text{stature}^2 (\text{m})}$$

#### 2. Slaughter's formula to calculate children's percentage body fat

$$\% \text{ body fat (girls)} = \frac{1.33(\text{tricep} + \text{subscapular}) - 0.013(\text{tricep} + \text{subscapular})^2}{2.5}$$

For a sum of tricep and subscapular greater than 35mm, the following equation was used:

$$\% \text{ body fat} = 0.546(\text{tricep} + \text{subscapular}) + 9.7$$

**Appendix E**

**Raw Data**

Subject	Date of birth	Sport participation	Height	Body mass	Tricep skinfold	Subscapular skinfold	Waist	Hip	Bleep Test	BMI	Waist-hip ratio	% body fat	SC	PC	BA	PS	PSW	Total
1	12/12/1986	>4	1.75	64	21	11	73	100.5	4.4	20.89795918	0.726368159	26.748	15	15	12	15	17	74
2	31/12/1987	2	1.55	78.15	30	36	89	110	2.5	32.52861602	0.809090909	45.736	8	8	12	17	18	63
3	05/02/1987	2	1.72	65	17	10	70	103.5	5.7	21.97133586	0.676328502	23.933	14	13	10	16	11	64
4	31/07/1987	1	1.485	52.75	33	22	72.5	90	2.4	23.92046163	0.805555556	39.73	14	13	8	10	11	56
5	11/06/1987	>4	1.7	63.25	14	8	81.5	101	8.3	21.88581315	0.806930693	20.468	22	22	15	18	17	94
6	24/12/1987	>4	1.6	50.75	26	17	70.5	94.5	7.2	19.82421875	0.746031746	33.178	17	20	20	16	21	94
7	22/06/1988	2	1.62	62.3	32	17	76	98.5	4.4	23.73875934	0.771573604	36.454	20	12	12	13	19	76
8	22/01/1986	3	1.7	55.8	17	7	68.5	94.5	6.2	19.30795848	0.724867725	21.932	23	23	23	24	23	116
9	27/04/1987	4	1.715	62.2	13	9	72.5	100	5.7	21.14765106	0.725	20.468	15	16	9	14	11	65
10	13/08/1987	4	1.58	64.5	36	21	82	104	3.2	25.83720558	0.788461538	40.822	13	16	13	15	15	72
11	20/05/1986	2	1.62	59.6	23	16	70.5	99	3.5	22.70995275	0.712121212	30.994	12	10	10	13	8	53
12	08/05/1987	3	1.565	68.15	23	20	77	103.5	3.2	27.82512836	0.743961353	33.178	18	17	9	12	15	71
13	28/12/1987	3	1.585	60.35	29	13	73.5	109.5	3.2	24.02252983	0.671232877	32.632	13	11	9	13	13	59
14	11/11/1987	3	1.645	48.45	13	9	67	89.5	6.8	17.9044909	0.748603352	20.468	12	17	24	8	15	76
15	01/07/1987	3	1.73	70.13	16	13	82	99.5	6.5	23.43212269	0.824120603	25.137	19	18	7	15	17	76
16	08/12/1987	3	1.67	67.2	37	21	75.5	100.5	4.2	24.09552153	0.751243781	41.368	14	12	8	13	11	58
17	21/05/1987	3	1.625	51.65	22	15	74	89	3.4	19.55976331	0.831460674	29.902	9	11	12	11	12	55
18	24/03/1987	0	1.66	49.5	10	7	67	84	5.2	17.96341994	0.797619048	16.353	13	11	19	11	15	69
19	24/04/1987	3	1.666	66.2	20	13	75	99.5	4.9	23.85107705	0.753768844	27.233	13	12	8	15	10	58
20	1987/05/03	>4	1.6	59.25	24	17	72.5	102.5	3.1	23.14453125	0.707317073	32.086	13	14	7	10	11	55
21	29/01/1988	0	1.59	49.95	23	14	76.5	89.5	3.2	19.75792097	0.854748603	29.902	11	14	15	11	17	68
22	02/02/1988	0	1.625	58.6	25	29	73	93	2.8	22.19171598	0.784946237	39.184	9	11	12	12	11	55
23	11/09/1987	>4	1.575	50.55	15	10	75.5	87.5	3.3	20.37792895	0.862857143	22.625	17	18	16	19	19	89
24	02/03/1987	2	1.775	72.9	23	14	74.5	100	5.4	23.13826622	0.745	29.902	14	14	19	16	11	74
25	30/04/1987	4	1.635	52.9	19	8	67	94	5.8	19.78883184	0.712765957	23.933	18	18	19	14	14	83
26	25/08/1987	0	1.655	49	13	10	66	86	3.2	17.8895775	0.76744186	21.213	12	13	22	11	13	71
27	06/06/1987	>4	1.71	61.75	23	14	78	98	6.8	21.11760884	0.795918367	29.902	20	20	11	19	17	87
28	19/03/1987	2	1.615	59.4	18	13	74.5	96.5	4.3	22.77410883	0.772020725	26.237	15	19	11	20	16	81
29	28/04/1987	>4	1.615	60.95	20	17	81	98.5	3.3	23.36838271	0.822335025	29.902	9	17	8	14	14	62
30	02/11/1987	2	1.665	58.7	19	14	75.5	96.5	3.7	21.17432748	0.78238342	27.233	16	15	16	18	17	82
31	31/03/1987	2	1.65	57.75	23	10	66	98	3.5	21.21212121	0.673469388	27.233	11	14	11	12	10	58
32	13/01/1988	3	1.65	57.95	18	17	73	91.5	3.3	21.2855831	0.797814208	28.125	14	14	11	15	14	68
33	17/04/1987	0	1.71	63.2	8	9	76.5	96	7.5	21.61348791	0.796875	16.353	10	13	10	16	11	60
34	16/03/1987	3	1.64	51.25	13	7	66	91	5.2	19.05487805	0.725274725	18.9	17	17	14	10	14	72
35	06/07/1987	3	1.67	57.8	15	8	74.5	101	4.7	20.72501703	0.737623762	21.213	20	21	7	14	8	70
36	01/10/1987	>4	1.59	47.8	11	7	63	89	6.1	18.90747993	0.707865169	17.228	11	9	11	11	11	53
37	19/03/1987	3	1.7	64.95	23	14	77	106.5	2.2	22.47404844	0.723004695	29.902	10	13	10	15	11	59
38	23/01/1987	4	1.62	59.95	19	16	82	100.5	4.5	22.84331657	0.815920398	28.125	19	19	8	18	15	79
39	05/04/1987	3	1.71	59	14	7	73	95	7.2	20.17714852	0.768421053	19.697	15	18	18	12	16	79
40	02/11/1987	3	1.61	59.2	20	13	71.5	99.5	3.7	22.83862505	0.718592965	27.233	14	16	12	18	15	75
41	17/01/1987	0	1.61	48.2	19	14	64	91	3.3	18.59496161	0.703296703	27.233	8	7	6	6	6	33
42	15/10/1987	4	1.605	47.95	13	11	65.5	91.5	5.2	18.61394979	0.715846995	21.932	16	21	20	16	15	88
43	04/02/1987	3	1.6	58	19	9	71.5	96.5	6.1	22.65625	0.740932642	24.548	11	14	6	9	7	47
44	09/05/1987	2	1.75	65.3	18	9	76	99	5.4	21.32244898	0.767676768	23.933	12	14	6	16	8	56
45	23/07/1986	3	1.57	74	29	27	85.5	112.5	2.5	30.02150189	0.76	40.276	11	12	12	14	12	61
46	04/02/1988	2	1.675	69.5	30	21	79	103	3.4	24.77166407	0.766990291	37.546	16	12	16	14	15	73
47	27/10/1988	3	1.515	42.4	11	12	59	85	4.1	18.47313444	0.694117647	21.213	13	17	15	14	18	77
48	19/04/1988	3	1.57	56	26	12	67	95	3.1	22.7189744	0.705263158	30.448	14	15	14	16	12	71
49	26/01/1989	0	1.635	94.5	55	45	106	132	1.6	35.35055972	0.803030303	64.3	7	8	6	12	11	44
50	19/05/1988	3	1.735	56.8	16	11	74	97	6.4	18.86902142	0.762886598	23.933	16	18	15	12	14	75
51	27/01/1988	0	1.645	68.8	34	27	76	97	3.1	25.42474663	0.783505155	43.006	11	12	11	16	14	64
52	15/06/1988	1	1.67	74.6	33	29	83.5	101.5	3.2	26.74889741	0.822660099	43.552	12	10	13	14	10	59
53	15/09/1988	4	1.73	53.9	12	8	65	87.5	7.5	18.00928865	0.742857143	18.9	12	15	17	11	17	72
54	20/01/1988	2	1.61	59.85	30	12	68.4	94.5	3.2	23.08938698	0.723809524	32.632	13	12	9	16	17	67
55	09/12/1987	3	1.69	52.8	16	11	67	89	7.1	18.48674766	0.752808989	23.933	18	20	14	18	17	87
56	10/03/1988	2	1.63	51.3	10	8	65	86.5	3.5	19.30821634	0.751445087	17.228	17	16	17	18	17	85

Subject	Date of birth	Sport participation	Height	Body mass	Tricep skinfold	Subscapular skinfold	Waist	Hip	Bleep Test	BMI	Waist-hip ratio	% body fat	SC	PC	BA	PS	PSW	Total	
57	08/01/1988		>4	1.68	54.75	12	7	66	92	10.4	19.39838435	0.717391304	18.077	24	24	23	12	16	99
58	28/03/1988		2	1.71	69	28	31	75	103	3.1	23.59700421	0.72815534	41.914	10	18	10	11	12	61
59	14/04/1988		2	1.675	55.8	25	14	70	94	3.2	19.88861662	0.744680851	30.994	13	13	14	15	15	70
60	14/10/1988		2	1.58	59.1	32	24	73	97	3.1	23.67409069	0.75257732	40.276	17	17	17	17	15	83
61	01/05/1988		3	1.64	63	18	12	72.5	98.5	7.3	23.42355741	0.736040609	25.7	20	13	13	17	12	75
62	08/07/1988		2	1.58	52.1	13	9	68	89.5	3.7	20.87005288	0.759776536	20.468	12	12	14	15	20	73
63	16/10/1988		2	1.65	50.4	18	11	67	89.5	3.2	18.51239669	0.748603352	25.137	15	18	17	17	21	89
64	21/03/1988		4	1.665	95	60	45	101	127	2.6	34.26850274	0.795275591	67.03	16	11	13	14	17	71
65	05/11/1988		2	1.59	49.6	23	20	74	91	3.1	19.61947708	0.813186813	33.178	12	13	13	10	19	67
66	05/11/1988		2	1.565	46.7	21	16	67	87	3.1	19.06725597	0.770114943	29.902	11	13	18	13	19	74
67	01/02/1988		3	1.635	59.75	21	17	74	98.5	5.2	22.35127982	0.751269036	30.448	16	17	16	17	19	85
68	11/06/1988		3	1.575	50.3	11	7	67	85.5	3.1	20.2771479	0.783625731	17.228	12	18	16	11	18	75
69	22/03/1988		3	1.685	56.45	21	11	73.5	93	7.3	19.88218616	0.790322581	26.748	17	15	11	13	12	68
70	06/01/1989		3	1.655	44	13	11	61.7	81	2.5	16.0641104	0.761728395	21.932	17	13	19	15	17	81
71	20/02/1989		3	1.465	50.95	21	29	72	92.5	6.3	23.73935631	0.778378378	37	10	8	9	16	7	50
72	13/09/1988		2	1.62	57.8	23	12	73.5	96.5	2.6	22.02408169	0.761658031	28.125	12	11	10	13	11	57
73	03/07/1988		2	1.685	56.5	26	15	74	96.5	3.1	19.8997966	0.766839378	32.086	22	17	22	20	23	104
74	01/09/1988		2	1.765	83.6	30	27	82	111	5.2	26.83594283	0.738738739	40.822	16	20	9	18	12	75
75	24/03/1988		2	1.64	59.9	16	15	71	94	6.4	22.27096966	0.755319149	26.237	15	15	18	17	12	77
76	10/05/1988		3	1.56	48.25	16	12	68	89	6.9	19.82659435	0.764044944	24.548	22	16	14	10	18	80
77	23/11/1987		3	1.825	72.75	29	13	81	108	3.5	21.84274723	0.75	32.632	17	15	11	18	14	75
78	10/02/1989		2	1.635	55.5	22	12	76	94	5.3	20.76143983	0.808510638	27.692	12	16	9	12	17	66
79	11/02/1988		2	1.64	67.45	20	28	81	102	2.3	25.07807852	0.794117647	35.908	13	10	8	17	13	61
80	04/06/1988		2	1.73	67.5	23	11	79	101.5	2.6	22.55337632	0.778325123	27.692	12	14	10	16	15	67
81	12/08/1988		4	1.72	75.6	28	19	76	97.5	5.3	25.5543537	0.779487179	35.362	9	12	10	17	12	60
82	04/06/1988		2	1.695	61.9	21	20	73.5	97.5	7.7	21.54523542	0.753846154	32.086	22	18	11	19	13	83
83	17/12/1987		2	1.625	54.4	24	14	72	91.5	2.6	20.60118343	0.786885246	30.448	15	15	12	15	15	72
84	20/01/1988		2	1.685	51.2	14	6	67.5	86	2.6	18.03309002	0.784883721	18.9	16	20	20	16	16	88
85	01/12/1987		>4	1.585	50.6	20	10	66.5	90.5	6.9	20.14150803	0.73480663	25.7	18	20	18	19	18	93
86	25/06/1988		2	1.535	36.7	10	5	61	78	6.3	15.57576208	0.782051282	14.525	10	15	6	11	15	57
87	30/11/1987		0	1.6	81.8	39	40	80.5	114.5	2.1	31.953125	0.703056769	52.834	6	6	7	8	9	36
88	28/05/1987		0	1.515	51	27	28	71	82	2.3	22.22004379	0.865853659	39.73	9	9	8	11	13	50
89	23/03/1987		3	1.64	52.4	22	11	63	88	5.4	19.48245092	0.715909091	27.233	12	10	16	11	18	67
90	16/01/1987		0	1.6	78.7	27	29	97	116	2.2	30.7421875	0.836206897	40.276	6	6	6	20	6	44
91	24/04/1987		2	1.61	60.65	19	13	76	98	3.2	23.39801705	0.775510204	26.748	14	11	9	13	10	57
92	25/02/1987		4	1.73	64.75	19	21	79	95	7.7	21.63453507	0.831578947	31.54	16	20	19	17	20	92
93	29/07/1987		3	1.679	72.4	32	26	78	109	3.1	25.68249273	0.71559633	41.368	14	10	8	13	12	57
94	30/07/1987		4	1.674	68.9	34	29	80.5	90.5	5.9	24.58715701	0.889502762	44.098	13	13	15	15	17	73
95	25/10/1987		>4	1.69	61.6	17	11	75.5	97.5	4.5	21.56787227	0.774358974	24.548	12	16	10	15	14	67
96	25/06/1987		3	1.62	62.5	28	16	70	99	6.9	23.81496723	0.707070707	33.724	19	17	11	18	14	79
97	30/12/1987		2	1.535	46.9	22	23	74	89.5	3.3	19.90472047	0.826815642	34.27	12	16	15	10	21	74
98	27/03/1987		1	1.585	54.45	16	17	69	91.5	3.1	21.67401407	0.754098361	27.233	16	10	15	12	16	69
99	27/03/1987		2	1.61	45.9	12	8	61.5	86	3.2	17.70765017	0.715116279	18.9	16	12	19	15	20	82
100	19/09/1987		4	1.765	62.1	13	9	67	94	2.8	19.93435466	0.712765957	20.468	16	17	12	19	18	82
101	29/08/1987		>4	1.675	65.6	16	9	70	96.5	6.4	23.38159947	0.725388601	22.625	22	20	17	13	22	94
102	12/02/1987		2	1.625	57.9	20	13	68	91.5	2.6	21.92662722	0.743169399	27.233	8	9	9	18	12	56
103	17/12/1987		2	1.675	52.7	12	8	69	89	6.5	18.78369347	0.775280899	18.9	15	15	15	13	14	72
104	10/10/1986		3	1.69	52.9	15	11	67	92	2.8	18.52176044	0.72826087	23.292	14	15	19	10	16	74
105	19/03/1987		2	1.706	55.35	21	15	65	95	4.1	19.01776916	0.684210526	29.356	11	13	13	14	9	60
106	29/06/1987		4	1.7	53.6	15	9	66	90	6.8	18.5467128	0.733333333	21.932	18	20	16	16	15	85
107	29/07/1987		3	1.67	58.1	15	11	67.5	87.5	6.8	20.83258632	0.771428571	23.292	14	16	10	12	13	65
108	19/05/1987		>4	1.55	45.55	17	7	74	89	8.8	18.95941727	0.831460674	21.932	20	22	14	19	22	97
109	27/05/1987		4	1.65	55.7	25	11	66	89	7.1	20.45913682	0.741573034	29.356	20	21	19	18	23	101
110	20/03/1987		3	1.66	55.5	13	10	66	88	3.8	20.14080418	0.75	21.213	12	10	16	11	18	67
111	12/10/1987		3	1.575	51	21	10	65	89	2.7	20.55933485	0.730337079	26.237	15	13	18	15	15	76
112	18/03/1987		2	1.59	67.9	39	25	80.5	104	3.4	26.85811479	0.774038462	44.644	13	10	6	16	7	52
113	10/05/1987		2	1.595	62	23	15	72	97	3.1	24.37082969	0.742268041	30.448	8	14	9	15	10	56
114	26/03/1987		3	1.595	66.8	34	19	74	103.5	4.5	26.2576036	0.714975845	38.638	10	18	11	16	9	64
115	02/03/1987		2	1.65	57.9	22	18	66	92	3.8	21.26721763	0.717391304	31.54	11	11	16	11	18	67
116	23/05/1986		2	1.64	62.3	29	17	73	102	4.5	23.16329566	0.715686275	34.816	14	14	9	16	19	72
117	15/08/1987		4	1.61	50.6	20	12	66	91	8.8	19.52085182	0.725274725	26.748	16	21	14	11	13	75

Subject	Date of birth	Sport participation	Height	Body mass	Tricep skinfold	Subscapular skinfold	Waist	Hip	Bleep Test	BMI	Waist-hip ratio	% body fat	SC	PC	BA	PS	PSW	Total	
118	07/08/1987		3	1.695	65.7	21	11	72.5	98	5.7	22.86788315	0.739795918	26.748	19	19	19	18	21	96
119	17/09/1987		1	1.615	47.2	11	9	64	87.5	3.2	18.09659826	0.731428571	18.9	13	14	19	15	14	75
120	16/11/1988		3	1.555	47.7	15	11	64.5	90.5	6.4	19.72684319	0.712707182	23.292	9	16	9	10	9	53
121	29/01/1989		4	1.655	46.45	9	4	63.5	83.5	11.5	16.95858928	0.760479042	12.593	18	21	8	17	11	75
122	01/08/1988		>4	1.7	55.8	17	11	69.5	95.5	10.2	19.30795848	0.727748691	24.548	19	20	19	14	20	92
123	12/05/1988		1	1.66	57.7	22	13	72	98.5	6.8	20.9391784	0.730964467	28.125	15	16	9	16	17	73
124	13/10/1988		1	1.685	53	15	13	71.5	95.5	5.1	18.66706584	0.748691099	24.548	10	13	19	13	14	69
125	09/05/1988		4	1.69	60.15	25	15	70	97	4.7	21.06018697	0.721649485	31.54	15	15	10	17	13	70
126	21/01/1988		>4	1.76	62	16	10	71.5	96.5	8.2	20.01549587	0.740932642	23.292	19	19	17	17	18	90
127	14/04/1988		3	1.65	63.35	25	22	75	101	4.3	23.26905418	0.742574257	35.362	13	15	14	15	17	74
128	29/08/1988		>4	1.69	53.2	16	9	68	93	7.6	18.62679878	0.731182796	22.625	17	17	15	17	16	82
129	25/03/1988		4	1.65	47.3	13	10	64.5	89.5	4.5	17.37373737	0.720670391	21.213	13	11	13	12	15	64
130	18/06/1988		3	1.59	52.9	20	17	67	91	6.1	20.92480519	0.736263736	29.902	15	13	13	18	16	75
131	12/09/1988		1	1.69	57	20	12	67.5	94.5	5.1	19.95728441	0.714285714	26.748	10	13	17	14	12	66
132	21/11/1988		2	1.675	47.8	16	7	65	87	4.5	17.03720205	0.747126437	21.213	8	11	11	15	13	58
133	09/12/1987		4	1.75	72	21	17	76	102	6.1	23.51020408	0.745098039	30.448	20	15	10	19	11	75
134	13/05/1988		2	1.62	57.45	21	18	74	96	7.5	21.89071788	0.770833333	30.994	16	16	8	13	8	61
135	13/03/1988		4	1.6	50.6	18	11	71.5	89.5	6.2	19.766525	0.798882682	25.137	14	15	7	13	11	60
136	06/04/1988		3	1.655	68.95	27	19	77	102.5	5.3	25.17319119	0.751219512	34.816	16	16	13	18	15	78
137	12/10/1988		>4	1.755	54.75	17	10	75	95	5.1	17.77582974	0.789473684	23.933	12	13	13	13	11	62
138	22/04/1988		4	1.65	48.15	11	6	66	87	8.1	17.68595041	0.75862069	16.353	22	21	18	10	21	92
139	05/08/1988		4	1.52	42	15	9	62.5	83.5	7.9	18.17867036	0.748502994	21.932	16	18	10	10	12	66
140	22/11/1988		3	1.665	62.9	13	9	75	99.5	7.9	22.68935602	0.753768844	20.468	15	12	14	14	17	72
141	16/01/1988		>4	1.645	59.55	17	12	71	99	7.6	22.00644857	0.717171717	25.137	15	11	7	14	6	53
142	19/04/1988		>4	1.68	60.75	13	8	75.5	98	9.1	21.52423469	0.770408163	19.697	13	18	12	20	12	75
143	25/07/1988		4	1.64	48.3	12	7	66	89.5	7.9	17.95806068	0.737430168	18.077	19	12	15	19	21	86
144	13/01/1988		3	1.585	53.55	28	20	68.5	92.5	5.5	21.3157659	0.740540541	35.908	12	12	12	12	14	62
145	10/06/1988		3	1.54	50.54	15	10	64.5	97	6.9	21.31050767	0.664948454	22.625	20	16	7	14	18	75
146	05/07/1988		>4	1.59	53.3	16	7	68.5	91.5	4.7	21.08302678	0.74863388	21.213	10	15	8	18	10	61
147	12/11/1987		2	1.71	54.34	12	15	69	94	3.5	18.58349578	0.734042553	23.933	9	10	8	8	8	43
148	13/09/1988		>4	1.59	50.02	12	7	67	89	4.5	19.78560975	0.752808989	18.077	15	17	16	14	16	78
149	18/12/1988		4	1.645	46.66	9	8	61.5	90.5	6.9	17.24300404	0.679558011	16.353	20	21	16	17	20	94
150	18/05/1988		2	1.77	63.82	14	11	67.5	94.5	4.4	20.37090236	0.714285714	22.625	24	21	20	24	23	112
151	10/10/1988		>4	1.68	85.36	28	28	90.5	117	4.4	30.24376417	0.773504274	40.276	15	16	13	13	18	75
152	24/04/1988		>4	1.71	60	18	12	72	98.5	2.8	20.51913409	0.730964467	25.7	9	13	19	14	12	67
153	30/12/1987		3	1.68	50.52	9	10	61.5	89	6.9	17.89965986	0.691011236	18.077	13	12	14	14	20	73
154	08/09/1988		1	1.685	54.3	18	12	67.5	92	5.3	19.12493726	0.733695652	25.7	15	15	11	10	18	69
155	01/01/1988		2	1.64	67.38	25	22	78.5	111	4.4	25.05205235	0.707202707	35.362	19	14	12	18	14	77
156	20/05/1988		3	1.735	63.78	18	18	72	102	4.7	21.18778497	0.705882353	29.356	17	13	11	13	13	67
157	13/12/1988		>4	1.58	50.14	13	7	66	90	6.9	20.08492229	0.733333333	18.9	21	20	16	8	14	79
158	25/11/1988		3	1.54	50.54	15	10	64.5	97	4.4	21.31050767	0.664948454	22.625	13	11	12	15	13	64
159	18/02/1988		3	1.66	67.18	23	17	79.8	102.3	4.1	24.37944549	0.780058651	31.54	9	7	6	11	9	42
160	07/01/1988		4	1.71	66.1	24	13	73	104	6.1	22.60524606	0.701923077	29.902	23	22	13	18	21	97
161	10/08/1988		4	1.67	69.9	22	17	78.5	108	6.9	25.06364516	0.726851852	30.994	14	15	6	18	15	68
162	16/05/1988		3	1.69	53.1	13	9	67	95	7.1	18.591786	0.705263158	20.468	16	15	13	15	13	72
163	23/01/1989		2	1.695	78.42	37	28	86.5	105.5	2.4	27.2952724	0.819905213	45.19	12	8	10	10	17	57
164	04/04/1988		2	1.65	47.82	11	5	64	84	5.1	17.56473829	0.761904762	15.452	22	19	17	17	17	92
165	19/07/1988		3	1.635	51.28	15	9	67	90	6.3	19.18282225	0.744444444	21.932	22	20	19	12	21	94
166	14/09/1988		1	1.76	79.58	30	26	85	112	2.1	25.69085744	0.758928571	40.276	8	6	7	13	16	50
167	18/08/1988		2	1.64	77.84	31	37	87	105.6	2.3	28.94110648	0.823863636	46.828	10	10	10	16	17	63

SC = Sports Competence; PC = Physical Condition; BA = Body Attractiveness; PS = Physical Strength; PSW = Physical Self-worth